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Understanding the environmental correlates of physical activity for adults (20 to 65 years) in a Mexican city (Cuernavaca)

by

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Doctor of Philosophy

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An abstract of
A dissertation submitted to the Faculty of the
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in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
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Abstract

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Physical inactivity has been defined as a pandemic. It is a known risk factor for obesity and several chronic diseases. Seven out of ten Mexican adults are either overweight or obese, and type II diabetes and cardiovascular diseases constitute the first causes of death in the country. The association of physical activity with the built environment is well established. The environmental correlates of physical activity have been extensively studied in countries such as the US, Australia, Canada, the UK and Belgium, but few studies from lower-to-middle income countries are available. The aim of this dissertation was to conduct the first study in Mexico to identify the environmental correlates of physical activity among adults in an urban setting (Cuernavaca). The study is part of the International Physical Activity Environment Network study, that uses data from twelve countries. A cross sectional study design was used and data were collected for a representative sample of adults (n=677) from Cuernavaca. Physical activity was measured objectively (accelerometry) and subjectively (International Physical Activity Questionnaire). Perception of the environment was measured through the Neighborhood Environment Walkability Scale, and Geographic Information Systems were used to obtain objective environmental data. Our findings show many variations from what is known for certain high income countries. We report the results of four analyses (including a preliminary analysis for Brazilian data) in this dissertation. Among the main findings, we saw that the accepted definition of walkability derived from evidence of standard US cities was inversely associated to PA among Mexican adults, while motor vehicle ownership is one of the strongest correlates (inverse) for PA among Mexicans. Our findings also highlight the importance of examining intensity and domain-specific PA instead of a compound variable for total to moderate physical activity. The data collected for this study will enable many future analyses that will be instrumental to elucidate the relationships of PA with sociodemographic, psychosocial and environmental variables among Mexicans. This is the first study of its kind for Mexico and will provide valuable information to guide interventions and policies in Mexico.

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1. Introduction

Latin American countries, such as Mexico, are currently going through an epidemiologic transition that has resulted in increasing obesity and chronic disease rates[1-5]. Both high energy intake and low energy expenditure are known to be associated with obesity and diseases such as type II diabetes, cardiovascular diseases and many types of cancer[1,6-8]. Most Latin American countries, including Mexico, have extensively documented the effect of diet and of the nutrition transition on obesity and chronic diseases[9-14], but few epidemiologic studies addressing the underlying factors that may be associated with the declining levels of physical activity have taken place in the Latin American region[15-21].

The ecologic theory suggests that multilevel influences, ranging from individual to environmental, are causing both low physical activity and high energy intake [22-24]. Therefore it is crucial to understand the relationships between the environment and the practice of physical activity amongst the population. Many studies with an ecological approach have demonstrated significant correlations between features of the built environment and physical activity [21,23,25-35]. Nevertheless most of these studies have taken place in high income countries such as the U.S.A., Canada, Northern European countries or Australia, with few emerging studies from lower to middle income countries such as Brazil and Colombia[16,17,19,20,36,37]. No study addressing the environmental correlates of physical activity has been done for Mexico.

Furthermore, very few of the available studies (from high income countries and few lower to middle income countries) have used objective measures both for their environmental and physical activity measures [34,38,39]. Newer technological approaches such as the use of accelerometers and Geographic Information Systems are now available and allow for a precise assessment of both physical activity and the built environment[40-44]. Nevertheless, these techniques still have some limitations that can only be addressed through self reported methods[44,45]. For instance, information on the domains of physical activity (e.g. transport physical activity versus leisure physical activity) is not available through accelerometry. Nonetheless, it is important to understand the association of domain-specific physical activity with environmental variables to design and target interventions and programs to promote physical activity. Furthermore, although Geographical Information Systems represent a valuable tool for the assessment of the built environment, certain features such as aesthetics or quality of available features cannot be determined by merely relying in objective measures.

This dissertation was motivated by the identification of a gap in knowledge of the environmental correlates for physical activity in Mexican urban contexts. This remains an understudied area in Latin America as a whole as well. The identification of this gap in knowledge was the result of previous work at the National Institute of Public Health in Mexico, and of previous work with Michael Pratt at the Centers for Disease Control.

As is further explained in the upcoming sections, many environmental correlates for physical activity are known for some high income countries with similar urban forms

(U.S., Canada, Australia, Northern European countries). Nevertheless, we have enough evidence supporting the idea that due to structural, cultural, social and political differences, these may not be the same for lower to middle income countries, and particularly in Latin American cities [21,46]. In fact, it has been seen that there are differences between them across some of the studied high-income countries [26,27,47], suggesting that the environmental correlates of physical activity may be context specific, even at the country level. It is important to identify the true environmental correlates of physical activity for Mexico, since it can extend our knowledge of the field and yield results useful for designing interventions, laws and programs that could have an impact upon the population´s health.

This dissertation is the result of three years of work, that included a secondary data analysis project in Curitiba, Brazil. These analyses provided evidence supporting the need for a study to assess the associations between the built environment and physical activity in a Mexican setting. The latter study was based in Cuernavaca, Mexico, and constitutes the backbone of this dissertation. The work developed in Mexico is part of a multinational study (International Physical Activity Environment Network Study) following rigorous standardized procedures[48], that will use data from twelve countries to carry out a pooled analysis. Data were collected in Mexico in 2011 and were analyzed in 2012 and 2013. The background, preliminary data, hypothesis and methods of the Mexican study are presented in this dissertation, as well as three manuscripts presenting the results of the analyses using the data collected for the study in Cuernavaca, Mexico.

The results of the four studies in the form of manuscripts focus on: The analysis of intensity-specific leisure time physical activity in association with perceived built environment among Brazilian adults; the description of objectively measured physical activity levels among Mexican adults, and their sociodemographic correlates; the description of intensity and domain-specific physical activity levels among Mexican adults, and their sociodemographic correlates; and the built environment (objectively measured) correlates of objectively measured physical activity among Mexican adults.

This study is the first of its kind in Mexico. Apart from being the first Mexican study to examine the environmental correlates of physical activity in a representative sample of adults, it was also the first to objectively measure (via accelerometry) the levels of physical activity for a representative sample of adults in a Mexican urban setting.

2. Aims and objectives

2.1 Primary Aim of Dissertation Project

To understand the sociodemographic and environmental correlates of physical activity for adults (20 to 65 years) in a Mexican city (Cuernavaca).

In order to address the primary aim of the dissertation project, four consecutive analyses (studies) were done, which are presented in the following chapters. The main objectives of each of these studies were:

2.2 Study I

The first study presented is a secondary analysis project using self-reported data on physical activity and built environment from Curitiba, Brazil. This study provided evidence to support the need for a correlate study examining the association of the built environment and physical activity in Mexico.

The objectives of this study were to identify the perceived environmental correlates for four intensity-specific categories of leisure-time physical activity for adults (>= 18 years) in Curitiba, Brazil, and to use these to build the best-fitting linear models to predict intensity-specific LTPA among adults.

This analysis provided evidence showing different associations of physical activity outcomes with built environment independent variables in a Latin American setting (Curitiba, Brazil), in comparison to what was known for certain high income countries.

2.3 Study II

This study presents the first analysis of the data derived from the IPEN-Mexico project, that was the first to collect objectively measured data on physical activity among a representative sample of adults from a Mexican city (Cuernavaca).

The objectives of this study were to describe the total and bout-specific (physical activity taking place in bouts of at least 10 consecutive minutes, further described in sections ahead) levels of objectively measured physical activity among a representative sample of Mexican adults (20-65 years) from the city of Cuernavaca. This first analysis of the IPEN-Mexico data also identified the sociodemographic (sex, age, socioeconomic status, education, marital status, motor vehicle ownership and BMI) correlates of accelerometer-based physical activity among adults from Cuernavaca, Mexico.

2.4 Study III

The third study provided an extended analysis of physical activity levels among Mexican adults from Cuernavaca using self-reported data to determine how much activity corresponded to leisure-time physical activity, and how much was transport-related physical activity.

The objectives were to describe the levels of leisure physical activity and transport physical activity among a representative sample of Mexican adults (20-65 years) from the city of Cuernavaca, using the long version of the International Physical Activity Questionnaire[49]. The study also identified the socio-demographic correlates of domain-specific (leisure and transport) physical activity for adults from Cuernavaca, Mexico, thus helping elucidate some of the associations previously found (study 2) between objectively measured physical activity and sociodemographic variables.

2.5 Study IV

The final study examined the association of physical activity with the built environment for adults from Cuernavaca, Mexico. This study used objectively measured data both for the physical activity outcomes and the built environment variables.

The objectives of this study were to identify the associations between objectively measured physical activity (via accelerometry) and objectively measured built environmental features (using Geographic Information Systems) among a representative sample of adults (20-65 years) from the city of Cuernavaca, Mexico. This study also incorporated a moderation analysis to understand if safety perception was affecting the associations of physical activity and the built environment among Mexican adults from Cuernavaca.

3. Background

Over the past two decades the prevalence of obesity and various chronic diseases have risen dramatically throughout the Latin American region and particularly in Mexico[10,50-53]. These include Type II Diabetes, cardiovascular diseases, various types of cancers, and osteoporosis, among others [54-59]. Although there is heterogeneity across Latin America in terms of the prevalence of obesity and the previously mentioned chronic diseases, the tendency to increase is clear and generalizable[50]. Mexico is currently one of the countries with the highest rates of obesity in adults with 71.2% being either overweight or obese[53].

Many determinants have been identified to explain the onset of obesity and the mentioned chronic diseases [60-65]. One of these is inadequate levels of physical activity [61,66-69]. In fact, physical inactivity is a leading cause of disease worldwide and 5.3 million deaths per year can be attributed to it[8,70]. It is also an additive component during weight loss through diet, and essential for weight maintenance [71,72]. Low physical activity has also been associated to the depletion and disruption of dietary fiber, and is known to have an effect on satiety, plasma-glucose and serum-insulin levels[73,74]. In recent years, research has also shown that sedentary time is associated to negative health outcomes independently of time spent in moderate to vigorous physical activity [75-79]. These include increased risk for cardiovascular disease and osteoporosis [45,70,75-78,80].

The relationship between the environment and people's habits or behaviors has long been studied[22,27,81-87]. While genetic factors have remained constant through time, this cannot be said for the environment. Latin American countries such as Mexico and Brazil are currently undergoing demographic, epidemiological and nutritional transitions, as a consequence of globalization and urbanization[11,12]. Using the ecological model of behavior as a conceptual framework, we can state that these phenomena have contributed to changes in both food and physical activity environments, which in turn have affected lifestyle patterns among the population [6,10,88]. The ecologic model proposes that individual (biological), inter-personal and environmental factors have an influence upon the individual as well as being interdependent across levels [24,89]. More recently, there has been increased focus on the role of the built environment and its influence upon physical activity practices within populations [25,34,90-94]. While evidence from a group of high income countries (U.S., Canada, Australia, U.K., Belgium, Hong Kong) continues to build up in this realm, few studies are underway in Latin America to explore such associations[21]. In fact, the recently published Lancet identified the need for more correlate studies from Latin America and other lower-to-middle income countries as a research priority[16,17,21,36,37].

Several environmental and some policy variables have been identified as correlates of physical activity for a group of high income nations in which cities share a similar urban form (U.S., U.K, Australia, Canada) [21,26,27,95-98]. Some examples include availability and quality of sidewalks, availability of walking and biking trails, neighborhood density, connectivity and mixed land use [21,26,27]. These variables have been included in a variety of instruments available to measure the physical activity environment. In fact, Frank et. al. developed what is known as the *walkability index*, (a measure that includes land use mix, intersection density and residential density) using data from Seattle and Washington D.C. / Baltimore[98]. Studies from the U.S., Australia and Northern Europe have shown that walkability (i.e. the walkability index developed by Frank et. al.) and access to parks, recreation centers or recreation programs are associated with physical activity for leisure, for transport, and to obesity [47,94,99-103]. Furthermore, researchers from Bogotá, Colombia, have reported that when attempting to stratify studies to assess the correlation between built environment variables and physical activity levels using the walkability index, limited variation is obtained across neighborhoods[104]. This is due to the weight given to residential density and land use mix in the walkability index, while these characteristics are extremely common in certain Latin American urban settings such as the ones in Colombia and Mexico. Nonetheless, in spite of widely spread residential density and land use mix in general across neighborhoods, Latin American countries like Mexico, Colombia or Brazil have reported variable levels of physical activity amongst their population. This may indicate that other environmental variables not originally considered in the walkability index (based on data from what can be considered "standard U.S. cities") may be associated to physical activity in urban settings in Mexico or other Latin American countries[52,105-107].

Evidence from the U.S., U.K., Canada, Belgium and Australia has shown that differences in the environmental correlates for physical activity occur even across these countries (all of them being high income countries), and therefore it could be expected to have more accentuated differences with Latin American urban contexts, given their unique cultural, social and structural characteristics[21,27,47]. Furthermore, although Latin American cities share some structural and cultural similarities amongst them, it may be possible that some of the environmental correlates of physical activity are country specific. For instance, it may be possible that the current crime rates in Mexico could be associated to physical activity, among many other potential differences with respect to the evidence from the group of high income countries generating most of the data in the field, as well as from other Latin American countries.

In addition, the levels of physical activity among the Mexican population have not been systematically measured in the Nutrition and Health surveys. Only the most current National and Nutrition Survey (2012) contains self reported physical activity information for a full sample of adolescents and adults[52,53]. Objective measures for physical activity have not been used to assess the level of activity and inactivity for a representative sample of a city in Mexico.

Few studies in Latin America have employed objective measures not only for physical activity levels but also for environmental factors, through the use of technologies such as GIS[16,108]. Such practice is currently limited to some high income countries, and few studies are underway for Latin America[104,109] apart from ours.

Until now, no study had been conducted in Mexico to fill this gap in knowledge. Hence, this study proposed to address it by identifying the environmental correlates of physical activity for Mexican urban settings, using the city of Cuernavaca as our study site. Our study is highly significant because it intended to extend the scarce knowledge regarding the environmental correlates for physical activity in Latin American urban environments, and it was the first one to do so for Mexico.

4. Preliminary Data

Previous studies such as the ILSI/PAHO Healthy Lifestyles Healthy People project in Mexico have identified unique aspects of Mexican physical activity and nutrition school environments[110]. In that study it was necessary to adapt some of the previously existing tools to measure both physical activity and nutrition environments. These included adaptations of SOFIT[111] and the decision to not use the School Health Index[112] due to drastic mismatches between what this tool assesses and the reality of the environments of Mexican public schools. These findings support the concept that it is essential to understand the actual underlying determinants of physical activity specifically for a Mexican context to better craft programs and interventions in Mexican urban settings.

A systematic review of the available tools to measure physical activity environments and policies that we conducted revealed that out of 90 available tools, only 6 had been translated into Spanish, and all of these were used among the Latino population in the U.S.,and not in any Latin American country. Of these, only 15 corresponded to objective measures (audits, direct observation or GIS based). Furthermore, all of the tools were from developed nations, mostly for the U.S., and were based on the known environmental and policy determinants of physical activity from the U.S., Canada, Australia and Northern Europe[113].

Based on consultations with researchers from Colombia and Brazil [104,109] as well as feedback from the Built Environment Assessment Training Institute team, we identified six unique key community settings for the practice of physical activity in Mexico and in Latin American contexts in general. These were: Plazas/Public Squares, Parks, Soccer Fields, Schools, Recreation Centers and Shopping Malls. Nonetheless it was found that their inclusion in the existent physical activity environmental assessment tools is very limited. Actually, the available tools only examine parks and schools, while the other four potential key settings are not assessed [113]. It was therefore found that there is a clear mismatch between what these tools assess and the reality of Mexican and Latin American urban environments, stressing the need to identify the environmental correlates of physical activity in Latin American settings such as Mexico. By identifying these correlates, it will be possible to latter develop tools, interventions and programs to increase physical activity through environmental changes in these contexts.

5. Hypotheses

Due to the cultural, social, economic and structural differences of Mexico with respect to certain high income countries where the majority of the evidence linking physical activity to the built environment comes from (U.S., Canada, Northern European countries, Australia), we hypothesized the following:

A) The built environment correlates for physical activity in adults (20 to 65 years) in Cuernavaca will not be within the domains included in the *walkability index*[98] developed in the U.S. (residential density, connectivity, commercial land use proportion and mixed land use), but rather within the domains of: public spaces (parks and plazas), safety from crime and transportation.

B) Physical activity will vary by socioeconomic status.

6. IPEN-Mexico Study Methods

6.1 Overview of IPEN study

This study corresponds to the Mexican site of the International Physical Activity Environment Network study (IPEN)[48]. The IPEN study is a multinational effort involving twelve countries, and it's coordination center is at the University of California in San Diego. The objective of IPEN is to accurately assess the strengths of association of features of the built environment with physical activity, using pooled data from twelve countries. The IPEN participating countries are: Australia, Belgium, Brazil, Colombia, Czech Republic, Denmark, Hong Kong, Mexico, New Zealand, Spain, the United Kingdom and the United States. It uses state of the art, standardized methods across countries to collect and analyze physical activity and built environment data[48].

IPEN-Mexico is the first study to address the associations of the built environment and physical activity levels among Mexican adults in an urban setting. Meanwhile, each site is using country-specific data to understand the context specific relationships of physical activity with the built environment, and provide evidence to guide local intervention programs and policies.

6.2 Collaboration with IPEN-Colombia and IPEN-Brazil

Being part of the IPEN study favored close collaboration with the two other Latin American sites of IPEN: Colombia and Brazil. In fact, there are certain survey items that were only included for the three Latin American sites of IPEN (for example a section on places where people do physical activity, that includes public squares, malls, etc.).

Mexico was the last country to be incorporated to the IPEN study, which allowed to learn from the previous data collection experiences of the two other Latin American sites. IPEN initially suggested that countries delivered the accelerometers by mail, and to apply surveys either by mail or by phone. Nevertheless, certain countries decided to do face-to-face recruitment and data collection since it is not common in all settings (particularly in lower to middle income countries) to conduct research through the mail or to apply phone-based surveys. This was the case of both Colombia and Brazil. In person data collection and recruitment supposes many logistic challenges, and for this reason I received training in each of these countries, at the Faculty of Medicine of the Universidad de los Andes, in Bogotá, Colombia, and the Department of Physical Education of the Universidade Catolica Pontificia do Paraná, in Curitiba, Brazil. The training topics included the logistic approach to recruit and collect in-person data in a Latin American setting, while following the strict procedures of the IPEN project. Apart from data collection procedures, the training also involved sampling procedures using Geographic Information Systems, as well as detailed instructions for field worker training to conduct the IPEN study in Mexico.

6.3 Collaboration with the Mexican National Institute of Public Health (INSP)

The IPEN-Mexico study was conducted in Cuernavaca, Morelos, Mexico, through the Center for Nutrition and Health Research (CINyS) at the Mexican National Institute of Public Health (INSP). INSP conducts cutting edge public health and epidemiology research in Mexico, and CINyS is at the forefront of documenting and addressing the nutritional transition in Mexico as it adapts from concerns about malnutrition to a burgeoning chronic disease epidemic. CINyS is responsible for conducting the Mexican National Health and Nutrition Survey, among many other epidemiologic studies related to nutrition, obesity and health promotion. INSP and the CDC Foundation, that supported this study, signed a collaborative agreement. INSP provided institutional support for the data collection phase of IPEN-Mexico. This was very important since INSP is a known and respected institution in Mexico, which facilitated the recruitment process. Furthermore, the hire of field workers and administrative personnel was done through INSP, that also provided office space and lent scales and stadiometers for data collection. This was a valuable addition to our study, since many IPEN sites only collected self reported weight and height.

6.4 Study Site: Cuernavaca, Mexico

Cuernavaca is a mid-sized city in central Mexico, located 76 kilometers south of Mexico City, in the state of Morelos. It has a population size of 365,168 inhabitants, and an area of 76 square kilometers[114]. The average temperature throughout the year is 23°C. Its average income per capita is 18,370.87 USD, while it has a Human Development Index (HDI) of 0.86 (National HDI=0.77)[115] which makes it a wealthy Mexican city[114,116]. The crime rate in Cuernavaca has highly increased over the past ten years, with a rise in homicides by 276.7% during this period[117].

The city of Cuernavaca represented an ideal setting for this study since it has very similar rates of overweight and obesity as the mean for the whole country[53], and can be considered a standard Mexican city in size and structure. Furthermore, it has a strong health and research system, including the fact that the National Institute of Public Health is located there, facilitating the study. A map showing the location of the city of Cuernavaca is found in appendix 1.

6.5 Study design and sampling

This was an observational, cross sectional study. A representative, stratified multistage clustered sample was selected. The study design and sampling frame was consistent with other correlate studies from developed countries [47,95,103,118], and followed the IPEN study methodological protocol (Appendix 2). The primary sampling units were census tracts within the Municipality of Cuernavaca, which were stratified by SES and walkability as defined by Frank et. al[98]. Blocks were the secondary sampling units, and households were the tertiary sampling units. One eligible participant was selected per household.

6.5.1 Stratification by the Walkability Index

The walkability index was developed by Frank et. al. and is a measure that has shown association to physical activity levels, particularly to walking, in high income countries such as the US, Belgium and Australia[98]. This measure was originally developed using evidence from the transportation research field, aiming to identify urban designs that favored active transport[98]. It was based on the the "three D's" model proposed by Cervero et. al., that establishes that the main built environment factors contributing to active transport are neighborhood density, diversity and design[119]. Cervero used data from the San Francisco Bay Area to propose the "three D's" model, while Frank et. al. used data from Seattle and Washington D.C./Baltimore to develop the walkability index.

The walkability index was calculated using z-scores of intersection density, land use mix, proportion of commercial land use and net residential density. Intersection density was defined as the number of 3 and 4-way intersections over total area per census tract. Land use mix referred to the diversity of land use types per census tract, using a normalized entropy score ranging from 0 to 1, obtained with the following formula: 1 X ((∑(pi)(lnpi))/lnk); where p=proportion of total land uses, i=land use category, ln=natural logarithm, k=number or land uses (range 0-1).[98] The land uses employed included: residential, commercial, educational/cultural, public spaces (includes parks and plazas) and others. The proportion of commercial land use was used instead of the retail to floor area ratio, since this GIS measure was not available in Mexico. The substitution was advised by the IPEN research directors at UCSD, and was used by other countries that didn't have retail to floor area ratio measures[16]. We obtained the proportion of commercial land use by dividing total area per census tract assigned to commercial land use over total census tract area. Net residential density was obtained by dividing total residences over the total area per census tract area destined for residential use [48,98]. The final formula for walkability used corresponds to Frank et. al. definition (based on US data), and is as follows:

Walkability=[(2 x z-intersection density) + (z-net residential density) + (z-proportion of commercial land use) + (z-land use mix)]

We calculated the walkability index for each of the 123 census tracts of the Municipality of Cuernavaca, and stratified them classifying them as having "low walkability" or "high walkability", using a median split.

6.5.2 Stratification by census tract level socioeconomic status

Census tract level socioeconomic status was defined as provided by the National Institute of Geography and Statistics of Mexico (INEGI), which categorizes census tracts by socioeconomic status based on estimated average income, and assigns scores based on quartiles (SES levels 1 to 4)[120].

6.5.3 Sampling

As mentioned earlier, we stratified census tracts by walkability (high or low) and socioeconomic status (levels 1 to 4), and therefore the sample had eight strata. A random selection of four census tracts per stratum took place, for a total of 32 census tracts in the study (primary sampling units). Next, seven blocks per census tract were randomly selected (secondary sampling units). This was followed by the random selection of two to four households per block (tertiary sampling unit). Finally, one participant per household was selected for the study. If more than one eligible participant that lived in the household was present at the time of recruitment, and more than one adults were willing to participate, a random selection took place, to only have one participant per household. Whenever there was a refusal, non-eligibility or not finding anyone at home after two visits (in different days), the household to the right (clockwise) was selected, always making sure it was within the same selected block.

The sampling procedures were determined based on a required sample size of 645 participants. The sample size was estimated to detect correlations of 0.10 with a statistical significance of alpha lower or equal to 0.05, and a maximum type II error of 0.20 (power=80%). Furthermore, the design effect (DEFF) was controlled for by employing an intra cluster correlation (ICC) of 0.06, as has been reported in the literature for similar studies[92]. The sample was calculated using the statistical program EPIDAT[121], which employs the principles described by Díaz and Fernández for sampling for correlate studies[122]. The design effect (DEFF) was determined through the following method described by Murray[123]:

$$ICC = \frac{DEFF-1}{m-1} \rightarrow DEFF = \big(ICC(m-1)\big) + 1$$

Where m = average cluster size, for this case m = 21 based on similar studies[92]

The DEFF was determined to be of 2.20, while the required sample, for a power of 80% and to detect a correlation coefficient of 0.10 was of 293 (calculated in EPIDAT). Hence after adjusting for the DEFF the sample size required was of 645 participants (293*2.20).

6.6 Inclusion and Exclusion Criteria

All census tracts within the Municipality of Cuernavaca (123) were considered for inclusion. Within these, blocks immediately proximal to a census tract with a different walkability or socioeconomic level were not considered for inclusion, to avoid overlapping of neighborhood characteristics and thus introduction of bias when analyzing the data. All private residences from the selected blocks were considered for inclusion. Adults ages 20 to 65 years, living permanently for over 6 months in a selected household, with no temporal or permanent disability to walk were considered for inclusion. Exclusion criteria at the participant level therefore included anyone not within the specified age range, any person with a permanent or temporal disability to walk at time of recruitment, anyone who has not been living permanently for at least six months in that household, anyone reporting that the household is not for permanent use (for example weekend or vacation homes), and anyone that did not speak Spanish (since surveys were in Spanish). Service personnel living in the household were excluded to avoid bias, since individual level SES would not match neighborhood level SES. Furthermore, blocks immediately proximal to a census tract of a different socioeconomic status or walkability level were excluded to avoid bias. Non-private residences, such as hotels, military bases, prisons, nursery homes, and any other form of communal living were excluded from randomization.

6.7 Instruments

The following measurement instruments were used to collect data for this study:

6.7.1 Objective measurement of physical activity: Accelerometers

Accelerometers were used to measure physical activity objectively. The ActiGraph GT3X model was used. These were provided by the IPEN coordinating center at UCSD.

Accelerometers are the most widespread tool for the objective assessment of physical activity at a population level. The use of accelerometers has been extensively validated for objective assessment of physical activity[44,124-126]. They constitute an effective tool for free living individuals since they can continuously record data over one second, thirty seconds or one minute time intervals. They have a large capacity for data storage over prolonged periods of time and allow to capture duration and intensity of physical activity.

This accelerometer model registers thirty electric signals per second, recording data on movement (acceleration) at three axis. For the purpose of this study, only the vertical axis will be used. The lateral axis and inclination data were not used for analysis since standardized procedures have not been developed to analyze this data. Furtheremore, lateral axis and inclination data are likely only to contribute to explain exercise and training based activities, while vertical axis data are known to be adequate to estimate physical activity in epidemiologic studies involving free living situations[125]. The data from the electric signals recorded by the meters are aggregated in timeframes referred to as epochs. For adults, the consensus is to use sixty second epochs, based on the available evidence and in compliance with the IPEN protocol[48]. The output data provided by the accelerometer thus indicates number of counts per epoch, which for the case of this study meant number of counts per minute.

Various formulas to convert counts per minute to energy expenditure have been developed[126-131]. The IPEN study protocol (Appendix 2) indicates the use of Freedson's cut points for adults to obtain minutes of sedentary time, light activity, moderate activity and vigorous activity[126]. Freedson's formula considers a physical activity intensity as moderate if it is greater or equal to 3 Metabolic Equivalents (MET) and lower than 6 METs, and vigorous physical activity when it is larger or equal to 6 METs[126].

Freedson's cut point for adults[126]

Intensity of physical activity	**Actigraph Counts per Minute**
Sedentary (<1.5 MET)	< 101
Light (1.5<= MET <3)	101-1951
Moderate (3 <= MET < 6)	1952-5724
Vigorous (>= 6 MET)	>=5725

The easy conversion of counts per epoch to minutes of activity per day or per week make them a powerful device for the objective assessment of physical activity levels in populations. Furthermore, these tamper-free electronic devices place little burden on the participants by being small in size and worn around the waist on the right hip with a belt, allowing participants to perform everyday activities including walking, running and exercising. Nevertheless, limitations include low sensibility to record activities such biking (due to a spine centered axis), and the impossibility to record swimming or any aquatic activity.

6.7.2 Self-Reported Physical Activity: International Physical Activity Questionnaire

The Colombian (Spanish) version of the long version of the International Physical Activity Questionnaire (IPAQ)[132] was adapted for a Mexican audience, using culturally appropriate wording and examples. In addition, extra questions developed in conjunction with research teams in Bogota, Colombia, and Curitiba, Brazil, were added. These "Latin American-specific" questions will allow for future data comparison across the three Latin American countries (Colombia, Brazil and Mexico), to understand if some correlates are regional and if others are country-specific[104,133,134]. These new sections included questions on Latin American specific activities, for example: dancing, soccer playing, and transportation related activities (specific times walking to and from Latin American specific public transport types).

The IPAQ is a well known tool that has been employed in several studies of various countries and has been tested with Actigraph accelerometers, proving to be a valid and reliable self-report tool for physical activity assessment[49]. For this study we used the long version of IPAQ, since it provides domain-specific information, meaning it assesses the amount of time spent in physical activity for different purposes, including: leisure, transportation, occupational and home-based. Nevertheless, we decided not to include the occupational and home-based domains since Latin American studies have consistently shown low validity and reliability for these domains[134]. Moreover, the transportation and leisure-time domains are thought to be more modifiable, and more prone to be affected by the environment, and thus hold a higher importance from a public health perspective[21,135].

IPAQ is formatted in such a way that it asks the participant to recall the activity he or she did during the last seven days, reporting uniquely those that had a minimum duration of ten minutes, since current international recommendations of physical activity for health indicate that it should take place within bouts of ten minutes or more[136]. The version used for this study included questions about walking time for leisure or transport, moderate activities (other than walking) for leisure, vigorous activities for leisure, biking for leisure or for transport, sedentary time and places where physical activity takes place (Latin American-specific version). For this study, IPAQ was applied in person in an interview form by trained field workers.

When objective measures of physical activity are available, as is the case for this study, the purpose of collecting IPAQ data is not to obtain accurate estimates of time spent doing physical activity at different intensities, since the objective measure (accelerometry) provide much more reliable estimates. The strengths of IPAQ are that it allows to monitor changes in activity levels in populations (i.e. to see if they increase or decrease with time, while assuming that self-reported physical activity is always over estimated at the same level), and more importantly for the purpose of our study, to understand the proportion of time spent in different domains, and with this, to be able to test how domain-specific activity is associated to other factors (e.g. socioeconomic, psychosocial or environmental variables). It is important to understand that IPAQ is a tool that measures a behavior, while accelerometers measure the motion (acceleration) caused by such behaviors. For instance, a participant may report two hours of vigorous activity since he or she engaged in a tennis match with that duration. Nevertheless accelerometry data will most likely not report two continuous hours of vigorous physical activity.

The final survey used for this study is available in Appendix 3 (Note: this survey comprises other questions on sociodemographic variables, IPAQ, the Abbreviated Neighborhood Environment Walkability Scale, questions on self-efficacy and social support for physical activity, and questions to assess individual level socioeconomic status).

6.7.3 Objective measurement of the built environment: Geographic Information Systems

Geographic Information Systems (GIS) were used to objectively assess the built environment in Cuernavaca. GIS combines computer-mapping with database management and analysis tools[137]. During the past few years, the use of GIS for public health has grown substantially, and many applications for the field have been developed, amongst which is the assessment of the built environment in relation to health behavior outcomes, such as physical activity[34,41,138].

Cartographic and demographic information from the INEGI (National Statistical and Geographical Information Institute of Mexico), INSP (National Institute of Public Health in Mexico), the Department of Land Registry of the Municipality of Cuernavaca, and the

Transportation Department of the state of Morelos were employed. These included, shapefiles, database files and others.

ESRI® ArcGIS 9.3 software (ArcMap) was used to for sampling and analytical purposes, as well as to create printable maps of the selected census tracts (Appendix 4), selected blocks per census tract (Appendix 5) and selected households per block (Appendix 6). These ArcGIS-generated maps were provided to the trained field workers in charge of recruitment and data collection. They were a valuable research tool, since, on the map, they marked the participant number assigned to the selected household. Upon rejection to participate in the study, non-eligibility in the selected household or not finding anyone in the selected household after two visits (in different days), the field workers attempted recruitment using the household to the right of the originally selected parcel. They used the maps to mark the final location of selected participants. Furthermore, these maps were also used to conduct an environmental audit in all the selected blocks (explained in greater detail ahead). Other tools such as Google Earth and Google Maps were employed in complementation to aid field workers to locate the selected census tracts and blocks.

All the information marked by participants on the ArcGIS-generated maps (participant location using participant codes, environmental audit codes, etc.) was manually geocoded using ESRI® ArcGIS 9.3 (ArcMap), thus generating specific shapefiles with their corresponding attribute tables allowing for spatial analysis of the data.

6.7.4 Perceived built environment: Abbreviated Neighborhood Environment Walkability Scale

The perception of the built environment was measured using the abbreviated version of the Neighborhood Environment Walkability Scale (NEWS)[139]. Several studies have established the importance of measuring the perception of the built environment, both to add information to GIS-based data, such as aesthetics variables, but also because many times the perception of the environment varies from the objectively measured environment. For instance, GIS data may show a large amount of parks in a neighborhood but its residents may still perceive that there are very few parks in the neighborhood. Perception of the built environment is likely to influence physical activity level as much (or more) as objectively measured built environment[140].

NEWS is a well known tool to assess the perceived built environment[139], and contains items to assess the participants' perception of the following environmental domains: residential density, land use mix (diversity of land uses in the neighborhood), connectivity (intersection density), pedestrian and biking infrastructure, barriers for walking (e.g. streets having many cul-de-sacs) safety for walking, safety from crime and aesthetics[139].

A homogenized Latin American-adapted version of the Neighborhood Environment Walkability Survey (NEWS) was developed with the Colombia and Brazil IPEN research teams to have comparable data for future analysis, and to be able to capture specific characteristics of the built environment present in Latin American urban settings [98,104,109]. These include availability and accessibility of soccer fields, public squares (plazas), shopping malls, recreation centers and availability of public transport systems specific to Latin America, among others.

The survey items of NEWS can be found in Appendix 3 (final study survey, that also includes IPAQ, survey on psychosocial measures, items on sociodemographic variables and questions on household characteristics and assets).

6.7.5 Survey to assess psychosocial measures

Given that this study used an ecological approach all IPEN sites measured psychosocial outcomes, even though our aims and objectives focus on understanding the association of environmental features to physical activity. After analyzing the main effects of the built environment measures on physical activity, further analyses examining potential moderation by psychosocial variables may take place. Therefore, these variables may help us better understand the overall associations found between built environment variables and physical activity outcomes[141-144]. We used a survey that included items to measure self-efficacy for physical activity (confidence that one can do physical activity) and social support for physical activity, that has been tested for validity and reliability[144]. This survey was merged to the overall study survey including questions on demographic characteristics, IPAQ, NEWS and questions on home characteristics and assets to estimate individual level socioeconomic status.

Some examples of the survey items to asses these psychosocial measures are: "I do vigorous physical activity even though I am feeling sad" (self-efficacy), "Someone that lives with me incentivizes me to do physical activity" (social support)".

The final survey used for this study, and including all the survey items to assess psychosocial measures is available in Appendix 3.

6.7.6 General information questionnaire for demographic information

Basic sociodemographic information was collected from all participants using a general information questionnaire. The information collected included data on sex, age, years of residence in the household, education level, occupation, motor vehicle ownership, number of residents in the household, among others.

These items can be found in Appendix 3, that is the final study survey, also including IPAQ, NEWS, survey on psychosocial measures and questions on household characteristics and assets.

6.7.7 Data collection instruments for Body Mass Index estimation

Scales for weight measurement

Weight was measured in kilograms using calibrated Tanita® electronic scales with centigram precision. The scales were provided by the Center for Nutrition and Health Research of the National Institute of Public Health in Mexico.

Weight was measured by standardized field workers. The scale was placed on a hard surface and set to zero before measurement. The participant was asked to remove his/her shoes and any heavy clothing item such as jackets, belts, etc. They were also asked to empty their pockets making sure they weren't carrying a wallet, cell phone, keys, coins or any other object. The participant was asked to stand straight but relaxed in the center of the scale, making sure their feet were entirely on the scale. For weight measurement, participants had to stand unassisted and looking ahead. Weight was recorded to the nearest centigram[145].

Fixed stadiometers for height measurement

Height was measured in meters using calibrated fixed wooden stadiometers with milimetric precision. The stadiometers were provided by the Center for Nutrition and Health Research of the National Institute of Public Health of Mexico.

Height was measured by standardized field workers. Participants were asked to remove their shoes for height measurement. They were asked to stand with their feet flat and with their heels almost together, with their arms at both sides, their knees together, and with their shoulder blades, buttocks and heals touching the stadiometer. They were instructed to look straight and the Frankfurt plane horizontal was used to ensure accurate face position for measurement. Height was recorded to the nearest millimeter[145].

6.7.8 Home characteristics and assets survey

A survey on household characteristics and assets was applied to all participants. Its purpose was to estimate individual-level socioeconomic status, since there was substancial variation within census tracts, classified as being in levels 1 to 4 for socioeconomic status. The items included for this survey are the same ones that were used by the National Health and Nutrition Survey in 2006 in Mexico[146] to estimate socioeconomic status. Only questions that were only applicable in rural settings were removed from the survey. A z-scored index resulting from this survey was used to determine individual level socioeconomic status. Although the survey includes motor vehicle ownership as one of its items, it wasn't included when computing the index, since this variable was of particular interest in association to the physical activity outcomes of study, and thus was handled independently. The items of this survey are part of the final study survey shown in appendix 3.

6.7.9 Block-level environmental audit tool

Block level environmental audit data was collected for all the selected blocks of the study. This simple environmental assessment consisted in walking around each of the selected blocks while marking in a printed map of the given block the location of every type of business present or public area. Fifty-five codes were generated to define all businesses or public areas. These were then manually geocoded in ArcGIS, generating a shapefile for which the attribute table per point showed the category of the business or public space. Examples of these include parks, public squares/plazas, recreation centers, sports courts/fields, sit-in restaurants, fast food restaurants, informal food outlets, supermarkets, convenience stores, retail shops, shopping malls, etc.

An example for this block level environmental audit is found in Appendix 7.

6.7.10 Audit tool for spaces for physical activity in Latin American urban settings

As a result of previous work with Michael Pratt at the Centers for Disease Control and Prevention, a tool to assess community settings where physical activity is likely to take place in Latin American countries was developed. This tool is a result of a systematic review of the available tools to measure physical activity environments and policies, that revealed that out of 90 available tools, only 6 had been translated into Spanish, and all of these were used among the Latino population in the U.S., not in any Latin American country. Of these, only 15 corresponded to objective measures (audits, direct observation or GIS based). Furthermore, all of the tools were from high-income countries, mostly from the U.S., and were based on the known environmental and policy determinants of physical activity from the U.S., Canada, Australia and Northern Europe[113].

As previously mentionde, based on consultations with researchers in Colombia and Brazil [104,109] as well as feedback from the Built Environment Assessment Training Institute team, we identified six unique key community settings for the practice of physical activity in Mexico and in Latin American contexts in general, and a simple audit tool was designed for these. These settings were: Plazas/Public Squares, Parks, Sports Fields/Courts, Schools, Recreation Centers and Shopping Malls.

This tool has been pilot tested by Luis Fernando Gómez (researcher of the Health Division of the Fundación para la Educacion y el Desarrollo Social of Colombia in schools and parks of Pasto, Colombia (unpublished work). We used this tool to conduct environmental audits of all the parks, public squares/plazas, sports fields, recreation centers and shopping malls within each of the 32 selected AGEBs, as well as for major parks and shopping malls located outside of the selected AGEBs. The data collected with this tool doesn't relate to the specific aims of this study, but is available for further analyses and can be integrated to the physical activity data (IPAQ and accelerometry) of participants residing within the AGEBs where these community settings are. The tool measures availability of features thought to be associated to physical activity, and the quality of such features. The assessment forms that compose the tool are available in Appendix 8.

6.8 Data collection procedures

Seven field workers, an office assistant and a project co-coordinator were hired to complete the data collection phase of the study.

6.8.1 Training

A three week training for field workers took place prior to data collection. The training included: use of maps to locate and mark selected participants households, recruitment procedures, accelerometer delivery and recovery, verification of accelerometer data, survey application, coding, performing monitoring phone calls, measuring weight and height, and office tasks.

6.8.2 Recruitment and data collection

Recruitment and data collection were done in person (face-to-face) via home visits with a team of standardized field workers. Two to three home visits per participant took place. Data collection took place from April 2011 to September 2011.

Home Visit One

The first home visit had a ten to fifteen minutes duration. During this first visit, the field workers informed the respondent that the household had been randomly selected for the study. The main aims and procedures of the study were explained and an eligible participant living in the household was invited to participate. Upon refusal, or if no eligible adult lived permanently in the selected household, or no one was found at the household after two recruitment attempts taking place in separate days, the next household to the right (clockwise) in the same block was selected. If more than one eligible participants that lived in the household were present at the time of recruitment, and were willing to participate in the study, a random selection took place to define which participant would be selected for the household (using simple methods such as drawing papers from a bowl or selecting the person who obtained a higher score when drawing a dice). A basic individualized report sheet with anthropometric results, a simple diagnosis of their physical activity pattern, and basic nutrition and physical activity recommendations (example shown in Appendix 12) was offered to participants as an incentive for participation, in addition to a 100 pesos supermarket voucher (both to be delivered upon completion of participation). Written informed consent was obtained on site.

The first part of the general information form (appendix 9) was applied (the rest was completed during the second home visit), collecting basic sociodemographic and contact information for the participant. Also during home visit 1, an accelerometer was delivered for use, with an instruction sheet (appendix 10) and an accelerometer log (appendix 11). Participants were instructed to wear the accelerometer for seven days, using it at all times except to sleep, shower or swim. They were instructed on site of the correct wearing position of the accelerometer, that is, using the belt provided with the meter and placing it on the right hip facing upwards.

An appointment date and time, at least seven days later, was set and recorded in the general information form for Home Visit 2 to take place. Participants were told that they would receive two one-minute-long monitoring phone calls throughout the week to make sure they are wearing the device, to report any significant event (e.g. having forgotten to wear it one or more days) and to confirm the appointment date and time for Home Visit 2. They were also informed that the second home visit would have a 45 minute to one hour duration.

Home Visit Two

The second home visit included accelerometer wear time verification, completion of general information form, face-to-face application of the full study survey (including sociodemographic questions, IPAQ, NEWS, psychosocial measures, home characteristics and assets questions), and objective measurement of weight and height. Home visit two had a duration of forty five minutes to one hour.

On-site accelerometer wear-time verification

Accelerometer wear time was verified on site using netbooks. Actilife 4.0 was used to download the original accelerometry file, which was then converted to a csv file to be viewed using Meterplus 4.2 software. The field workers verified that at least five valid days were obtained. A valid day was defined as having at least ten valid hours. Delivery and recover dates were not considered valid days, even if delivery occurred early in the morning or recovery occurred late in the evening. This was because it would record activity corresponding to the fieldworker carrying the device for delivery or to take it back to the office after recovery. An hour was invalidated (set as non-wear time) if it recorded sixty consecutive zeros or more; this was pre-programmed during the initialization of the device. All of these conditions (minimum of five valid days, definition of valid hour, etc.) were in accordance to the IPEN study protocol (Appendix 2). If accelerometer wear time verification showed that the participant had at least five valid wear days, a third visit was not required. On the other hand, if there were not enough days of valid wear time, the participant was asked to wear the accelerometer for the given amount of days necessary to achieve a minimum of five valid days, and an appointment was set for a third home visit.

Survey application

During the second home visit, the complete study survey, including items on sociodemographic characteristics, IPAQ, NEWS, psychosocial measures, home characteristics and assets was applied face to face by trained field workers. The application of the survey had a duration of thirty to forty five minutes.

Height and Weight measurement

Weight and height measures were obtained on site at the end of home visit two, using the standardized procedures that were previously described.

If a third home visit was required (if the participant did not achieve enough valid wear days for the accelerometer), it was programmed during the second home visit. If a third home visit was not required, the 100 pesos voucher was delivered at the end of home visit two.

Home Visit Three

Home visit three only took place if the participant did not achieve enough wear time of the accelerometer. Home visit three had a duration of ten minutes and consistent on accelerometer wear time verification and delivery of the 100 pesos voucher.

Delivery of Individualized Participant Results

The simple individualized result sheet (appendix 12) was delivered to participants in a sealed envelope via mail or through in person delivery by field workers. Delivery of the individualized result sheet occured two weeks to two months after completing their participation in the study.

Office Work

Office work during data collection included accelerometer initialization, accelerometer battery charging, accelerometer data download and scanning for implausible values, database updates and management, data entry, survey quality control, monitoring phone calls to participants, responding phone calls from participants, elaborating bi-monthly reports for the IPEN study coordinating center, elaborating the individual results report sheets for participants, preparing data collection packages (sorted by home visit 1 and home visit 2 material), among others.

Accelerometer initialization

Accelerometers were initialized using Actilife 4.0 software by either of the study coordinators (Deborah Salvo or Catalina Torres) and were set to record data using sixty second epochs, and programmed to start recording data at 00:00 hrs of the day following initialization.

Accelerometer final data download and verification

When field workers returned accelerometers to the office after having collected data, the data was downloaded and re-checked for accuracy with respect to number of valid days (recorded by the field workers in the general information form) by either of the study coordinators (Deborah Salvo and Catalina Torres). All wear days (valid and invalid) were visually scanned for implausible values. The final files to be latter used for scoring and analysis were saved.

Survey quality control and data entry

All general information forms and final study surveys were checked for adequate filling by either of the study coordinators (Deborah Salvo or Catalina Torres). This took place no later than a day after the complete forms had been returned to the office. Data entry of all the forms was done twice, in Microsoft Excel, by Deborah Salvo and Catalina Torres. The databases were compared for data entry errors using SAS 9.3, and were manually corrected by Deborah Salvo by returning to the original surveys when mismatches occurred.

A Guide for Field Work for IPEN-Mexico was developed in Spanish with the input of all the field workers involved, as well as the office assistants and both coordinators, and is found in Appendix 15.

6.9 Protection to human subjects

This study was approved by the Institutional Review Boards of Emory University and the National Institute of Public Health of Mexico (INSP). As previously noted, written informed consent was obtained for all participants in the study.

6.10 Accelerometry data scoring

Accelerometer data scoring took place in 2012. Freedson cut-points for adults[126] were used to score the data in compliance with the IPEN protocol, allowing to obtain minutes spent in sedentary time (counts per minute <101), light activity (counts per minute: 101-1951), moderate activity (counts per minute: 1952-5724), and vigorous activity (counts per minute >5725). Prior to scoring, all accelerometry files and days were re-scanned for implausible values or patterns indicating device malfunction or non-human activity[147]. All wear-days were scored (delivery and recovery dates were excluded), weather valid or invalid, but were coded as such for analysis. Scoring was done using MeterPlus 4.2.

6.11 Variables for analysis

Many variables can be generated for analysis using the data derived from this study. Full lists with descriptions of GIS, IPAQ, NEWS and sociodemographic variables are available in Appendices 13 and 14.

In this section we will describe the variables used for analysis in the three initial studies of the IPEN-Mexico dataset presented in this dissertation. These variables are defined in greater detail in each of the studies (following chapters) that used them.

6.11.1 Physical activity outcome variables

<u>Accelerometry derived variables (objectively measured physical activity)</u>

These were estimated using total valid minutes per week (minutes within valid hours and valid days) of the given physical activity outcome, and total valid days and wear time per participant. Two types of variables were derived from objectively measured physical activity: total physical activity and bouted physical activity. Bouts were defined as: a) having a duration of at least ten minutes, b) having an intensity of activity defined as moderate-to-vigorous (>= 1952 counts per minute), c) having 80% or more of the bout consisting of moderate-to-vigorous intensity of activity (>=1952 counts per minute; therefore, break time, defined as activity below 1952 counts per minute, could not be more than 20% of the bout), d) each break below the cut point (1952 counts per minute) could have a maximum duration of two minutes. If any of the points mentioned above was not met, the bout was interrupted.

The following accelerometry derived variables were used for analysis:

1. Total minutes per week of objectively measured moderate physical activity (total minutes per week of activity between 1952 to 5724 counts per minute, regardless of bouts)
2. Total minutes per week of objectively measured vigorous physical activity (Total minutes per week of activity above 5725 counts per minute, regardless of bouts)
3. Total minutes per week of objectively measured moderate to vigorous physical activity (Total minutes per week of activity above 1952 counts per minute, regardless of bouts)
4. Minutes per week of objectively measured moderate physical activity occurring within bouts (Minutes per week of activity within 1952 to 5724 counts per minute, registered within MVPA bouts as defined for this study)
5. Minutes per week of objectively measured vigorous physical activity occurring within bouts (Minutes per week of activity above 5724 counts per minute, registered within MVPA bouts as defined for this study)
6. Minutes per week of objectively measured moderate to vigorous physical activity occurring within bouts (Minutes per week of activity above 1952 counts per minute, registered within MVPA bouts as defined for this study)

Self reported physical activity variables (IPAQ)

The following variables derived from the data collected via IPAQ were used for the analyses presented in this dissertation. It is important to note that IPAQ requires participants to only report physical activity occurring within bouts of at least ten minutes. Hence, IPAQ in itself is a measure of self-reported bouted physical activity, and not of total physical activity which would include sporadic (less than ten minutes duration) activity. Therefore, a participant that has "zero" minutes per week of a given physical activity variable derived from IPAQ, is a person that did not report any *bouted* physical activity.

Self reported physical activity variables used in this study:

1. Transport walking-minutes per week (total minutes per week spent walking exclusively for transportation purposes. In compliance with the IPAQ protocol[132], only bouts of at least ten minutes were reported)
2. Transport biking-minutes per week (total minutes per week spent bicycling exclusively for transportation. Only bouts of at least ten minutes were reported)
3. Total Transport PA-minutes per week (total minutes per week spent in PA for transportation. This variable is the result of the addition of TWLK and TBKG)
4. Minutes per week of leisure-time walking (total minutes per week spent walking exclusively for leisure. Only bouts of at least ten minutes were reported)

5. Moderate-intensity leisure-time physical activity (total minutes per week spent doing moderate-intensity physical activity for leisure, not including walking; IPAQ defines moderate activities as those that cause one to "breathe slightly faster than usual"; only bouts of at least ten minutes were reported)

6. Minutes per week of vigorous-intensity leisure-time physical activity (total minutes per week spent in vigorous PA for leisure; IPAQ defines it as activities that have a minimal duration of ten minutes, and cause the participant to "breathe much faster than usual"[148])

7. Minutes per week of moderate to vigorous leisure-time physical activity (this variable results from the addition of self-reported physical activity variables 4, 5 and 6 in this list)

6.11.2 Built environment (independent) variables

Objectively measured built environment variables (GIS-derived)

The location of each participant's home residence was manually marked in a paper map (an example is shown in appendix 15) by trained fieldworkers upon recruitment and manually geocoded in ArcGIS as a point shapefile. This was done since the maps provided by INEGI did not allow for automated address matching. Two buffers (500 and 1000 meters) around each participant's residence were generated using ESRI® ArcGIS 9.3 Software. These two sizes were used since the optimal buffer size has not been clearly defined yet in the literature. For instance, it is thought that the association of certain environmental features may be stronger when considering only a more proximal environment (e.g. 500 meters), while others are thought to be more likely affected by a larger surrounding area (e.g. 1000 meters). The buffers created were not simple crow-fly buffers, but rather were street network buffers. This means that the street network was used to create these buffers and they actually represent a walkable distance from the center (household location).

The following GIS variables were used for analysis:

1. Net-residential density (defined as number of households per buffer over the total area in the buffer designated to residential land use)
2. Commercial land-use proportion (defined as area within the buffer designated for commercial land-use over total buffer area)
3. Connectivity (it refers to intersection density within the buffer; number of 3 and 4 way intersections per kilometer squared, obtained by dividing total number of 3 plus 4 way intersections within the buffer over total buffer area in kilometers)
4. Land use mix (it refers to diversity of land uses within the buffer; it was obtained through the following formula, known as the entropy index: 1 X ((∑(pi)(lnpi))/lnk)[16,98] where p=proportion of total land uses, i=land use category, ln=natural logarithm, k=number or land uses. Range 0-1; the land uses considered included: residential, commercial, educational/cultural, public spaces and others)
5. Walkability index [(2 x z-intersection density) + (z-net residential density) + (z-proportion of commercial land use) + (z-land use mix)]

6. Number of parks per buffer (number of parks intersecting the buffer, whether they are completely within the buffer or not)
7. Number of public transportation routes (number of public transportation -bus- routes intersecting the buffer; a shapefile of official bus stops was not provided, yet in Mexico it is permitted to stop the bus anywhere along its route)
8. Distance to the nearest park in meters.

The GIS variables listed represent the ones used for analysis in this study. Nevertheless a full list of variables created and currently available in the IPEN-Mexico dataset is available in Appendix 13.

Perceived built environment variables (NEWS)

For the analyses presented as part of this dissertation, only safety from crime perception variables were used. These included:

1. Neighborhood safety perception. Derived from the NEWS items scored on an agreement scale of 1-4: The crime rate in my neighborhood is high, the crime rate in my neighborhood makes it unsafe to walk during the day, the crime rate in my neighborhood makes it unsafe to walk during the night, the parks and plazas in my neighborhood are unsafe to visit during the day, the parks and plazas in my neighborhood are unsafe to visit during the night. An average score was obtained, and a binary variable was created. "Unsafe neighborhood" >=3, "Safe neighborhood"<3 (reference).

2. Parks safety perception. Derived from the NEWS items scored on an agreement scale of 1-4: The parks and plazas in my neighborhood are unsafe to visit during the day, the parks and plazas in my neighborhood are unsafe to visit during the night. An average score was obtained, and a binary variable was created. "Unsafe parks" >=3, "Safe parks"<3 (reference).

Although these two variables showed a moderate correlation (R-squared=0.28), it was decided to use them separately since they may influence different types of physical activity, both by intensity and by domain. Park safety perception was thought likely to be correlated to park use, and physical activity in parks is mainly recreational (leisure-time). Neighborhoods safety perception may be correlated to both leisure-time (e.g. walking for leisure or certain vigorous leisure-time physical activities such as running) and transport-related physical activity. Moreover, it seemed plausible that these two variables could differentially moderate the association of physical activity outcomes with different environmental variables.

A complete list of all the available NEWS derived variables, as well as other IPAQ derived variables, psychosocial measure variables, and sociodemographic variables, see Appendix 14.

6.12 Statistical Analysis

6.12.1 Weights

Prior to performing descriptive and correlation analyses, sampling weights to adjust for unequal probability of selection as well as weights for non-response by sex, were obtained. Sampling weights were calculated using census data from Cuernavaca provided by INEGI[116,120], employing this information as the known population total values. We followed standardized procedures (post stratification), as defined by the United Nations Statistics Division in their Handbook for Designing Sample Surveys[149]. All of the analyses presented using IPEN-Mexico data are therefore weighed for probability of selection and non-response by sex. Accelerometry data is further weighted for total wear time.

6.12.2 Descriptive analysis

A descriptive analysis of the outcome variables was performed as is described in greater detail in each of the three IPEN-Mexico studies presented in this dissertation. Prevalences of meeting WHO recommendations using objectively-measured PA were obtained, as well as mean minutes per week of MVPA, MPA and VPA, with and without ten minute bouts. Values for the 25th, 50th and 70th percentile were also obtained for objectively measured physical activity. Mean minutes per week of transport physical activity and intensity-specific leisure time physical activity were obtained, as well as prevalences of meeting WHO guidelines[136] through leisure-time physical activity only and through transport physical activity only. Furthermore, prevalences of doing "any" (at least one bout of ten minutes reported) activity for transportation or leisure were obtained. The results were stratified by sex, age and SES in some cases, as shown in each specific study in the following sections of the dissertation.

6.12.3 Correlation analysis

Unadjusted and adjusted linear regression models were run to study the association between minutes per week of objectively and subjectively measured physical activity with sociodemographic and GIS-derived built environment variables. The adjusted models included all the studied sociodemographic variables studied. Multicollinearity was assessed using Variance Inflation Factor (VIF) values, and was determined when VIF>10. Significance was considered when $p \leq 0.05$.

The following correlation analyses were performed:

1. Associations between objectively measured weekly minutes of physical activity and sociodemographic variables (study 2 of the dissertation). Specific models were run to assess the correlations of sociodemographic variables with: minutes of moderate physical activity per week, minutes of vigorous physical activity per week, and minutes of moderate to vigorous physical activity per week. Furthermore, specific models were run

to assess the correlations of both total and bouted physical activity for each of the mentioned physical activity outcomes.

2. Associations between subjectively measured weekly minutes of physical activity and sociodemographic variables. Specific models were run to assess the correlations of sociodemographic variables with domain and intensity-specific physical activity outcomes (minutes per week of transport physical activity, minutes per week of walking for leisure, minutes per week of moderate physical activity for leisure, minutes per week of vigorous physical activity for leisure, minutes per week of total physical activity for leisure). Since IPAQ only reports physical activity with a duration of at least ten minutes for all of its categories, these models represent the associations of domain-specific, self-reported bouted physical activity with sociodemographic variables.

3. Associations between objectively measured minutes per week of moderate-to-vigorous physical activity (accelerometry) and objectively measured built environment variables (GIS-derived). For this analysis we also tested for interactions between the GIS variables and safety perception variables, using likelihood ratio tests.

6.12.4 Modeling strategy

All models were run using a design-based approach, due to the complex survey design of our study, which has representative data for adults from Cuernavaca. We obtained design-based estimates using the Taylor series linearization method, by using SAS's survey procedures (surveyreg) [150]. SAS's survey procedures, also including surveyfreq and surveymeans, incorporate sampling weights and account for the complex, stratified, multistage clustered survey design employed [149,151,152]. Furthermore, given that the surveyreg procedure is design-based, rather than being based on a given probabilistic distribution (which is appropriate since we are using a survey sample rather than an experimental design), it allows for the linear modeling of non-normally distributed and non-symmetric outcomes (with non-normal errors), without the need for log transformation of the data[151,152]. Therefore, the survey procedures are not based on the standard general linear model with independent, identically-distributed, normal errors, for which it is not necessary to test for normality or for heteroskedasticity[151,152]. This represents a great advantage when dealing with physical activity data, that is usually skewed to the right, and for which log transformations are common. Nevertheless, log transformed data are hard to interpret and to translate for policy and program recommendations. With this modeling strategy, the correlation coefficients obtained represent minutes per week gained or lost due to the association with a given sociodemographic or environmental variable. The surveyreg procedure only allows for single level linear modeling[151,152] , that is, multilevel models cannot be run using this analytic procedure. For this reason, our buffer-based variables around each participant's household location were a good approach, providing individual level built environment data. Nonetheless, for future analysis involving block level data from the environmental audit tool, or census tract level data, we will need to use other multilevel methods (e.g. proc mixed) for which, if a linear model is desired, data transformation will need to take place.

6.12.5 Statistical software

All statistical analyses were performed in 2012 and 2013 using SAS 9.3 (SAS Institute Inc., Cary, NC, USA). The code to generate all bout-related variables was done using MatLab 7.7 (The MathWorks Inc., Natick, MA, USA) by Umberto Villa.

6.13 Final sample for analysis

(response rate, losses to follow up/substitution and accelerometer re-use)

The study had a response rate of 58.9%, and no significant differences were found in the response rate by strata. This response rate is similar to those seen in other countries for these types of studies, as well as for those reported in the most recent National Health and Nutrition Surveys in Mexico (ENSANUT)[43,53,146,153]. Moreover, 98 (42 male, 56 female) participants that were recruited and handed accelerometers for use decided not to complete participation in the study and returned the accelerometer without having worn it, and did not complete the final study survey (sociodemographic characteristics, IPAQ, NEWS, psychosocial measures, home characteristics and assets), nor was their weight and height measured. Each of these cases were substituted for another eligible participant, preferably from the same household (n=18), or if not, from the same block (n=80), following the standard selection procedures of moving to the next household to the right (clockwise). The final sample for analysis was of 677 participants. All of the 677 participants had valid survey data, 669 had valid accelerometry data, and 662 had valid GIS data. Furthermore, 30.1% (n=202) were required to re-use the accelerometer beyond home visit two, to complete enough valid days (minimum of five valid days required, defined as having at least ten valid hours).

7. Study I

7.1 Title: Intensity-specific leisure time physical activity and the built environment among Brazilian adults: A best-fit model

Salvo D, Reis RS, Hino AF, Hallal P, Pratt M.

Word Count: 3453

Abstract Word Count: 200

7.2 ABSTRACT

BACKGROUND: There is little understanding about which sets of environmental features could simultaneously predict intensity-specific leisure-time physical activity (LTPA) among Brazilians. The objectives were to identify the environmental correlates for intensity-specific LTPA, and to build the best-fit linear models to predict intensity-specific LTPA among adults of Curitiba, Brazil.

METHODS: Cross sectional study in Curitiba, Brazil (2009, n=1461). The International Physical Activity Questionnaire and Abbreviated Neighborhood Environment Assessment Scale were used. Ninety perceived environment variables were categorized in 10 domains. LTPA was classified as: walking for leisure (LWLK), moderate-intensity leisure-time PA (MLPA), vigorous-intensity leisure-time PA (VLPA) and moderate-to-vigorous intensity leisure-time PA (MVLPA). Best fitting linear predictive models were built.

RESULTS: Forty environmental variables were correlated to at least one LTPA outcome. The variability explained by the four best-fit models ranged from 17% (MLPA) to 46% (MVLPA). All models contained recreation areas and aesthetics variables; none included residential density predictors. At least one neighborhood satisfaction variable was present in each of the intensity-specific models, but not for overall MVLPA.

CONCLUSIONS: This study demonstrates the simultaneous effect of sets of perceived environmental features on intensity-specific LTPA among Brazilian adults. The

differences found compared to high-income countries suggest caution in generalizing results across settings.

7.3 BACKGROUND

The global importance of physical activity (PA) is well recognized.[1, 2] Over the past decades the prevalence of obesity and non-communicable diseases (NCDs) have risen dramatically in Brazil and Latin America. [3-6] Physical inactivity is a risk factor for obesity and NCDs, [2, 7, 8] and accounts for as many as 5.3 million deaths per year worldwide. [8] It is estimated that 49.2% of Brazilian adults are inactive.[1]

Recently there has been an increased focus on the built environment and its influence on PA within urban populations. Evidence suggests there is an association between both the objectively measured and the perceived built environment with PA. [9-13] Leisure and transport PA may be more affected by the objective and perceived built environment than other types of activity.[14, 15] Studies from high-income countries (HIC) show inconsistent results for the association of mixed land use, residential density and connectivity to transport-related PA for adults.[9, 14-17] Evidence from HIC also suggests that aesthetics, proximity to recreation areas and pedestrian facilities may be of higher importance for leisure-time PA (LTPA) among adults.[9, 14, 15, 18] Nonetheless, fewer studies examining the environmental correlates of LTPA with respect to transport PA have taken place.[14, 19]

Modifying only a few aspects of the built environment is not enough to increase PA levels in a population.[19, 20] There is relatively little understanding about which combinations of environmental features could maximize the impact upon LTPA levels.[15, 21]

Moreover, LTPA can be practiced at different intensities known to be beneficial to health, ranging from walking to vigorous-intensity PA and sports. Each intensity level of LTPA is achieved by different types of activities, and thus represent distinct behaviors[22], and may therefore be associated to different built environment features.[23] In fact, a few studies from HIC show that the environmental predictors of LTPA may vary across intensity levels.[23-25]

Due to the unique cultural and structural characteristics of Brazil and other low to middle income countries (LMIC), different results may be expected from those of HIC.[15, 26-30] For instance, in Latin America and other LMIC, public space plays a key role for leisure-time activities.[31] The use of streets, parks and plazas for leisure in these settings may be driven by elements beyond physical activity and health, such as social equity and social cohesion factors.[27, 32] Hence, the associations of LTPA with the perceived built environment in LMIC such as Brazil may vary from those known for HIC, and their understanding is essential to guide local policies and programs to promote PA through environmental change.[15, 30]

The aims of this study were to identify the perceived environmental correlates for four specific categories of LTPA for adults in Curitiba, Brazil, and to use these to build the best-fitting linear models to predict intensity-specific LTPA among adults.

7.4 METHODS

Study population and study design

This study used data collected for a cross sectional study conducted during 2009 in Curitiba/PR, Brazil. Data analysis took place in 2012. Curitiba is the seventh largest city in Brazil.[33] It has been recognized for policies promoting green space, recreation areas and active transportation.[34] The city has 21 large parks, 454 plazas (pocket parks) and 40 public sports and recreation centers.[35]

The sample selection of the original study had a cross-sectional, multistage clustered design. Eight parks and plazas were selected (primary sampling unit).[33, 36] A random sample of 1461 healthy adults residing within 500 meters of a selected park/plaza were included in the original study, that used a household survey and aimed to analyze lifestyle, health aspects, leisure PA practice and quality of life of individuals living around selected parks and squares in the city of Curitiba, Paraná, Brazil. More details about the sampling procedures and study design are available elsewhere.[33, 36-38] This is a secondary data analysis project (2012).

Instruments

LTPA duration and intensity were assessed using the International Physical Activity Questionnaire-long version (IPAQ), which is a known valid measure for adult PA levels in Brazil and Latin America.[39-41] The Abbreviated Neighborhood Environment Walkability Scale (ANEWS) was culturally adapted and used to assess neighborhood perception.[42] Questions regarding weather as a barrier for PA, neighborhood satisfaction, demographics, motor vehicle ownership, self reported height and weight, occupation, and income were also included. The survey was applied face to face to all participants by trained field workers.[37, 38] Written informed consent was obtained from all participants prior to survey application. This study was approved by the IRB of the Federal University of Pelotas, Brazil.

Variables for analysis

Only the IPAQ section on leisure time physical activity was used for the analyses.
The analysis considered 92 perceived environmental (independent) variables, which corresponded to each individual ANEWS item. It was decided to analyze the items independently instead of using the NEWS subscale sum-scores, since the assignment of weights and direction per item was based on evidence from HIC[24] that may not best reflect the relationships of perceived environmental features with LTPA in Brazil. The 92 items were categorized into 10 domains: safety from traffic, safety from crime, aesthetics, neighborhood satisfaction, pedestrian infrastructure, mixed land use, residential density, transportation, recreation spaces and weather.

The following outcome (dependent) variables were obtained:

Leisure-time walking (LWLK): Total minutes per week spent walking exclusively for leisure. In compliance with the IPAQ protocol,[43] only bouts of at least ten minutes were reported. Although moderate-intensity PA can be achieved through walking,[44] it was classified independently from other leisure moderate activities reported in compliance to the format of IPAQ,[41] and since it represents a different behavior.[22] As such, it may have different associations to the perceived environment.[23]

Moderate-intensity leisure-time physical activity (MLPA): Total minutes per week spent doing moderate-intensity physical activity for leisure (excluding walking). Moderate-intensity is defined as that which "noticeably accelerates the heart rate", and where energy expenditure is of 3 to 6 METs.[44, 45] Culturally appropriate examples such as dancing were included during the face to face application of IPAQ, which defines this category as all free time activities that make the participant "breathe slightly faster than usual". Only bouts of at least ten minutes were reported.

Vigorous-intensity leisure-time physical activity (VLPA): Total minutes per week spent doing vigorous PA for leisure that cause a "substantial increase in heart rate".[45] IPAQ describes vigorous-intensity activities as any free time activity with a minimum duration of ten consecutive minutes, that makes the participant "breathe much faster than usual".[45] Culturally appropriate examples such as playing soccer were provided.

Moderate to vigorous leisure-time physical activity (MVLPA): Total minutes per week of moderate to vigorous LTPA. This variable is the result of the summation of LWLK, MLPA and VLPA.

Correlation analysis

All PA variables were log-transformed (natural log, ln). Unadjusted linear regression models were run to assess the correlation between ln of each LTPA variable and the 92 perceived environment variables.

Modeling strategy

Four linear regression predictive models were built, one per LTPA outcome. Environmental variables that were correlated at the $p<0.05$ or $p<0.10$ level to the PA dependent variable in the unadjusted models (previous step) were considered for inclusion. Intraclass correlations were calculated to assess the variability of the outcome explained by being sampled proximal to the same park (primary sampling unit). All models accounted for the clustered study design.

An all-possible models selection strategy was employed. Sex, age and socioeconomic status (SES) were forced into each model as potential confounders based since they are known correlates of PA.[15, 46] The modeling strategy was set to drop any predictors with p-values higher than 0.10. This condition was not required for the three confounders. Adjusted R-Squared (R2adj) and Mallow's CP values were used to select the models with maximum predictive power. High R2adj values were used to obtain models that explain an optimal proportion of the variability of the given LTPA outcome. Low CP values were used to obtain a good fit and the simplest model per outcome. When deciding between models with similar R2adj values, those with lower Cp values and fewer predictors were prioritized. All models considered potential interactions between sex, age and/or SES with each predictor. Multicollinearity was assessed using Variance Inflation Factor (VIF) values, and was determined when VIF>10. Statistical analyses were performed using SAS 9.3 (SAS Institute Inc., Cary, NC, USA).

7.5 RESULTS

Of the 1461 participants who completed the survey, 19 were excluded due to missing data. There was a higher proportion of females than males (63.6 vs. 36.4%, $p<0.0001$), while one third participants were either overweight or obese, and half owned a motorized vehicle (car or motorcycle). No differences were found across age groups or education levels. The mean age was of 43.2 ± 13.5 years. Appendix 1 shows detailed demographic characteristics of the study population.

The mean minutes per week of total (leisure plus transport) moderate to vigorous PA was 250.81 ± 299.37, while the mean MVLPA minutes per week was 137.38 ± 214.10. When considering total moderate to vigorous PA minutes per week, 54.87% of the sample met the recommendations for activity of 150 minutes per week, [47] yet only 33.33% met recommendations if considering only MVLPA.

Unadjusted Correlations

40 perceived environmental variables were correlated to at least one LTPA outcome (Appendix 2). Specifically, 24 were correlated to LWLK, 20 to MLPA, 23 to VLPA and 31 to MVLPA. The domains with more correlates were mixed land use and recreation

spaces, while the transportation and weather domains had the least correlates. All leisure-time PA outcomes had at least one unadjusted correlate within the domains of: recreation spaces, residential density, land use, pedestrian infrastructure, safety from crime, aesthetics and neighborhood satisfaction. Meanwhile, perceived environmental variables within the domains of transportation, safety from traffic and weather, were only correlated to intensity-specific leisure time PA outcomes.

Best-Fit Models

Tables 1-4 show the best fitting linear predictive models for the four LTPA outcomes. The results for each model are presented by describing the variability of the LTPA outcome explained by the model (R2adj), the strongest predictors per model and any significant interactions found between an environmental predictor and a confounder (sex, age and SES).

Leisure-Time Walking: Best-Fit Model

20% of the variability of LWLK was explained by the best-fitting model (Table 1). Among the strongest predictors, rainy weather negatively predicted LWLK (β=-3.04, p=0.03) and "many natural attractions in the neighborhood" had a positive association (β=2.95, p=0.04). Having many beautiful buildings in the neighborhood was positively correlated to LWLK only for high SES participants (β=1.02, p=0.048).

Moderate Leisure-Time PA: Best-Fit Model

The best fitting model for MLPA had an R2adj of 0.17 (Table 2). The strongest predictors were "many natural attractions" (β=3.74, p=0.01) and proximity to a small park (β=3.12, p<0.001), which were both positively associated to MLPA. Meanwhile, to "like to live in the neighborhood" had a high positive correlation coefficient but marginal significance (β=4.44, p=0.09). No significant interactions with sex, age or SES were found for the MLPA model.

Vigorous Leisure-Time PA: Best-Fit Model

The best fitting model for VLPA (Table 3) explained 26 % of the variability. The strongest predictor included in the model was "interesting things to see" in the neighborhood (β=2.89, p=0.04), which was positively associated to VLPA. Living near to a biking trail was only a significant positive predictor of VLPA among males (β=2.05, p=0.001), while choosing to live elsewhere if possible negatively predicted VLPA only for high-SES participants (β=-3.98, p=0.02).

Moderate to Vigorous Leisure-Time PA: Best-fit model

The overall MVLPA best fitting model (Table 4) had an R2adj of 0.46. The strongest positive predictor was proximity to a large park (β=4.58, p=0.02). Cars driving over the speed limit was negatively associated to MVLPA and had a high beta coefficient (β=-4.12), but was marginally significant (p=0.08). Proximity to public transportation interacted with SES, such that living close to a public transportation stop was only negatively associated to MVLPA for high SES participants (β=-1.19, p<0.001).

Composition of the models: Size and environmental domains

Figure 1 illustrates the similarities and differences across the best fitting intensity specific LTPA models. In addition to the intercept and the forced confounders (sex, age and SES), the four best fitting models are composed of five (MLPA) to nine (LWLK) predictors. LWLK and VLPA had the highest number of predictors (nine and eight, respectively), and MLPA had the lowest with five. All models contained variables from the recreation areas and aesthetics domains, and no model included residential density predictors. At least one neighborhood satisfaction predictor was present in each of the intensity-specific models, but not in the overall MVLPA one. Similarly, the LWLK model and the VLPA models had three and two predictors, respectively, from the mixed land uses domain, while the overall MVLPA model did not include any variable from this domain. Pedestrian infrastructure variables were present in all but the LWLK model. Meanwhile, variables from the safety from traffic, safety from crime and public transportation domains were included in the best fitting model for overall MVLPA, but not in any of the intensity-specific ones.

7.6 DISCUSSION

This study aimed to build best-fit models to predict intensity-specific LTPA among adults in Curitiba, Brazil, and this was achieved with a high proportion of the variability explained by the models, ranging from 17%(LWLK) to 46% (MVLPA). The results show that the perceived environmental predictors of LTPA varied by intensity, and suggest that a compound measure of MVLPA may lead to loss of information that an intensity-specific approach provides.

The composition of the best fitting models per LTPA intensity varied in size (number of predictors per model), content (domains represented by the environmental variables in each model) and complexity (interactions found between environmental predictors and confounding variables) (Figure 1). LWLK and VLPA were best predicted by a combination of a higher number of environmental factors (nine and eight, respectively), while MLPA only had five predictors. Furthermore, no environmental variable in the best fitting model for MLPA interacted with sex, age or SES, making it the smallest and simplest model.

Some of the intensity-specific models included more than one variable within the same environmental domain (Figure 1). For the LWLK model, mixed land use variables constituted one third of the environmental predictors of the model. The same model also included two recreation areas variables, and two aesthetics ones. The best fitting VLPA model had three recreation areas and two mixed land use predictors. The fact that more than one variable per domain remained in the best-fit models after testing for multicollinearity is relevant. This implies that in spite of being from the same domain, each variable contributes independently towards the given LTPA outcome. Future studies in LMIC settings addressing the independent influence upon LTPA of environmental factors regularly classified within the same category are needed to verify these findings.

The results are consistent with recent studies in Brazil showing associations between access/proximity to recreation areas and LTPA.[29, 48] In fact all the models included at least one variable from the recreation areas domain. Previous studies have only found LTPA associations with a limited number of environmental features after controlling for confounders. [29, 48-50] These include the availability of sidewalks,[49, 50] proximity and accessibility to biking trails and parks,[29, 48] and proximity to gyms.[48] By fitting linear models rather than dichotomizing the LTPA outcomes for logistic models, and studying a wider range of variables, more associations with perceived environmental features were detected providing further insight on these relationships.

All of the intensity-specific LTPA models included aesthetics and mixed land use predictors. This association is consistent with recent studies on LWLK from high income countries.[14, 21, 51] While in HIC proximity to recreation areas is only associated to total MVPA and non-walking MLVPA,[19, 52] the present findings suggest that in Curitiba it is one of the strongest predictors for all intensity-specific LTPA outcomes, including LWLK.

A major contribution of this study is the observed environmental associations of VLPA in a LMIC setting. Studies from HIC haven't found significant environmental associations for vigorous PA.[53, 54] In contrast, this study provided a VLPA model that included four environmental variables with $p<0.05$, and four with marginal significance ($p<0.10$). It was also the intensity-specific LTPA model with the highest R2adj (0.26). This could be due to the high availability of recreation areas in Curitiba and to cultural influences that could make Brazilian adults more prone to outdoor exercise in comparison to HIC. These hypotheses should be further explored.

While the importance of understanding the environmental associations of domain-specific PA outcomes (e.g. leisure vs. transport) is now well recognized,[14, 15] few studies have addressed all intensity-specific PA outcomes. [25] Recent studies have focused on LWLK,[14, 21, 29, 49] and some have also used a compound measure for non-walking MVLPA.[29, 52] De Bourdeaudhuij et al. reported the environmental correlates of walking, MPA and VPA independently, but their study was not specific to LTPA.[25] This is the first study to report intensity-specific environmental correlates and best-fit models for each intensity-specific LTPA outcome.

This study had several limitations. As for most studies of this type the cross-sectional design precludes determining causality.[15] The modeling approach of building best-fit predictive models was exploratory rather than explanatory. These models did not necessarily include the most relevant variables, but the set of independent predictors that within the same model provide the best fitting estimate of the outcome of interest while adjusting for each other.[55] Therefore the interpretation of our findings should be conservative, understanding that the predictors represent their environmental domain. Few psycho-social correlates of activity were studied, such as neighborhood satisfaction. All data was self-reported which may have lead to overestimation of PA.[56, 57] While this represents a limitation, self-report provides domain-specific PA data. Meanwhile, self-reported measures provide insight on perceptions of the environment that objective measures such as Geographic Information Systems can't capture.[58] Like other correlate studies, there was a high proportion of females in our sample.[48, 53] This was a secondary analysis of existing data, and the sampling procedure using parks as primary sampling units may have limited the variability among park-related variables. Although the unique cultural and physical characteristics of Curitiba make it an ideal setting for environmental studies of PA, the results may not be generalizable to other cities. The abundance of public spaces and infrastructure for PA may help explain the high R2adj values found for the models in comparison to similar studies in other settings, although further studies are needed to verify this statement.[25] This could also suggest that when a city achieves sufficient urban design modifications, the potential impact of the environment upon PA may increase, but the cross sectional design of our study doesn't allow us to determine this.[19, 20] Longitudinal studies in Curitiba are therefore needed to identify the facilitating and non-facilitating environmental attributes affecting LTPA. Furthermore, prospective studies in other settings addressing these hypotheses are needed to ensure generalizability.[59]

Despite several limitations this study had many strengths including the large sample from a LMIC city, and high quality data. The study population had sociodemographic characteristics and obesity rates comparable with national data from 2009 (obesity in our sample = 15.1 % vs. obesity in Brazil 13.9%).[6] The analytical approach of finding best-fit models rather than individual adjusted models for each environmental variable is innovative and in line with the recognized need to find combinations of environmental features to predict activity levels.[15] Recent studies in HIC have started to use similar strategies, [21, 60] yet this is the first study of its kind for a LMIC. The use of individual items (tested for multicollinearity) rather than scored subscales per environmental domain allows for higher predictive power in the models and provides more in-depth understanding of the strength and direction of the environmental associations with PA outcomes in a LMIC setting. The same is true for the use of linear regression, preventing the loss of detail that may occur when dichotomizing the outcomes for logistic regression. Although the interpretation of log-transformed data is more complex, it seems relevant to study the linear associations between perceived environmental features and PA, given that more time and higher intensities of PA at any level are associated with more health benefits.[47, 61]

This study demonstrates the association that given sets of perceived environmental features have simultaneously (in the same model, while adjusting for each other) on intensity-specific leisure-time PA outcomes for adults in Curitiba, Brazil. Our findings stress the need to understand the intensity-specific correlates for LTPA in all settings. Given the well established evidence of the health benefits of MPA (including walking),[8, 46, 47] the low contribution of VPA to total PA[56, 62, 63] and the fact that it may be more relevant to promote MPA to increase population level PA[64], public health efforts should target environmental interventions based on intensity-specific evidence to increase the probability of their success. Furthermore, the differences found compared to similar studies of HIC suggest caution in generalizing results from one type of city, country or culture to another. Our findings support the increasingly recognized need for more studies on the environmental determinants of leisure-time PA in LMIC to help guide environmental policies and programs to promote PA, rather than being based on evidence from HIC.[29, 65]

7.7 ACKNOWLEDGEMENTS

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7.8 TABLES, APPENDICES AND FIGURES

7.9 REFERENCES

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Table 1: Best-fit predictive model of leisure time walking[a] among adults of Curitiba, Brazil, 2009.

Variable		Parameter Estimate	Standard Error	P value
Intercept	------------------------	1.79	0.53	0.04
Male [b]	*Binary (ref=female)*	-1.03	1.44	0.48
30 to 49 years [b]	*Dummy (ref=less than 30 years)*	0.16	0.59	0.24
50 or more years [b]	*Dummy (ref=less than 30 years)*	-3.06	2.70	0.26
High SES [b]	*Binary (ref=low SES)*	-1.97	0.61	0.05
Proximity to any park	*Binary (ref=no)*	1.77	0.70	0.01
Proximity to a walking trail	*Binary (ref=no)*	1.85	0.39	0.00
Proximity to post office	*Binary (ref=no)*	1.08	0.85	0.04
Proximity to bank	*Binary (ref=no)*	0.18	0.58	0.01
Proximity to work/school	*Binary (ref=no)*	-2.55	3.75	0.10
Many natural attractions	*Binary (ref=no)*	2.95	1.51	0.04
Many beautiful buildings	*Binary (ref=no)*	0.42	0.21	0.09
Satisfied with neighborhood	*Binary (ref=no)*	1.33	2.07	0.01
Rain	*Binary (ref=rain not a barrier for walking)*	-3.04	1.57	0.03
Interaction_1 [c]	*Many beautiful buildings (yes) * High SES*	1.02	0.59	0.05
	*Many beautiful buildings (yes) * Low SES*	0.96	0.77	0.11
	*Many beautiful buildings (no) * High SES*	-0.21	0.33	0.16
Intraclass correlation = 0.03				
	$R^2_{adj} = 0.20$, $C_P = 13.84$			

[a] Model predicts *ln* of minutes per week of leisure time walking, [b] Forced into the model as potential confounders, [c] Interaction_1 = Many beautiful buildings in neighborhood *SES (p<0.001). Reference=no*Low SES, NOTE: For all 'proximity' variables: Yes=walking distance of 20 minutes or less to location, No=walking distance of more than 20 minutes to location. The SES variable compares the highest income tertile to the combination of the first and second tertiles. No significant interactions where found between the sex and age variables, and the environmental exposure variables.

Table 2: Best-fit predictive model for leisure time MPA[a] among adults of Curitiba, Brazil, 2009.

Variable		**Parameter Estimate**	**Standard Error**	**P Value**
Intercept	-------------------------	1.22	1.19	0.00
Male [b]	*Binary (ref=female)*	0.56	0.21	0.13
30 to 49 years [b]	*Dummy (ref=less than 30 years)*	-1.96	3.06	0.06
50 or more years [b]	*Dummy (ref=less than 30 years)*	-2.57	2.06	0.26
High SES [b]	*Binary (ref=low SES)*	-1.36	0.42	0.31
Proximity to a small park	*Binary (ref=no)*	3.12	3.98	0.00
Rain	*Binary (ref=rain not barrier for MLPA)*	-1.25	2.88	0.07
Many dead end streets	*Binary (ref=no)*	-1.98	3.79	0.01
Many natural attractions	*Binary (ref=no)*	3.74	3.07	0.01
Like to live in neighborhood	*Binary (ref=no)*	4.44	3.13	0.09
Intraclass correlation = 0.02				
	R^2_{adj} = 0.17, C_P = 11.80			

[a] Model predicts *ln* of minutes per week of leisure time moderate physical activity, [b] Forced into the model as potential confounders. NOTE: For all 'proximity' variables: Yes=walking distance of 20 minutes or less to location, No=walking distance of more than 20 minutes to location. The SES variable compares the highest income tertile to the combination of the first and second tertiles. No significant interactions where found between the sex, age and SES variables, and the environmental predictor variables.

Table 3: Best-fit predictive model for leisure time VPA[a] among adults of Curitiba, Brazil, 2009.

Variable		Parameter Estimate	Standard Error	P Value
Intercept	-------------------------	1.15	1.12	0.30
Male [b]	*Binary (ref=female)*	1.24	1.20	0.13
30 to 49 years [b]	*Dummy (ref=less than 30 years)*	-0.15	0.13	0.27
50 or more years [b]	*Dummy (ref=less than 30 years)*	-1.31	0.50	0.53
High SES [b]	*Binary (ref=low SES)*	2.31	0.50	0.11
Proximity to any park	*Binary (ref=no)*	2.40	0.38	0.09
Proximity to walking trail	*Binary (ref=no)*	1.04	0.81	0.04
Proximity to biking trail	*Binary (ref=no)*	1.45	1.42	0.05
Proximity to a school	*Binary (ref=no)*	0.69	0.41	0.02
Sidewalks in most streets	*Binary (ref=no)*	1.19	0.31	0.09
Interesting things to see	*Binary (ref=no)*	2.89	1.26	0.04
Would live elsewhere if possible	*Binary (ref=no)*	-2.40	1.47	0.06
Proximity to post office	*Binary (ref=no)*	-1.80	0.23	0.00
Interaction_1 [c]	*Proximity to biking trail (yes) * Male*	2.05	0.56	0.00
	*Proximity to biking trail (yes) * Female*	1.82	1.23	0.12
	*Proximity to biking trail (no) * Male*	-2.12	0.85	0.06
Interaction_2 [d]	*Would live elsewhere if possible (yes) * High SES*	-3.98	0.83	0.02
	*Would live elsewhere if possible (yes) * Low SES*	-1.59	0.90	0.11
	*Would live elsewhere if possible (no) * High SES*	1.29	0.64	0.09
Intracluster correlation = 0.02				
	$R^2_{adj} = 0.26$, $C_P = 14.18$			

[a] Model predicts *ln* of minutes per week of leisure time vigorous physical activity, [b] Forced into the model as potential confounders, [c] Interaction_1: Proximity to biking trail * Sex ($p<0.001$). Reference=no*Female, [d] Interaction_2: Would live elsewhere if possible * SES ($p<0.001$). Reference=no*Low SES. NOTE: For all 'proximity' variables: Yes=walking distance of 20 minutes or less to location, No=walking distance of more than 20 minutes to location. The SES variable compares the highest income tertile to the combination of the first and second tertiles. No significant interactions where found between age and the environmental predictor variables.

Table 4: Best-fit predictive model for overall leisure time MVPA[a] among adults of Curitiba, Brazil, 2009.

Variable		Parameter Estimate	Standard Error	P Value
Intercept	------------------------------	1.44	0.72	0.00
Male [b]	*Binary (ref=female)*	0.34	0.36	0.84
30 to 49 years [b]	*Dummy (ref=less than 30 years)*	-0.48	0.48	0.33
50 or more years [b]	*Dummy (ref=less than 30 years)*	1.92	1.70	0.11
High SES[b]	*Binary (ref=low SES)*	1.88	1.12	0.01
Proximity to large park	*Binary (ref=no)*	4.58	2.87	0.02
Proximity to community center	*Binary (ref=no)*	1.30	1.93	0.01
High crime rate	*Binary (ref=no)*	-1.22	0.39	0.04
Many natural attractions	*Binary (ref=no)*	1.23	0.42	0.01
Cross walks in most roads	*Binary (ref=no)*	0.15	0.44	0.00
Cars drive over speed limit	*Binary (ref=no)*	-4.12	5.65	0.08
Proximity to public transportation	*Binary (ref=no)*	-1.01	1.40	0.02
Interaction_1 [c]	*Proximity to public transportation (yes) * High SES*	-1.19	0.60	0.00
	*Proximity to public transportation (no) * High SES*	1.26	0.91	0.21
	*Proximity to public transportation (yes) * Low SES*	-1.07	1.01	0.14
Intraclass Correlation = 0.06				

R^2_{adj} ***= 0.46, CP = 14.61***

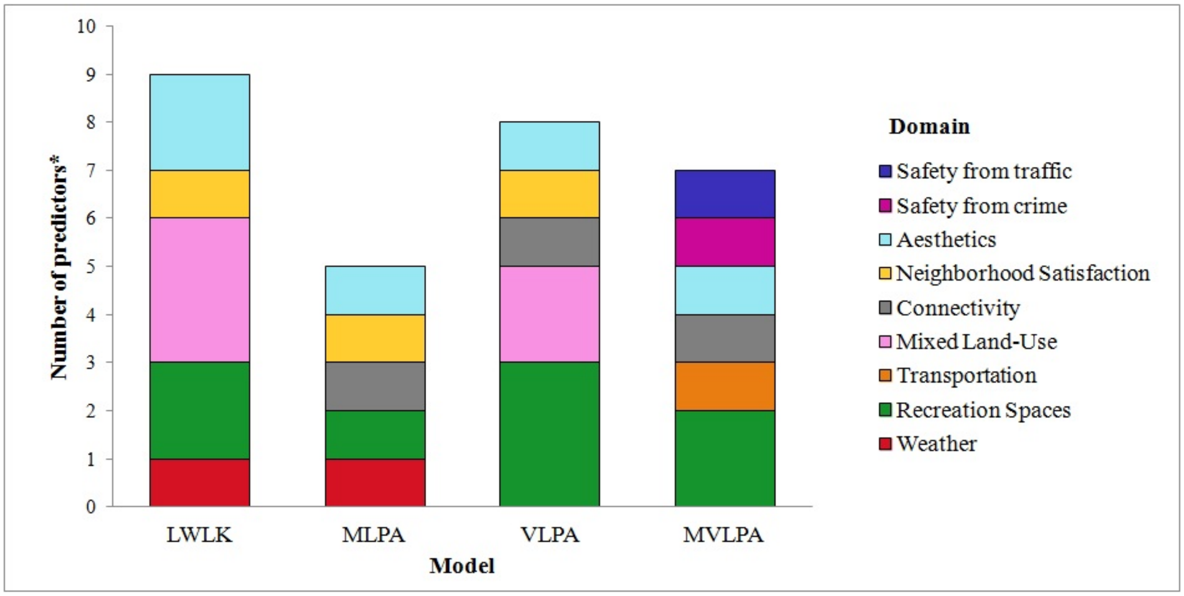
[a] Model predicts *ln* of minutes per week of moderate to vigorous leisure time physical activity, [b] Forced into the model as potential confounders, [c]Interaction_1= Proximity to public transportation * SES (p=0.001). Reference=not proximal to public transportation*low SES. NOTE: For all 'proximity' variables: Yes=walking distance of 20 minutes or less to location, No=walking distance of more than 20 minutes to location. The SES variable compares the highest income tertile to the combination of the first and second tertiles. No significant interactions where found between the sex and age variables, and the environmental predictor variables.

Appendix 1: Demographic characteristics, transportation modes and physical activity levels of the study population. Curitiba, Brazil, 2009.

Socio-demographic / Transportation / Physical Activity Variable	n	%
Total	1442	100.0
Sex		
Male	525	36.4
Age		
<30 years	318	22.
30 ≤ years < 40 years	283	19.6
40 ≤ years < 50 years	326	22.6
50 ≤ years < 60 years	334	23.2
≥ 60 years	181	12.6
Nutritional Status		
Normal (BMI <25)	743	51.5
Overweight (25 ≤ BMI < 30)	482	33.4
Obese (BMI ≥ 30)	217	15.1
Income		
Low	182	12.6
Medium	714	49.5
High	546	37.9
Education level		
Less than highschool	451	31.3
Hischool	624	43.3
Some college or above	367	25.5
Marital Status		
Single, Divorced or Separated	403	28.0
Married or living with a partner	1039	72.1
Occupation		
Work	811	56.2
Study	83	5.8
Work and study	143	9.9
Unemployed/Retired	405	28.1

Socio-demographic / Transportation / Physical Activity Variable	n	%
Motor Vehichle ownership		
One	682	47.3
More than one	412	28.6
Does not own motor vehicle	348	24.13
Main Mode of Transportation		
Bicycle	31	2.2
Walking	181	12.6
Car	667	46.3
Motorcycle	30	2.1
Private bus	16	1.1
Public bus	509	35.3
Other	8	0.6
Total MVPA minutes per week		
<150	652	45.2
≥ 150	790	54.8
Leisure Time MVPA minutes per week		
<150	963	66.8
>=150	479	33.2

Figure 1: Composition of best-fitting predictive models[a] across intensity-specific physical activity outcomes.



[a] Intercept and confounder variables (sex, age and SES) that were forced into all best-fitting models are not included in this figure. Variables found to interact with either sex, age or SES are only counted once per model.

8. Study II

8.1 Title: Sociodemographic correlates of objectively measured physical activity among Mexican adults

Salvo D, Torres C, Villa U, Sarmiento O, Rivera J, Pratt M.

Word Count: 3814

Abstract Word Count: 249

8.2 ABSTRACT

INTRODUCTION: The levels of objectively measured physical activity (PA), and their sociodemographic correlates, remain unknown for Mexican adults. The objectives were to describe the objectively measured total and bout-specific PA levels, and to identify the sociodemographic correlates of total and bouted PA for adults from Cuernavaca, Mexico.

METHODS: Cross sectional study of adults from Cuernavaca, Mexico (2011, n=677). Participants wore Actigraph GT3X accelerometers for seven days and sociodemographic data was collected through a survey. Weight and height were objectively measured. Total minutes/week of moderate-to-vigorous PA (MVPA) and of MVPA occurring within bouts of at least ten minutes were obtained. Intensity-specific (moderate and vigorous) total PA and bouted-PA was also obtained. Adjusted and unadjusted linear models were run to calculate the association of each PA variable with sex, age, socioeconomic status, education, marital status and BMI.

RESULTS: When considering total MVPA, 58.6% of adults from Cuernavaca met international recommendations (MVPA >=150 minutes/week), while13.9% met recommendations when considering only bouted-PA. Significant associations were found for total and bouted MVPA with being male (positive) and owning a motor vehicle (negative). Additional associations were found for the intensity-specific PA outcomes. Mexican adults were more active during weekdays than weekends.

CONCLUSIONS: This was the first study to objectively measure PA for a representative sample of Mexican adults in an urban setting. Prevalence of meeting recommendations drops considerably when only considering bouted PA. The sociodemographic correlates

vary from those known from high income countries, stressing the need for more correlate studies from lower-to-middle income countries.

8.3 INTRODUCTION

Physical inactivity has been defined as a pandemic[1]. It is a well known risk factor for obesity, cardiovascular disease, type II diabetes, osteoporosis and many types of cancer.[2-4] During 2008, 5.3 million deaths were attributable to physical inactivity worldwide.[3] The World Health Organization (WHO) recommends at least 150 minutes of moderate to vigorous physical activity (PA) per week for adults, or 75 minutes of vigorous activity per week, to be done within bouts of at least ten minutes of sustained duration.[5] In Mexico it is estimated that physical inactivity accounted for 4.4% of total deaths and 1.2% of total DALYS in 2004, making it a leading risk factor for disease burden.[6] Currently, 71.2% of Mexican adults are either overweight or obese,[7] and the first two causes of death are cardiovascular diseases and type II diabetes.[8]

In many high income countries (HIC) surveillance of population physical activity has been taking place for decades.[9-16] This has not been the case for Mexico where only a few school and community intervention studies have been published.[17-19] At a population level, self-reported physical activity prevalences were measured among adolescents in the National Health and Nutrition Survey (ENSANUT) of 2006.[20, 21] Among Mexican adolescents (10 to 19 years) 35.2% were active, 24.4% moderately active, and 40.4% inactive.[21] For the latest ENSANUT (2012), the short version of the International Physical Activity Questionnaire was applied to the entire sample, including adults, of whom 17.2% were categorized as inactive.[7]

Up to now, representative PA data of Mexican adults is entirely based on self-report.[7] There are many known concerns of relying solely on self-reported data to estimate PA levels in populations. One of the main issues is the overestimation of time spent in PA at different intensities and domains.[11, 22, 23] Latin American populations are more likely to over report their occupational and home PA.[24] The importance of using objective measures to accurately report PA levels for populations is now well recognized. Accelerometers are the most widespread research tools to measure PA objectively, allowing the precise recording of time spent in PA by intensity level.[22, 25, 26] Nationally representative accelerometry data is available for Norway, Portugal, Sweden and the US.[27] Recently, various researchers have also used this tool to study the levels of PA in different populations within bouts of at least ten minutes of prolonged activity, as indicated in the WHO guidelines.[22, 28-31] Neither total nor bouted accelerometer-based PA levels have been studied for a representative sample of Mexican adults.

The purpose of this study was to describe the total and bout-specific levels of objectively measured PA among a representative sample of Mexican adults from the city of Cuernavaca. This study also identified the sociodemographic correlates of accelerometer-based PA among adults from Cuernavaca, Mexico.

8.4 METHDOS

Cuernavaca is a mid-sized city with a population of 365,168 in central Mexico.[32] The average temperature throughout the year is 23°C, its mean income per capita is 18,370.87

USD and it has a Human Development Index (HDI) of 0.86 (National HDI=0.77)[33] making it a wealthy Mexican city.[32, 34]

Study design and sampling

This was a cross-sectional study, and was part of the IPEN-Mexico study (IPEN: International Physical Activity Environment Network).[35] The main purpose of IPEN-Mexico is to understand the associations between the built environment and physical activity levels among adults in a Mexican urban setting, and to contribute data for the pooled analysis of the IPEN study that includes data from twelve countries. Both the built environment and physical activity were measured via objective and subjective measures. These included accelerometry, the International Physical Activity Questionnaire, the Abbreviated Neighborhood Environment Walkability Scale, and GIS measures. This analysis focuses on objectively measured PA and the associations with socio-demographic variables.

Data collection took place from April to September, 2011. A representative stratified multistage clustered sample was selected. Census tracts were the primary sampling units. All census tracts within the Municipality of Cuernavaca (123) were stratified by high (above the median) and low (below the median) walkability. The walkability index was calculated using z-scores of intersection density (number of 4-way intersections over total area per census tract), land use mix (diversity of land use types per census tract, using a normalized entropy score ranging from 0 to 1),[36] proportion of commercial land use (over total census tract area) and net residential density (total residences over area destined for residential use per census tract).[35, 36] Census tracts were also stratified by socioeconomic status (SES) as provided by the National Institute of Geography and Statistics of Mexico (INEGI), which categorizes census tracts by SES based on average income, and assigns scores based on quartiles (SES levels 1 to 4).[37] The sample had eight strata, derived from the combination of walkability (high and low) and SES (1 to 4). Four census tracts were randomly selected per stratum, for a total of 32 census tracts in the study. Seven blocks were randomly selected per census tract (secondary sampling units). Finally, two to four households were randomly selected per block (tertiary sampling unit). One participant per household was selected for the study. In case of refusal, non-eligibility or not finding anyone at home after two visits, the household to the right (clockwise) was selected.

Inclusion and Exclusion Criteria

All census tracts within the Municipality of Cuernavaca were considered for inclusion. Blocks on the border of a census tract with a different walkability score or SES were excluded from the study to avoid bias in the association of environmental features with PA, the primary outcome of interest in IPEN. Eligible participants were residents between 20 to 65, with no temporary or permanent disability preventing walking, and had been living at that address for at least six months.

Instruments

IPEN-Mexico used many measurement tools, but only those pertaining to the aim of this study will be described.

Accelerometers: Activity data was recorded using Actigraph GT3X meters. Participants wore the meter for seven days and were instructed to use it at all times except during sleep, showers and swimming. Sixty second epochs were used to record data.

General Information Survey: Included items on sex, age, time of residence in the household, marital status, education, motor vehicle ownership, household characteristics and assets.

Scales: Tanita® scales with centigram precision were used to measure weight using standardized procedures.[38]

Stadiometers: Fixed wooden stadiometers with milimetric precision were used to measure height using standardized procedures.[38]

Recruitment and data collection

Recruitment and data collection were done in person via home visits with a team of trained field workers. The first home visit was to inform the household that it had been randomly selected for the study. The aims and procedures of the study were explained and an eligible participant living in the household was invited to participate. Written informed consent was obtained, an accelerometer was provided with instructions and a log, and an appointment was set for a second visit. Two monitoring phone calls during the week verified correct use of the meter. During the second visit the survey was applied, weight and height were measured and accelerometer wear-time was verified.

Accelerometer data verification and scoring

Data verification was done on site using Actilife 4.0 to download the data and MeterPlus 4.2 to verify wear time. A minimum of five valid days of ten valid hours were required. An invalid hour was defined as having sixty or more consecutive zeros. Delivery and recovery dates were not included when computing valid days. If required, the participant was asked to wear the accelerometer for additional days to complete a minimum of five valid days. A third home visit was scheduled to recover the accelerometer. The field workers returned each accelerometer with the corresponding forms to the project's office where the study coordinators re-verified the validity of the data and saved the final files for scoring. Freedson cut-points for adults[39] were used to score the data in compliance with the IPEN protocol[40] using MeterPlus 4.2.

Variables

Minutes of activity per week (Table 1) were estimated using total valid minutes per week (minutes within valid hours and valid days) of the given physical activity outcome and total valid days per participant. All study outcomes using bouts are based on the definition of Bouts A (MVPA-bouts with a minimum duration of ten minutes, with at least 80% of the bout corresponding to MVPA), described in greater detail in Table 1. The following outcome variables were used: Total minutes of moderate PA per week (TMPA), total minutes of vigorous PA per week (TVPA), total minutes of moderate-to-vigorous PA per week (TMVPA), minutes of moderate PA per week within bouts (BMPA), minutes of vigorous PA per week (BVPA) and minutes of moderate-to-vigorous PA per week within bouts. Similarly, intensity-specific variables were generated to estimate total and bouted-PA for weekdays (Monday through Friday) and weekends for descriptive purposes.

Independent variables included: sex, age, individual-level SES, education, motor vehicle ownership, marital status and BMI (Table 1). Individual level SES was obtained by building a centered z-scored index based on twenty-five items from the general information survey regarding household characteristics and assets. These questions were used in the 2006 Mexican National Health and Nutrition Survey to estimate individual-level SES.[21]

Statistical Analysis

Descriptive analysis

Prevalence of meeting WHO recommendations using objectively-measured PA was obtained, as well as mean minutes per week of MVPA, MPA and VPA, with and without 10 minute bouts. Since weekly minutes of PA were not normally distributed, values for the 25th, 50th and 70th percentile were also obtained. Results were stratified by sex, age and SES. All results were weighted by total valid wear time per participant, probability of selection, and non-response by sex.

Correlation analysis

Unadjusted and adjusted linear regression models were run to study the association between sociodemographic variables and each continuous outcome. The adjusted models included all the studied sociodemographic variables and also controlled for total wear-time. Significance was considered when $p \leq 0.05$.

Analytical Software

MatLab 7.7 (The MathWorks Inc., Natick, MA, USA) by UV was used to generate all bout-related variables. Statistical analyses were performed in 2012 using SAS 9.3 (SAS Institute Inc., Cary, NC, USA). The surveymeans and surveyfreq procedures in SAS were used for the descriptive analyses. The surveyreg procedure of SAS was employed for the correlation analyses. By obtaining design-based estimates and using the Taylor series linearization method,[41] SAS's surveyreg allows for the linear modeling of non-normal and non-symmetric outcomes, such as those used in this study.[42] All of SAS's survey procedures account for the complex stratified multistage clustered study design.[43]

8.5 RESULTS

The response rate for the study was 58.9%. Table 2 shows the sociodemographic characteristics of the final study sample. The mean age was of 42.0 years. 48.0% were male, 32.3% had education beyond high school, 54.7% owned at least one motor vehicle (car or motorcycle), 40.9% were overweight and 31.7% were obese (weighted percentages). Eight participants were excluded due to missing valid accelerometry data, leaving a total sample for analysis of 669 participants. No differences were found for any of the sociodemographic variables between the full sample (n=677) and the sample used for analysis (n=669).

Table 3 shows the results of the descriptive analysis. The mean and median TMVPA among adults from Cuernavaca were 221.3±10.0 and 178.3 mins/wk, respectively. TMPA had a mean of 214.7±9.7 and a median of 176.2 mins/wk. For TVPA the mean was 6.6±0.8 mins/wk and the median was 0.0 mins/wk. When considering only PA registered within bouts (Bouts A), the average BMVPA was 65.8±4.7 mins/wk (median=30.0 mins/wk), and intensity specific values were 61.1±4.5 mins/wk (median=29.6 mins/wk) and 4.7±0.6 mins/wk (median=0.0 mins/wk) for BMPA and BVPA. 29.7% of TMVPA occurred within bouts as defined for this study. The results by sex show that males had a higher average TMVPA and BMVPA than females (270.1±13.9 vs. 175.2±7.5 mins/wk, and 82.2±7.6 vs. 50.3±5.1 mins/wk), and they spent a higher proportion of their TMVPA and BMVPA in VPA than females (4.0 vs. 1.6%, and 9.0 vs. 4.3%).

Figure 1 shows a comparison of the prevalence of meeting WHO guidelines using TMVPA (no bouts), BMVPA (MVPA within Bouts A), and an alternative definition for bouts commonly found in the literature (Bouts B=bouts of a minimum duration of ten minutes, allowing for breaks of up to two minutes; see definition in Table 1).[29, 31] Considering TMVPA, 58.6% of adults from Cuernavaca met the 150 minutes per week of MVPA recommended by WHO. WHO also specifies that the activity should take place within bouts of at least ten continuous minutes of activity. Under this definition, only 13.9% of adults achieved the recommended levels of activity. For both TMVPA and BMVPA, a higher percentage of men met recommended levels of activity than women. A decreasing tendency of meeting recommendations as SES and age increased, was only found when using TMVPA (no bouts). For BMVPA, the percentage of adults meeting recommendations is similar across age groups (16.2%, 11.9% and 13.9%). For SES, the two bottom quartiles (low and medium SES groups) had similar higher values for meeting WHO guidelines (16.3 and 16.5%), in comparison to the lower values of the top SES quartiles (medium-high=10.9% and high=10.8%).

The comparison of PA levels during weekdays and weekends (Table 4) showed that on average Mexican adults spend 169.7±7.7 (median=138.7) minutes during weekdays doing MVPA, versus 52.6±2.8 (median=35.5) minutes during weekends. The daily average MVPA for weekdays was of 52.1±3.8 (median=22.1) minutes, compared to 14.3±1.2 (median=0.0) minutes during weekend days. The lower amount of PA during weekends is consistent for both sexes and for all intensities (Table 4).

The unadjusted correlation analyses (Table 5) showed significant associations between both TMVPA and BMVPA with being male (TMVPA:94.88±13.12, p<0.001; BMVPA: 31.94±8.92, p<0.001), owning a motor vehicle (TMVPA:-72.07±13.30, p<0.001 BMVPA: -37.48±8.42, p<0.001) and being divorced (TMVPA:-68.85±20.99, p=0.003 BMVPA: -30.±15.30, p=0.04). Meanwhile, being 51 to 65 years (-58.87±17.14, p=0.003), being of high SES (-87.98±23.15, p=0.001) and having an education level beyond high school (-44.35±19.03, p=0.03) were associated with TMVPA but not to BMVPA. Once adjusting for all sociodemographic variables and for total accelerometer wear time (Table 4), only the correlations for being male and owning a motor vehicle remained significant. Males had 110.71±12.68 (p<0.001) more mins/wk of total MVPA than females, and 38.66±8.38

(p=0.001) more mins/wk of MVPA within bouts than females. Owning at least (>=1) a motor vehicle was associated with 79.86±17.30 mins/wk (p=0.001) less of total MVPA in comparison to adults that did not own a motor vehicle. Similarly, motor vehicle ownership was negatively correlated to MVPA within bouts (-49.67±10.33 mins/wk, p=0.003).

The intensity-specific correlation analysis (Table 6) showed significant positive associations between TMPA (102.49±12.38, p<0.001), TVPA (8.22±1.45, p=0.001), BMPA (33.40±8.35, p=0.003) and BVPA (5.26±1.22, p=0.002) with being male after adjusting for all covariates. Being 51 to 65 years was negatively correlated with TMPA (-41.56±13.16, p=0.001) and had marginal significance for TVPA (-5.27±2.75, p=0.07), but no association was found for either BMPA or BVPA. Having an education level higher than high school was positively correlated with both TVPA (7.49±3.66, p=0.04) and BVPA (6.06±2.90, p=0.04), but not to TMPA or BMPA. Finally, motor vehicle ownership was only significantly associated with the moderate PA outcomes (TMPA:-75.89±16.95, p<0.001; and BMPA:-47.70±10.13, p=0.001), but not with TVPA or BVPA.

8.6 DISCUSSION

This study describes objectively measured PA among Mexican adults from Cuernavaca. The percentages of the population meeting WHO recommended levels of activity vary substantially when considering TMVPA (58.6%) versus BMVPA (13.9%), and are both considerably lower than those reported by the latest ENSANUT that measured PA via self-report (82.6% of Mexican adults reported meeting recommended levels).[7] More

TMVPA and BMVPA takes place during weekdays versus weekends. Being female and owning a motor vehicle were strongly and inversely correlated to MVPA (total and within bouts) after adjusting for all other covariates.

Our results are consistent with studies from HIC that show that when considering only activity within bouts using objective measures, the percentage of the population meeting recommendations drops considerably.[22, 44, 45] Since the importance of considering PA within bouts is highly recognized and more studies on this topic are emerging, it is important to know the proportion of the population doing any bouted-PA at all, and how bouts are characterized in length and composition. Figure 2 examines this in more detail for weekly minutes of BMVPA, stratifying by sex and motor vehicle ownership, the strongest predictors of BMVPA in our study. Fewer females and motor vehicle owners registered any BMVPA compared to their counterparts. Furthermore, among adults with any BMVPA, females and motor vehicle owners had fewer BMVPA mins/wk. They were less likely to do any BMVPA and among those that did, the duration of BMVPA was lower than that of men and non-vehicle owners. The proportion of bout-time per week corresponding to breaks is stable across sexes and motor vehicle ownership status, varying from 8.2 to 8.7%. Yet, a higher proportion of weekly bout-time is spent in BVPA among men compared to women (8.2 vs. 4.0%), while among motor vehicle owners there is a higher percentage of BVPA in comparison to non-vehicle owners (8.3 vs. 5.4%). The proportion of both TVPA and BVPA over TMVPA and TBMVPA, respectively, is very small among Mexican adults, consistent with US data.[22, 44, 45] In contrast, MPA is considerably more widespread among the Mexican adult population, suggesting that public health efforts might better focus on promoting MPA rather than VPA.

For both sexes, all intensities, and for total and bouted PA, more PA occurred during weekdays than weekends. This was true not only for absolute PA values (i.e. total estimated PA occurring Monday-Friday versus total estimated PA occurring Saturday-Sunday), but also for daily averages for weekdays versus weekends. Our results may help inform policy makers to target programs and interventions to increase PA during weekends among adults from Cuernavaca. Furthermore, this finding suggests that transport PA (presumably occurring in higher frequency during weekdays) is a larger contributor to TMVPA than leisure PA among Mexican adults. This hypothesis should be further studied using domain-specific PA data.

The inverse relationship with motor vehicle ownership is consistent with recent findings from several countries contrasting the levels of activity between private and public transport users, and showing that car ownership in certain settings is negatively correlated to activity levels and obesity.[46-50] A possible explanation for our findings showing a lower percentage of BMPA occurring among vehicle owners (Figure 2) may be that this is due to more transport-related PA (walking) taking place among the non-vehicle owners. This hypothesis is also supported by the significant negative correlation of motor vehicle ownership only to BMPA and not to BVPA. Meanwhile, the higher percentage of BVPA among vehicle owners may imply that their BMVPA is more leisure than transport-related. Furthermore, findings from Colombia suggest that access to public transportation is associated to both leisure and transport PA.[51] Further studies are needed to address these hypotheses for Mexican population.

While the positive correlation of male sex and MVPA is consistent with findings from HIC,[52-54] other results may be more context specific. SES had no effect on total or bouted-MVPA or for any of the intensity-specific outcomes in the adjusted analyses. Higher education level was associated with more VPA minutes per week, adjusting for SES. There may be specific social constructs among Mexicans supporting this type of behavior, independent of wealth, but related to higher education levels. Another interesting finding was the null effect of age after adjusting for all the covariates. Findings from HIC show an inverse correlation between age and MVPA.[52, 54, 55] In our case, a significant association was found for the highest age group only for TMPA, but not for BMPA, (Figure 1). Among older Mexicans, the amount of non-bouted or sporadic MPA decreases in comparison to the younger group, but no difference is found for bouted-activity. Further studies are needed to understand these relationships.

This study had several limitations. The cross sectional design did not allow determination of causality. Most socio-demographic variables (except BMI) were based on self-report, perhaps decreasing precision. The sample is only representative of adults from the city of Cuernavaca, and not for all Mexicans. Yet the similar rates of overweight and obesity to nationally representative data (72.6% vs. 71.3%) suggest comparability to the overall urban Mexican population.[7] We only addressed basic socio-demographic correlates of PA, but did not address psychosocial and environmental correlates of PA. Further analyses using other levels of variables and their correlations to objectively measured PA are needed for Mexico.

Our study had several strengths as well. This is the first study reporting objectively measured PA levels for a representative sample of Mexican adults, and for a Latin American country.[27] To our knowledge, it is also the first Mexican study addressing sociodemographic correlates of PA for adults. The data collection and scoring protocol was standardized with that of a multinational study (IPEN), with strict, state of the art procedures.[35, 40] Our definition of bouts was consistent with recent approaches that consider a bout to be valid bout when 80% of it corresponds to MVPA (allowing for each break to have a maximum duration of two minutes) (Bout A),[28] in contrast to the older approach allowing for a maximum break time of two minutes throughout an entire bout of any duration (Bout B).[31, 56] The two-minute method is limited since for ten-minute bouts (minimum duration), 80% of corresponds to MVPA; yet, if a bout were to last one hour, 96.7% of the time would be MVPA. The 80% approach enables the identification of more bouts of activity that may be occurring in real life situations (e.g. walking in an urban setting with occasional interruptions). Our study also provided further insight on the proportion of MPA and VPA within MVPA bouts. The use of linear rather than logistic models avoids the loss of detail when examining the socio-demographic correlates of objectively measured PA. Furthermore, the use of SAS's survey procedures allowed for linear regression of non-normal outcomes, providing meaningful information since the coefficients represent minutes per week of the each PA outcome, while accounting for the complex study design.

8.7 CONCLUSIONS

A very low percentage of adults in Cuernavaca met recommended levels of PA based on objective measures and considering bouts only. These values are consistent with those from HIC, where the prevalence of meeting guidelines also drops considerably when using objective measures, in comparison to self reported data.[22, 44, 45] This highlights the need for more health outcome studies in which PA is measured objectively, to generate standardized international recommendations of activity based on objective measures rather than applying a standard fully based on total-self reported PA. Subjective measures do complement objective tools, since they provide valuable information on domain-specific PA that is key for intervention and program design. Finally, some contrasting results were found in comparison to HIC, stressing the need for more high quality PA epidemiologic studies from LMIC. Further studies to understand the intensity-specific correlations found. Furthermore, future studies should address the psycho-social, economic, environmental and political determinants of motor-vehicle ownership and its relationship with PA among Mexicans.

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8.9 TABLES AND FIGURES

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Table 1: Definition of outcome and independent variables used for correlation analyses.

Variable	Abbreviation	Type	Definition
<u>Outcome variables</u>			
Total minutes of moderate PA per week	TMPA	Continuous	Total minutes per week of activity between 1952 to 5724 counts per minute, regardless of bouts
Total minutes of vigorous PA per week	TVPA	Continuous	Total minutes per week of activity above 5725 counts per minute, regardless of bouts
Total minutes of moderate-to-vigorous PA per week	TMVPA	Continuous	Total minutes per week of activity above 1952 counts per minute, regardless of bouts
Minutes of moderate PA per week within bouts of at least ten minutes	BMPA	Continuous	Minutes per week of activity within 1952 to 5724 counts per minute, registered within MVPA bouts as defined for this study (Bouts A)*
Minutes of vigorous PA per week within bouts of at least ten minutes	BVPA	Continuous	Minutes per week of activity above counts per minute, registered within MVPA bouts as defined for this study (Bouts A)*
Minutes of moderate-to-vigorous PA within bouts of at least ten minutes	BMVPA	Continuous	Minutes per week of activity above 1952 counts per minute, registered within MVPA bouts as defined for this study (Bouts A)*
MVPA bouts *This definition corresponds to all the analyses presented in this study, including descriptive and correlation analyses.*	Bouts A	------	<u>All</u> of the following characteristics were required for a MVPA bout: 1. Duration of at least ten minutes 2. Intensity of activity: moderate-to-vigorous (>= 1952 counts per minute) 3. >= 80% of the bout consisted of moderate-to-vigorous intensity of activity (>= 1952 counts per minute). Therefore <= 20% of the bout could correspond to breaks below 1952 counts per minute. 4. Each break below the cut point (1952 counts per minute) had a maximum duration of two minutes *If points 3 OR 4 were not met, the bout was interrupted*

Variable	Abbreviation	Type	Definition
MVPA bouts-alternative definition *Bouts_B was only used for the prevalence analysis of Figure 1, as a comparison with our definition of bouts (Bouts_A). All other analyses use "Bouts A"*	Bouts B	-------	Corresponds to the most commonly found definition of bouts in the literature (REF). Under this definition an MVPA bout has a duration of at least ten minutes, with an intensity of >=1952 bouts per minute. The maximum break time allowed for the entire bout is of 2 minutes, which may be broken up in two 1-minute breaks, or occur within a single 2-minute break.
<u>Independent Variables</u>			
Sex	------	Categorical	Binary. Male=1, Female =0 (reference)
Age	------	Categorical	Dummies. <= 35 years (reference); 35<years<=50; 50<years<=65
Individual socio-economic status	SES	Categorical	Dummies. Low (reference), medium, medium-high, high. Based on quartiles of individual SES index, constructed using centralized z-scores from a set of twenty-five questions on household characteristics and assets per participant. The index excluded motor vehicle ownership and education.
Education level	EL	Categorical	Dummies. Less than high school (<12 years of education, reference) High school (12 years of education) More than high school (>12 years of education)
Marital status	MS	Categorical	Dummies. Single (not living with a partner, reference) Married (includes living with a partner) Divorced (includes separated and widowers)
Motor vehicle ownership	MVO	Categorical	Binary. Yes=1, No=0 (reference) Yes = owning at least one car or motorcycle
BMI status	BMI	Categorical	Dummies. BMI<25 (normal, reference) 25<= BMI < 30 (overweight) BMI >= 30 (obese)

[a] *Based on cut-points by Freedson et al. 1998[39]*

Table 2: Socio-Demographic characteristics of study population.

Variable		n	Weighted %[a]
Total		677.0	100.0
Male		302.0	48.0
Age			
	<=35 years	222.0	33.4
	35<years<=50	263.0	39.0
	50<years<=65	192.0	27.6
SES[b]			
	Low	201.0	31.2
	Medium	165.0	24.0
	Medium-High	198.0	28.9
	High	113.0	15.9
Education			
	Some Elementary	36.0	5.0
	Complete Elementary	67.0	10.1
	Some Middle School	23.0	3.9
	Complete Middle School	140.0	21.1
	Some High School	29.0	4.4
	Complete Highschool	162.0	23.2
	Some College	34.0	5.5
	Complete College or more	186.0	26.8
Motor Vehicle Ownership			
	Car	363.0	53.2
	Motorcycle	32.0	5.1
	Either	371.0	54.7
Marital Status			
	Single	166.0	25.0
	Married or living with someone	438.0	65.3
	Separated or Divorced	56.0	7.4
	Widower	17.0	2.4
Nutritional Status			
	Under-nutrition (BMI<20)	22.0	3.2
	Normal (20<=BMI<25)	165.0	24.2
	Overweight (25<=BMI<30)	278.0	40.9
	Obese (BMI>=30)	212.0	31.7

[a] *Weighted for probability of selection and non-response by sex.*
[b] *SES: Classifications based on quartiles of SES-index. SES-index based on household characteristics and assets.*

Table 3: Means, quartiles and prevalences of intensity-specific, objectively measured physical activity by sex and age among adults from Cuernavaca, Mexico, 2011.

Outcome	*Overall*					*<=35 years*					*35<years<=50*					*50<years<=65*				
	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3
Overall																				
Total Mins/Week of Activity																				
Moderate	214.7	9.7	97.0	176.2	296.9	238.1	14.1	125.0	207.4	320.1	215.3	11.6	103.4	185.9	301.5	185.9	14.8	60.5	131.0	234.0
Vigorous	6.6	0.8	0.0	0.0	2.2	10.9	2.2	0.0	0.9	8.1	4.7	1.0	0.0	0.0	2.2	4.2	1.4	0.0	0.0	0.0
Moderate-to-Vigorous	221.3	10.0	97.5	178.3	305.5	249.0	15.6	127.8	214.2	327.6	220.0	11.8	107.1	188.5	309.7	190.1	14.4	60.5	135.1	247.6
% with any MVPA in bouts[a]	71.2	469.0	---	---	---	78.1	170.0	---	---	---	72.4	184.0	---	---	---	61.4	115.0	---	---	---
Number of bouts[a] per week[b]	5.9	0.4	2.0	4.1	6.9	6.0	0.5	2.0	4.5	7.1	5.1	0.4	1.9	3.3	6.6	6.8	0.5	1.9	4.5	6.9
Average bout[a] duration[b]	17.0	0.5	12.3	14.7	18.2	16.3	0.8	12.1	14.5	17.8	17.0	0.8	12.0	14.6	18.2	18.0	0.8	12.4	15.0	20.3
% with no MVPA in bouts	28.8	200.0	---	---	---	21.9	48.0	---	---	---	27.6	75.0	---	---	---	38.6	77.0	---	---	---
Mins/Week of Activity-bouts[a] (Total Sample)																				
Activity Breaks	6.1	0.6	0.0	2.3	8.1	6.4	0.8	0.0	3.8	9.1	5.8	0.6	0.0	2.3	7.6	6.2	1.1	0.0	1.7	7.7
Moderate Activity	61.1	4.5	0.0	29.6	79.2	62.4	6.6	8.1	44.2	86.3	55.7	4.8	0.0	27.8	75.6	67.1	7.1	0.0	15.4	77.5
Vigorous Activity	4.7	0.6	0.0	0.0	0.0	7.1	1.5	0.0	0.0	2.5	3.4	0.9	0.0	0.0	0.0	3.7	1.4	0.0	0.0	0.0
Moderate-to-Vigorous	65.8	4.7	0.0	30.0	86.5	69.5	7.4	8.5	45.7	95.2	59.1	5.1	0.0	28.4	81.5	70.8	6.9	0.0	15.4	85.9
Mins/Week of Activity-bouts[a] (any MVPA in bouts=yes)[b]																				
Activity Breaks	8.6	0.7	2.1	5.3	10.3	8.2	0.9	2.2	5.6	10.2	8.0	0.8	2.1	4.8	9.6	10.1	1.6	2.2	5.1	11.8
Moderate Activity	85.8	5.2	24.4	55.3	114.3	79.9	6.7	25.0	57.1	109.1	76.8	5.9	24.2	50.1	103.8	109.3	9.6	23.3	65.4	129.9
Vigorous Activity	6.6	0.9	0.0	0.0	2.2	9.0	2.0	0.0	0.0	5.8	4.7	1.2	0.0	0.0	1.9	6.1	2.3	0.0	0.0	0.0
Moderate-to-Vigorous	92.4	5.4	25.1	58.3	120.9	89.0	7.9	26.2	58.2	121.0	81.6	6.2	24.9	53.2	114.3	115.4	9.2	23.3	69.5	137.1

Outcome	Overall					<=35 years					35<years<=50					50<years<=65				
	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3
% Meeting Guidelines[c]																				
No bouts	58.6	380.0	---	---	---	68.7	150.0	---	---	---	58.8	149.0	---	---	---	46.4	81.0	---	---	---
Bouts[a]	13.9	93.0	---	---	---	16.2	38.0	---	---	---	11.9	32.0	---	---	---	13.9	23.0	---	---	---
Male																				
Total Mins/Week of Activity																				
Moderate Activity	259.4	13.4	121.1	213.8	349.1	286.7	17.5	150.0	267.7	357.1	237.1	13.4	113.3	194.6	337.1	255.0	29.0	109.8	163.7	326.2
Vigorous Activity	10.7	1.4	0.0	0.9	8.0	18.5	3.7	0.0	2.0	17.1	5.1	1.4	0.0	0.0	4.0	8.5	3.1	0.0	0.0	2.8
Moderate-to-Vigorous	270.1	13.9	127.8	232.7	372.4	305.2	19.8	151.4	285.8	398.2	242.2	14.0	115.0	206.2	338.8	263.5	28.4	112.1	170.4	335.3
% with any MVPA in bouts[a]	74.6	226.0	---	---	---	82.7	84.0	---	---	---	70.5	81.0	---	---	---	70.0	61.0	---	---	---
Number of bouts[a] per week[b]	7.1	0.4	2.1	5.2	9.3	7.4	0.7	2.2	5.7	10.3	5.2	0.5	1.4	3.3	7.8	9.2	0.8	3.1	5.4	11.6
Average bout[a] duration[b]	16.8	0.7	12.8	14.9	17.8	16.9	0.4	12.8	14.6	17.8	16.2	0.6	13.3	14.7	17.7	17.6	1.1	13.4	15.0	18.0
% with no MVPA in bouts	25.2	76.0	---	---	---	17.3	15.0	---	---	---	29.5	35.0	---	---	---	30.0	26.0	---	---	---
Mins/Week of Activity-bouts[a] (Total Sample)																				
Activity Breaks	7.8	0.9	0.0	3.9	9.8	8.1	1.2	1.1	5.7	10.3	5.9	0.9	0.0	2.4	7.5	10.0	2.0	0.0	3.5	11.0
Moderate Activity	74.9	7.4	0.0	43.5	102.5	80.7	9.9	9.8	56.2	119.7	52.1	5.9	0.0	29.0	70.7	98.0	15.0	0.0	47.1	109.9
Vigorous Activity	7.4	1.1	0.0	0.0	2.2	11.8	2.5	0.0	0.0	8.0	3.0	1.1	0.0	0.0	1.1	7.6	3.1	0.0	0.0	1.4
Moderate-to-Vigorous	82.2	7.6	0.0	45.2	113.2	92.5	10.9	13.2	58.3	157.2	55.0	6.2	0.0	29.0	76.2	105.7	14.2	0.0	52.4	126.0
Mins/Week of Activity-bouts[a] (any MVPA in bouts=yes)[b]																				
Activity Breaks	10.5	1.1	2.8	6.4	11.6	9.8	1.2	3.1	7.2	11.3	8.3	1.1	2.2	5.5	9.9	14.3	2.4	3.3	7.9	12.8
Moderate Activity	100.4	8.0	31.4	62.0	129.7	97.6	8.9	43.7	70.6	131.2	73.9	6.9	25.4	46.5	112.3	140.1	16.3	43.9	67.6	181.1
Vigorous Activity	9.9	1.5	0.0	0.0	5.9	14.3	3.4	0.0	1.5	13.9	4.2	1.6	0.0	0.0	2.0	10.9	4.5	0.0	0.0	3.8
Moderate-to-Vigorous	110.3	8.0	32.2	66.8	156.9	111.9	10.7	43.7	75.6	163.0	78.1	7.3	26.2	51.6	116.1	151.0	14.5	43.9	76.2	214.1

Outcome	*Overall*					*<=35 years*					*35<years<=50*					*50<years<=65*				
	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3
% Meeting Guidelines[c]																				
No bouts	67.9	203.0	---	---	---	76.9	78.0	---	---	---	62.5	74.0	---	---	---	64.0	51.0	---	---	---
Bouts[a]	19.5	61.0	---	---	---	27.2	30.0	---	---	---	11.2	15.0	---	---	---	20.9	16.0	---	---	---
Female																				
Total Mins/Week of Activity																				
Moderate Activity	172.5	7.4	74.0	146.6	236.4	187.8	12.9	98.0	177.4	237.0	196.4	13.6	89.9	161.4	291.7	120.5	10.1	52.9	85.3	159.5
Vigorous Activity	2.8	0.5	0.0	0.0	1.0	3.0	0.6	0.0	0.0	1.1	4.3	1.3	0.0	0.0	1.3	0.2	0.1	0.0	0.0	0.0
Moderate-to-Vigorous	175.2	7.5	74.0	148.1	236.9	190.8	13.2	98.0	177.5	238.0	200.7	13.9	89.9	173.7	296.6	120.7	10.1	52.9	85.3	163.3
% with any MVPA in bouts[a]	68.1	243.0	---	---	---	73.4	86.0	---	---	---	74.1	103.0	---	---	---	53.3	54.0	---	---	---
Number of bouts[a] per week[b]	4.6	0.3	1.3	3.1	5.8	4.3	0.4	1.3	3.3	5.5	5.1	0.5	2.0	3.2	6.3	4.0	0.5	1.1	2.5	5.0
Average bout[a] duration[b]	17.1	0.7	11.8	14.5	19.3	15.5	0.4	11.6	14.5	17.7	17.6	1.2	11.9	14.4	20.7	18.6	1.2	10.9	14.9	23.2
% with no MVPA in bouts	33.8	124.0	---	---	---	29.6	33.0	---	---	---	25.9	40.0	---	---	---	46.7	51.0	---	---	---
Mins/Week of Activity-bouts[a] (Total Sample)																				
Activity Breaks	4.5	0.4	0.0	2.0	6.1	4.5	0.7	0.0	2.3	5.8	5.7	0.7	0.0	2.3	7.9	2.6	0.3	0.0	0.0	2.3
Moderate Activity	48.1	4.9	0.0	23.0	65.6	43.5	5.9	0.0	25.3	61.6	58.8	7.3	0.0	27.4	78.6	37.9	6.9	0.0	6.0	43.5
Vigorous Activity	2.2	0.5	0.0	0.0	0.0	2.1	0.5	0.0	0.0	0.0	3.8	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Moderate-to-Vigorous	50.3	5.1	0.0	23.1	72.6	45.6	6.1	0.0	25.9	61.6	62.6	8.0	0.0	27.6	82.8	37.9	6.9	0.0	6.0	43.5
Mins/Week of Activity-bouts[a] (any MVPA in bouts=yes)[b]																				
Activity Breaks	6.6	0.5	2.0	4.2	8.6	6.2	0.6	2.0	4.4	7.9	7.7	0.9	2.1	4.5	9.1	4.9	0.6	1.1	2.3	8.0
Moderate Activity	70.7	5.9	20.9	46.8	93.7	59.2	5.7	23.3	46.1	67.8	79.3	8.2	23.5	51.2	100.7	71.1	10.8	12.8	41.4	104.2
Vigorous Activity	3.2	0.7	0.0	0.0	0.0	2.9	0.6	0.0	0.0	0.0	5.1	1.7	0.0	0.0	1.1	0.1	0.1	0.0	0.0	0.0
Moderate-to-Vigorous	73.9	6.1	21.7	47.9	97.2	62.1	5.8	23.3	46.9	75.5	84.4	9.0	24.2	55.2	107.5	71.2	10.9	12.8	41.4	104.7

Outcome	Overall					<=35 years					35<years<=50					50<years<=65				
	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3	Mean/ %	SE / n	Q1	Med	Q3
% Meeting Guidelines[c]																				
No bouts	49.8	177.0	---	---	---	60.2	72.0	---	---	---	55.6	75.0	---	---	---	29.8	30.0	---	---	---
Bouts[a]	8.6	32.0	---	---	---	4.8	8.0	---	---	---	12.5	17.0	---	---	---	7.3	7.0	---	---	---

[a] Only activity registered within MVPA-bouts of at least 10 minutes duration, with ≥80% corresponding to MVPA (Bouts A) is reported. [b] Reported figures are only for participants with any MVPA within bouts (MVPA within bouts>0). [c] WHO recommended PA for adults: 150 minutes of MVPA per week, or 75 mins of VPA per week. Q1=Quartile 1, 25th percentile, Med=Median, 50th percentile, Q3=Quartile 3, 75th percentile. NOTE: All values are weighted for total valid wear time, selection probability and non-response by sex

Table 4: Comparison of intensity-specific physical activity levels during weekdays and weekends by sex, among Mexican adults from Cuernavaca, Mexico, 2011.

Outcome	*Weekdays*				*Weekends*			
	Mean (SE)	Q1	Med	Q3	Mean (SE)	Q1	Med	Q3
Overall (n=630)								
Total Activity								
Mon-Fri: MVPA total mins	169.7 (7.7)	66.1	138.7	237.3	52.6 (2.8)	15.6	35.5	71.3
Average daily MVPA mins	33.9 (1.5)	13.2	27.7	47.5	26.3 (1.4)	7.8	17.8	35.6
Mon-Fri: MPA total minutes	163.9 (7.3)	64.9	135.0	229.4	51.6 (2.8)	15.6	35.4	69.4
Average daily MPA mins	32.8 (1.5)	13.0	27.0	45.9	25.8 (1.4)	7.8	17.7	34.7
Mon-Fri: VPA total mins	5.7 (0.8)	0.0	0.0	1.9	1.0 (0.2)	0.0	0.0	0.0
Average daily VPA mins	1.1 (0.2)	0.0	0.0	0.4	0.5 (0.1)	0.0	0.0	0.0
Activity within bouts[a]								
Mon-Fri: MVPA bouted mins	52.1 (3.8)	0.0	22.1	68.5	14.3 (1.2)	0.0	0.0	17.7
Average daily bouted-MVPA mins	10.4 (0.8)	0.0	4.4	13.7	7.1 (0.6)	0.0	0.0	8.8
Mon-Fri: MPA bouted mins	48.0 (3.6)	0.0	21.1	65.0	13.6 (1.2)	0.0	0.0	16.5
Average daily bouted-MPA mins	9.6 (0.7)	0.0	4.2	13.0	6.8 (0.6)	0.0	0.0	8.3
Mon-Fri: VPA bouted mins	4.1 (0.6)	0.0	0.0	0.0	0.7 (0.2)	0.0	0.0	0.0
Average daily bouted-VPA mins	0.8 (0.1)	0.0	0.0	0.0	0.3 (0.1)	0.0	0.0	0.0
Male (n=279)								
Total Activity								
Mon-Fri: MVPA total mins	205.7 (10.5)	96.3	157.3	279.8	67.4 (4.7)	20.6	52.9	95.7
Average daily MVPA mins	41.1 (2.1)	18.7	31.5	56.0	33.7 (2.3)	10.3	26.5	47.8
Mon-Fri: MPA total minutes	196.3 (9.9)	89.8	149.0	270.6	65.8 (4.6)	19.9	52.8	89.7
Average daily MPA mins	39.3 (2.0)	18	29.8	54.1	32.9 (2.3)	9.9	26.4	44.8
Mon-Fri: VPA total mins	9.4 (1.4)	0.0	0.0	5.9	1.6 (0.3)	0.0	0.0	0.6
Average daily VPA mins	1.9 (0.3)	0.0	0.0	1.2	0.8 (0.1)	0.0	0.0	0.3
Activity within bouts[a]								
Mon-Fri: MVPA bouted mins	65.0 (6.3)	0.0	31.9	85.1	19.1 (2.1)	0.0	0.0	27.2
Average daily bouted-MVPA mins	13.0 (1.3)	0.0	6.4	17.0	9.6 (1.0)	0.0	0.0	13.6
Mon-Fri: MPA bouted mins	58.5 (6.1)	0.0	30.5	73.5	18.1 (2.1)	0.0	0.0	24.2
Average daily bouted-MPA mins	11.7 (1.2)	0.0	6.1	14.7	9.0 (1.0)	0.0	0.0	12.1
Mon-Fri: VPA bouted mins	6.5 (1.1)	0.0	0.0	1.7	1.1 (0.2)	0.0	0.0	0.0
Average daily bouted-VPA mins	1.3 (0.2)	0.0	0.0	0.3	0.5 (0.1)	0.0	0.0	0.0
Female (n=351)								
Total Activity								
Mon-Fri: MVPA total mins	136.8 (6.5)	53.5	110.7	190.1	39.2 (2.1)	11.7	28.2	55.8

Outcome	Weekdays				Weekends			
	Mean (SE)	Q1	Med	Q3	Mean (SE)	Q1	Med	Q3
Average daily MVPA mins	27.4 (1.3)	10.7	22.1	38.0	19.6 (1.0)	5.8	14.1	27.9
Mon-Fri: MPA total minutes	134.5 (6.3)	52.7	110.7	189.0	38.7 (2.1)	11.7	27.9	55.3
Average daily MPA mins	26.9 (1.3)	10.5	22.1	37.8	19.4 (1.0)	5.8	14.0	27.7
Mon-Fri: VPA total mins	2.3 (0.5)	0.0	0.0	0.0	0.4 (0.2)	0.0	0.0	0.0
Average daily VPA mins	0.5 (0.1)	0.0	0.0	0.0	0.2 (0.1)	0.0	0.0	0.0
Activity within bouts[a]								
Mon-Fri: MVPA bouted mins	40.2 (4.3)	0.0	13.6	57.3	9.8 (1.5)	0.0	0.0	10.3
Average daily bouted-MVPA mins	8.0 (0.9)	0.0	2.7	11.5	4.9 (0.8)	0.0	0.0	5.1
Mon-Fri: MPA bouted mins	38.4 (4.2)	0.0	13.6	55.1	9.5 (1.5)	0.0	0.0	10.3
Average daily bouted-MPA mins	7.7 (0.8)	0.0	2.7	11.0	4.7 (0.7)	0.0	0.0	5.1
Mon-Fri: VPA bouted mins	1.9 (0.5)	0.0	0.0	0.0	0.3 (0.2)	0.0	0.0	0.0
Average daily bouted-VPA mins	0.4 (0.1)	0.0	0.0	0.0	0.2 (0.1)	0.0	0.0	0.0

[a] Only activity registered within MVPA-bouts of at least 10 minutes duration, with ≥80% corresponding to MVPA (Bouts A) is reported.
*Mon-Fri PA outcome variables: total valid weekday minutes registered for given PA outcome*5 / total valid weekdays; and weighed for total valid weekday wear time*
*Sat-Sun PA outcome variables: total valid weekend minutes registered for given PA outcome*2 / total valid weekend days; and weighed for total valid weekend wear time*

Table 5. Socio-demographic correlates of objectively measured minutes per week of MVPA among adults, Cuernavaca, Mexico, 2011.

Sociodemographic Variables	MVPA mins/wk, no bouts		MVPA mins/wk, bouts[b]	
	Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]
	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)
Sex				
Female	0.00	0.00	0.00	0.00
Male	**94.88±13.12 (0.00)**	**110.71±12.68 (0.00)**	**31.94±8.92 (0.00)**	**38.66±8.38 (0.00)**
Age				
≤ 35 years	0.00	0.00	0.00	0.00
35< years ≤ 50	-29.00±18.27 (0.12)	-17.99±16.38 (0.28)	-10.44±8.29 (0.22)	-3.00±8.32 (0.72)
50 < years ≤ 65	**-58.87±17.14 (0.00)**	**-46.83±13.47 (0.00)**	1.35±7.57 (0.86)	9.23±7.03 (0.20)
SES				
Low	0.00	0.00	0.00	0.00
Medium	-32.86±28.42 (0.26)	-23.98±23.50 (0.32)	-10.49±12.77 (0.42)	-5.03±10.97 (0.65)
Medium-High	-52.05±25.61 (0.05)	-16.13±24.57 (0.30)	-15.49±10.99 (0.17)	1.10±11.69 (0.93)
High	**-87.98±23.15 (0.00)**	-25.32±27.91 (0.37)	-19.84±12.14 (0.11)	5.90±15.44 (0.71)
Education				
Less than Highschool	0.00	0.00	0.00	0.00
Highschool	-10.26±20.24 (0.62)	-10.61±20.85 (0.62)	-5.73±7.57 (0.47)	-3.39±8.64 (0.70)
More than highschool	**-44.35±19.03 (0.03)**	-24.73±23.52 (0.30)	-4.68±7.87 (0.56)	3.74±12.47 (0.77)
Motor vehichle ownership				
No	0.00	0.00	0.00	0.00
Yes	**-72.07±13.30 (0.00)**	**-79.86±17.30 (0.00)**	**-37.48±8.42 (0.00)**	**-49.67±10.33 (0.00)**
Marital status				
Single	0.00	0.00	0.00	0.00
Married[c]	-9.97±19.07 (0.61)	15.47±16.37 (0.35)	-0.31±8.42 (0.39)	4.05±9.68 (0.68)
Divorced[d]	**-68.85±20.99 (0.00)**	**-38.63±23.68 (0.10)**	**-30.78±15.30 (0.04)**	-28.34±17.28 (0.11)

Sociodemographic Variables	MVPA mins/wk, no bouts		MVPA mins/wk, bouts[b]	
	Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]
	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)
Nutritional Status				
BMI < 25	0.00	0.00	0.00	0.00
25 ≤ BMI < 30	-11.96±17.56	-16.84±17.20	-13.11±10.65	-15.89±10.75
	(0.50)	(0.34)	(0.23)	(0.15)
BMI > 30	-20.77±20.49	-27.83±19.61	-12.13±11.59	-15.13±11.65
	(0.32)	(0.17)	(0.30)	(0.21)

NOTE: All models account for the multistage clustered design of the study
[a] *Adjusted models control for total wear time and for all sociodemographic variables*
[b] *Only activity registered within MVPA-bouts of at least 10 minutes duration, with ≥80% corresponding to MVPA (Bouts A) is reported*
[c] *Also includes "living with someone"*
[d] *Also includes "divorced" and "widower"*

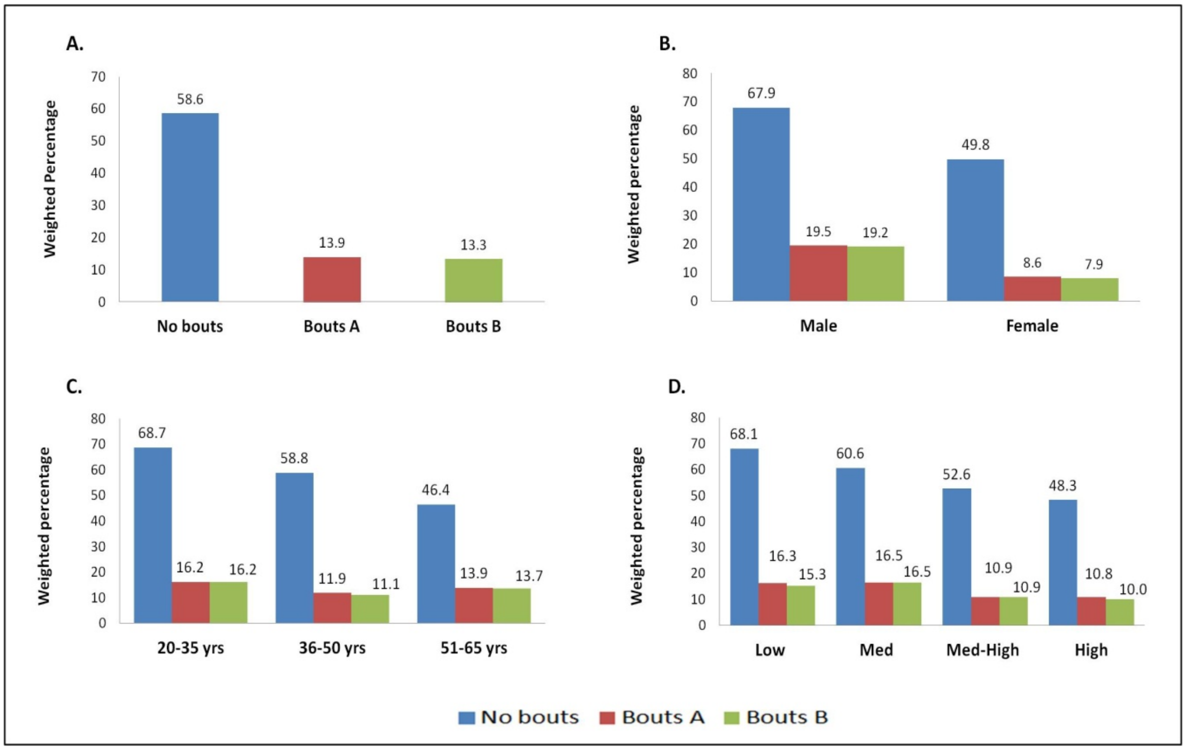
Table 6. Socio-demographic correlates of intensity-specific objectively PA among adults, Cuernavaca, Mexico, 2011

Sociodemographic Variables	**Mins/Wk of MPA, no bouts**		**Mins/Wk of MPA, bouts[b]**		**Mins/Wk of VPA, no bouts**		**Mins/Wk of VPA, bouts[b]**	
	Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]
	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)
Sex								
Female	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Male	**86.92±12.57**	**102.49±12.38**	**26.79±8.85**	**33.40±8.35**	**7.95±1.38**	**8.22±1.45**	**5.15±1.11**	**5.26±1.22**
	(0.00)	**(0.00)**	**(0.01)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**	**(0.00)**
Age								
≤ 35 years	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35< years ≤ 50	-22.79±16.89	-13.02±15.71	-6.79±7.30	-0.34±7.84	**-6.21±2.76**	**-4.97±2.56**	**-3.65±1.97**	-2.66±1.83
	(0.19)	(0.41)	(0.36)	(0.97)	**(0.03)**	**(0.06)**	**(0.08)**	(0.16)
50 < years ≤ 65	**-52.21±16.90**	**-41.56±13.16**	4.68±7.22	11.41±6.91	**-6.67±2.71**	**-5.27±2.75**	-3.33±2.13	-2.15±1.16
	(0.00)	**(0.00)**	(0.52)	(0.11)	**(0.02)**	**(0.07)**	(0.13)	(0.33)
SES								
Low	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium	-31.93±27.24	-22.36±22.91	-9.35±12.08	-3.17±10.73	-0.93±3.01	-1.62±3.20	-1.14±2.11	-1.87±2.41
	(0.25)	(0.34)	(0.45)	(0.77)	(0.76)	(0.62)	(0.59)	(0.45)
Medium-High	-50.69±25.08	-12.99±24.45	-14.45±10.69	4.17±11.80	-1.36±1.88	-3.14±3.19	-1.05±1.77	-3.07±3.14
	(0.05)	(0.60)	(0.19)	(0.73)	(0.48)	(0.33)	(0.56)	(0.34)
High	**-87.88±22.24**	-22.00±27.91	**-20.12±11.42**	8.78±15.72	-0.60±2.75	-3.32±3.93	0.28±2.22	-2.88±3.54
	(0.00)	(0.44)	**(0.09)**	(0.58)	(0.83)	(0.41)	(0.90)	(0.42)
Education								
Less than Highschool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Highschool	-11.74±19.51	-11.92±20.08	-6.56±7.06	-4.27±8.15	1.48±1.64	1.32±1.62	0.83±1.15	0.88±1.22

Sociodemographic Variables	Mins/Wk of MPA, no bouts		Mins/Wk of MPA, bouts[b]		Mins/Wk of VPA, no bouts		Mins/Wk of VPA, bouts[b]	
	Unadjusted Correlation Coefficient (p value)	Adjusted[a] Correlation Coefficient (p value)	Unadjusted Correlation Coefficient (p value)	Adjusted[a] Correlation Coefficient (p value)	Unadjusted Correlation Coefficient (p value)	Adjusted[a] Correlation Coefficient (p value)	Unadjusted Correlation Coefficient (p value)	Adjusted[a] Correlation Coefficient (p value)
	(0.55)	(0.56)	(0.36)	(0.60)	(0.37)	(0.42)	(0.48)	(0.48)
More than highschool	**-50.38±18.22**	-32.22±22.99	-9.66±7.21	-2.31±11.38	**6.03±2.29**	**7.49±3.66**	**4.98±1.73**	**6.06±2.90**
	(0.01)	(0.17)	(0.19)	(0.84)	**(0.01)**	**(0.04)**	**(0.01)**	**(0.04)**
Motor vehichle ownership								
No	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yes	**-70.09±13.27**	**-75.89±16.95**	**-36.81±8.08**	**-47.70±10.13**	-1.98±2.11	-3.96±2.86	-0.67±1.72	-1.97±2.22
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**	(0.36)	(0.18)	(0.70)	(0.38)
Marital status								
Single	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Married[c]	-7.24±17.53	13.51±14.95	-5.59±7.20	2.87±8.46	-2.74±2.61	1.95±2.89	-1.71±2.05	1.18±2.06
	(0.68)	(0.37)	(0.44)	(0.74)	(0.30)	(0.51)	(0.41)	(0.57)
Divorced[d]	**-62.54±19.22**	**-37.41±22.19**	**-26.66±13.03**	**-27.19±15.25**	-6.30±3.12	-1.22±2.95	-4.12±2.67	-1.15±2.45
	(0.00)	**(0.10)**	**(0.04)**	**(0.09)**	(0.05)	(0.68)	(0.13)	(0.64)
Nutritional Status								
BMI < 25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 ≤ BMI < 30	-7.68±16.98	-12.70±16.30	-9.30±10.55	-12.13±10.23	-4.28±2.66	-4.15±2.66	**-3.81±2.22**	-3.76±2.30
	(0.65)	(0.44)	(0.39)	(0.25)	(0.12)	(0.13)	**(0.09)**	(0.11)
BMI > 30	-16.11±19.81	-23.87±18.80	-8.20±11.27	-11.63±10.84	**-4.66±2.38**	-3.95±2.63	**-3.93±2.18**	-3.50±2.51
	(0.42)	(0.21)	(0.47)	(0.29)	**(0.06)**	(0.15)	**(0.08)**	(0.17)

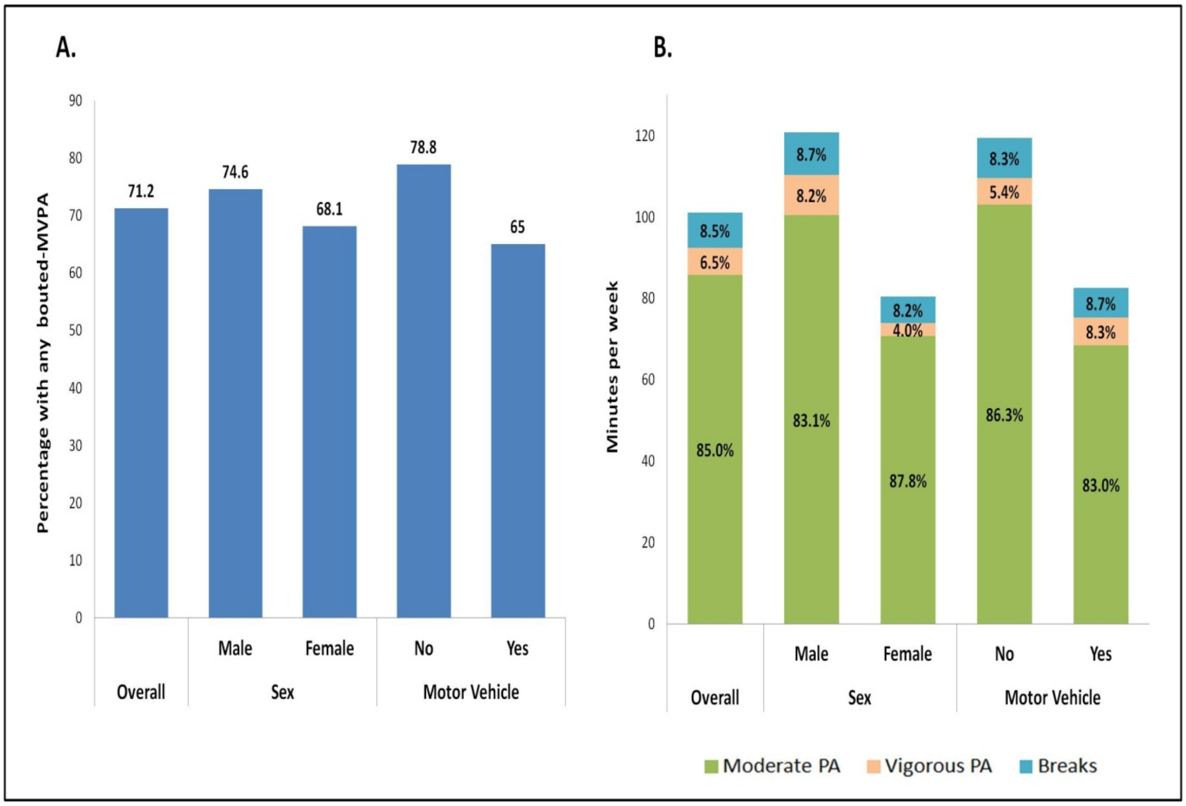
NOTE: All models account for the multistage clustered design of the study
[a] Adjusted models control for total wear time and for all sociodemographic variables
[b] Only activity registered within MVPA-bouts of at least 10 minutes duration, with ≥80% corresponding to MVPA (Bouts A) is reported
[c] Also includes "living with someone"; [d] Also includes "divorced" and "widower"

Figure 1: Prevalence of adults from Cuernavaca, Mexico (2011), meeting WHO recommendations for PA using total weekly minutes of MVPA and MVPA within bouts



A. Overall, B. Stratified by sex, C. Stratified by age, D. Stratified by SES quartiles. WHO recommendations for adults: ≥150 mins/wk of MVPA or ≥75 mins/wk of VPA. Bouts A: MVPA-bouts of at least 10 minutes duration, with ≥80% corresponding to MVPA. If total break-time per bout exceeded 20% of the total bout duration, or if a single break exceeded 2 minutes, the bout was interrupted. Bouts B: MVPA-bouts of at least 10 minutes duration, with a maximum total break time of 2 minutes per bout.

Figure 2: Prevalence, length and composition of MVPA bouts among Mexican adults from Cuernavaca, Mexico, 2011.



A. Percentage of Mexican adults from Cuernavaca (2011) with any MVPA within bouts (i.e. ≥1 valid MVPA bout), by sex and motor vehicle ownership. B. Length and composition of MVPA bouts by sex and motor vehicle ownership. Bouts are defined as having a minimum duration of ten consecutive minutes, with 80% of the bout corresponding to MVPA (Bouts A).

9. Study III

9.1 <u>Title</u>: Sociodemographic correlates of leisure and transport physical activity among Mexican adults

Salvo D, Torres C, Reis RS, Rivera J, Pratt M

Word Count: 3599

Abstract Word Count: 250

9.2 ABSTRACT

INTRODUCTION: The levels of domain-specific physical activity (PA), and their sociodemographic correlates, remain unknown for Mexican adults. The objectives were to describe the levels of transport and leisure PA, and to identify the sociodemographic correlates of transport and leisure PA for adults from Cuernavaca, Mexico.

METHODS: Cross sectional study of adults from Cuernavaca, Mexico (2011, n=677). The Self reported domain-specific PA (using the International Physical Activity Questionnaire-IPAQ). Weight and height were objectively measured. Minutes per week of total transport PA, walking for transport, biking for transport, total leisure-time PA, walking for leisure, moderate leisure-time PA and vigorous leisure time PA were obtained. Adjusted and unadjusted linear models were run to calculate the association between each PA variable and sex, age, socioeconomic status, education, marital status and BMI.

RESULTS: 46.8% of adults from Cuernavaca reported meeting international recommendations (MVPA >=150 minutes/week) through transport PA only, while 30.2% did so with leisure-time PA only. Being male was positively associated to transport PA. A higher education than high school was positively correlated to total leisure-time PA, while negative correlations were found for being married and being overweight. Motor vehicle ownership was negatively associated to leisure-time walking.

CONCLUSIONS: This was the first study to measure domain-specific PA for a representative sample of Mexican adults in a city. Some sociodemographic correlates vary from those known from high income countries, highlighting that further studies are needed

from lower-to-middle income countries. Intensity-specific relationships were found, stressing the importance of assessing these separately to better target PA interventions.

9.3 INTRODUCTION

Physical inactivity is known to be associated to an increased risk of obesity and chronic diseases, and has been recently described as a pandemic.[1-3] As many as 5.3 million deaths per year are attributable to physical inactivity worldwide, and it is a risk factor for obesity and many chronic diseases, including type II diabetes, cardiovascular diseases, osteoporosis and various cancers.[2] In Mexico the leading causes of death are type II diabetes and cardiovascular diseases, and seven out of ten adults are either overweight or obese.[4, 5]

The World Health Organization (WHO) recommends a minimum of 150 minutes per week of moderate to vigorous PA, or 75 minutes per week of vigorous PA for adults, all within bouts of at least ten minutes of sustained duration.[6] The importance of understanding the duration and intensity of PA within different domains is well recognized.[7, 8] These domains include leisure, transport, occupational or home-based PA, since they can all contribute to meeting guidelines and provide health benefits.[7]

In spite of the known limitations of using self report tools to measure physical activity levels, they provide valuable information on time spent in different domains of activity, that would otherwise remain unknown.[9, 10] Each domain of activity represents a different behavior, in which physical activity is taking place for different purposes .[8, 11, 12] Therefore, each domain may be affected by different individual and environmental factors, as has been seen in other countries.[8, 11] The understanding of domain-specific associations can help to design and target interventions to increase physical activity within different domains for different populations.[12] Domain-specific correlate studies of PA have been identified as a research priority for lower to middle income countries (LMIC), where urbanization and globalization are rapidly changing the physical activity determinants, yielding less active transportation and more sedentary leisure activities.[12]

The International Physical Activity Questionnaire (IPAQ) has been validated for the assessment of PA levels in population studies of many countries.[13] It is the most widespread self-report PA tool in Latin America,[14] and has a short and a long version.[13, 15] Only the long version measures PA within four specific domains. Validation studies have shown that only the leisure-time PA (LPA) and transportation PA (TPA) domains are accurately assessed when using IPAQ-long in Latin American contexts.[14]

The last Mexican Health and Nutrition Survey collected self-reported levels of total PA for all participants using the short version of the IPAQ.[5] Objectively measured (accelerometers) PA levels of a representative sample of Mexican adults from Cuernavaca have also been recently reported (Ref. IPEN-Mex accelerometry study). Nonetheless, there is currently no information on domain-specific PA levels among Mexican adults.

The aims of this study were to describe the levels of LPA and TPA among a representative sample of Mexican adults from the city of Cuernavaca, using IPAQ-long, and to identify the socio-demographic correlates of domain-specific PA for adults from Cuernavaca, Mexico.

9.4 METHODS

Study location and design

This was a cross sectional study in the city of Cuernavaca, located 76 kilometers south of Mexico City (central Mexico), with an area of 76 square kilometers and a population of 365,168 inhabitants.[16] The weather is temperate with an average temperature of 23°C, and the income per capita of 18,370.87 USD per year makes Cuernavaca one of the wealthiest cities in Mexico.[17] Data collection took place from April to September, 2011.

International Physical Activity and Environment Network - IPEN

The study was part of the IPEN-Mexico project. [18] (Ref. IPEN-Mex accelerometry study) IPEN-Mexico is the first study to address the associations of the built environment and physical activity levels among Mexican adults in an urban setting (Ref. IPEN-Mex accelerometry study), and will contribute to the pooled analysis of the twelve-country IPEN study[18]. IPEN uses high-quality standardized measures and protocols for data collection across all study sites. It considers both objective and subjective measures for the built environment (Abbreviated Neighborhood Environment Walkability Scale,[19, 20] Geographic Information Systems) and for PA (IPAQ-long and accelerometry).[18] The present study focused on self-reported leisure and transport PA from IPAQ-long and the associations with socio-demographic variables.

Sampling

A representative stratified multistage clustered sample was selected, with a final sample of 677 adults from Cuernavaca (response rate=58.9%). All census tracts within the Municipality of Cuernavaca (primary sampling units) were stratified by walkability[21] and socioeconomic status (SES) as previously described (Ref. IPEN-Mex accelerometry study), yielding eight strata. Four census tracts were randomly selected per strata, and seven blocks (secondary sampling units) were randomly selected per census tract. Blocks on the border of a census tract with a different walkability score or SES were excluded from the study to avoid bias for the larger project (IPEN), that seeks to understand the associations of PA with the built environment proximal to each participant's home address.[18] Two to four households (tertiary sampling units) were randomly selected per block. Finally, one participant was selected per household.

Recruitment and data collection took place through two home visits (face-to-face) with a team of trained field workers. The first visit included informing the household that it had been randomly selected for the study, and inviting an eligible participant residing in the household to participate. Eligibility was defined as being between 20 to 65 years of age, having lived permanently in the selected household for at least six months, and having no permanent or temporary disability that precluded walking. If there were no eligible participants living in the selected household or no one was found after two recruitment attempts (separate days), the next household to the right (clockwise) in the same block was selected. Written informed consent was obtained. The second home visit took place seven to ten days later, during which the general information survey and the IPAQ-long were applied in person. Weight and height were objectively measured using standardized procedures.[22] The details on other field procedures for the larger IPEN-Mexico study have been previously described (Ref. IPEN-Mex accelerometry study).

This study was approved by the Institutional Review Boards of Emory University and the National Institute of Public Health of Mexico.

Instruments

Although IPEN-Mexico used several measurement instruments, only the ones contributing to the purpose of this study are described in this paper.

Physical Activity

The International Physical Activity Questionnaire-Long Version (IPAQ) was used to assess physical activity. IPAQ is a validated self-report measurement tool for PA in Latin America[13, 14]. Only the sections on LPA and TPA were included, due to greater importance of these domains in public health and lack of validity of the occupational and home-based PA IPAQ sections in Latin American urban settings,[14] and to.[7, 12] The Colombian (Spanish) version of IPAQ[15] was adapted for a Mexican audience, using culturally appropriate wording and examples.

Demographics

Sex, age, time of residence in the household, marital status, education level, motor vehicle ownership, household characteristics and assets were assessed though standardized questions.

Weight and Height

Tanita® scales with centigram precision were used to measure weight in kilograms. Fixed wooden stadiometers with milimetric precision were employed to measure height in meters. The protocols for measuring weight and height followed international standards that have been previously reported.[22]

Variables

Using only the TPA and LPA sections of the IPAQ-long, the following outcome variables were obtained:

Transport walking-minutes per week (TWK): Total minutes per week occurring within bouts of at least ten minutes spent walking exclusively for transportation purposes. In compliance with the IPAQ protocol,[15] only bouts of at least ten minutes were reported.

Transport biking-minutes per week (TBKG): Total minutes per week spent bicycling exclusively for transportation. Only bouts of at least ten minutes were reported.

Total Transport PA-minutes per week (TTPA): Total minutes per week spent in PA for transportation. This variable results of the addition of TWLK and TBKG.

Leisure-time walking (LWLK): Total minutes per week spent walking exclusively for leisure. Only bouts of at least ten minutes were reported.

Moderate-intensity leisure-time physical activity (MLPA): Total minutes per week spent doing moderate-intensity physical activity for leisure, not including walking. WHO defines moderate-intensity PA as that which "noticeably accelerates the heart rate", and where energy expenditure is of 3 to 6 METs.[23, 24] IPAQ defines moderate activities as those that cause one to "breathe slightly faster than usual". Only bouts of at least ten minutes were reported.

Vigorous-intensity leisure-time physical activity (VLPA): Total minutes per week spent in vigorous PA for leisure, defined by WHO as that which causes a "substantial increase in heart rate".[23] IPAQ defines it as activities that have a minimal duration of ten minutes, and cause the participant to "breathe much faster than usual".[23]

Moderate to vigorous leisure-time physical activity (MVLPA): This variable results from the addition of LWLK, MLPA and VLPA.

The independent (sociodemographic) variables were the following:

Sex (binary; 0=female, 1=male), age (categorical; 20-35 years, 36-50 years, 51-65 years), individual-level SES (quartiles obtained using a z-centered index based on twenty-five survey items on household characteristics and assets, based on the questions used by the 2006 Health and Nutrition Survey of Mexico[25]), education level (categorical; less than high school, high school completed and more than high school), motor vehicle ownership (binary; 0=no car or motorcycle, 1=at least one car or motorcycle), marital status (categorical; single, married and divorced) and BMI status (categorical; normal: BMI<25, overweight: 25<=BMI<30 and obese: BMI>30).

Statistical Analyses

Proportions for meeting WHO recommendations[26] considering only PA done within specific domains (leisure and transport) and intensities, as well as of doing any PA at all (>=1 bout of at least 10 minutes duration) per specific domain and intensity were calculated. Mean minutes per week of domain and intensity-specific self-reported PA were also calculated. The results were weighted to compensate for unequal probabilities of selection due to the study design, and post-stratification weighing based on sex was used to partially adjust for non-response.

Unadjusted and adjusted linear regression models were run to find the association between the continuous PA outcomes (minutes per week of bouted domain and intensity-specific PA variables) and each sociodemographic independent variable. All studied sociodemographic variables were included in the adjusted models. All independent variables were tested for multicollinearity defined as having a Variance Inflation Factor (VIF)>10. Significance was considered when $p \leq 0.05$.

Statistical analyses took place in 2012 employing SAS 9.3 (SAS Institute Inc., Cary, NC, USA). The survey procedures were used since they control for the multistage stratified clustered sampling of the study.[27] The descriptive analysis was performed using surveymeans and surveyfreq, while the surveyreg procedure was used for the correlation analyses. SAS's surveyreg models linear outcomes even if these are not normal or symmetric.[27-29]

9.5 RESULTS

Table 1 shows the sociodemographic characteristics of the study population. The final sample for analysis was of 677 participants, of which 52% were female (weighted percentage), and had a mean age of 42.0 years. 32.3% had education beyond high school, 54.7% owned at least one motor vehicle (car or motorcycle) and 65.6% were either married or living with someone. Moreover, 40.9% were classified as overweight, while 31.7% were obese.

The results on Table 2 show the prevalence of total and intensity-specific leisure and transport PA among Mexican adults from Cuernavaca. 90.4% reported engaging in at least ten consecutive minutes of TPA per week, while 52.1% did so for LPA. Biking for transportation was very low, with only 1.5% reporting any at all during the last seven days. Overall, 46.8% achieved 150 minutes of TPA or more per week, with this figure being higher for males than for females (51.8% vs. 42.2%). For the case of LPA, 34.3% reported spending at least ten consecutive minutes walking for leisure per week, 23.3% in MLPA (excluding walking) and 21.4% in VLPA. It must be noted that these categories are not mutually exclusive, meaning that the same participants may have reported walking for leisure as well as engaging in MLPA and/or VLPA during the past week. 30.2% of Mexican adults met the WHO guidelines of 150 minutes of MVPA per week when considering only leisure-time PA. No differences were found across sexes for meeting guidelines using only total MVLPA (male=29.8% vs. female=30.6%). Nevertheless, more women reported any LWLK (36.7% vs. 31.7%), while men reported any VLPA more frequently (26.3% vs. 17.0%).

Of all the studied sociodemographic variables, only sex was significantly correlated to TTPA in the adjusted model, with males achieving 115.09±44.19 (p=0.01) minutes per week more of TTPA than females. Since only 8 participants (1.5%, weighted percentage) bicycled for transportation, it was not viable to run separate correlation analyses for TWK and TBKG, and therefore the relationships found reflect those of TWK (Table3).

Three variables were found to be significantly correlated to MVLPA in the adjusted model (Table 3). Having an education higher than high school was positively correlated to overall MVLPA (66.35±31.64, p=0.02). Married adults from Cuernavaca achieved 42.76±20.99 minutes less of weekly MVLPA with respect to singles (p=04). Finally, being overweight versus having a normal weight was negatively correlated to weekly minutes of MVLPA (-54.46±18.33, p=0.01).

The intensity-specific linear models for LPA are shown in Table 4. Although motor vehicle ownership had no significant correlation for total MVLPA, it was the only sociodemographic variable correlated to weekly minutes of LWLK, both in the unadjusted (-20.25±9.40 mins/wk, p=0.04) and adjusted model (-37.20±12.81 mins/wk, p=0.01). Meanwhile, married (-41.28±19.11 mins/wk, p=0.04) and divorced (-45.25±13.55

mins/wk) Mexican adults achieved less weekly minutes of MLPA in comparison to single adults (adjusted values). The adjusted model for VLPA showed significant positive correlations for being male (20.44±8.20 mins/wk, p=0.02) and for having an education level higher than high school (37.39±16.28 mins/wk, p=0.03). In addition, being in either of the two top age groups studied with respect to the lower age-group was negatively correlated to weekly minutes of VLPA ($35<\text{years}\leq 50$ = -26.83±9.75 mins/wk, p=0.01; $50<\text{years}\leq 65$ = -36.69±13.82 mins/wk, p=0.01). Finally, owning at least one motor vehicle was marginally correlated to achieving 12.23±7.46 minutes per week more of VLPA than non-motor vehicle owners (p=0.06).

9.6 DISCUSSION

This study describes the levels of transport and leisure PA among Mexican adults from Cuernavaca. The only sociodemographic feature found to be significantly and positively associated to TPA was being male. Walking was the most predominant form of TPA, while bicycling was almost nonexistent among Mexican adults (n=8, weighted percentage=1.5%). Education, marital status and BMI were significantly correlated to overall MVLPA. The associations varied by intensity level, and some correlates were found for the intensity-specific LPA models that were not seen in the compound MVLPA model and vice versa, such as the inverse relationship of motor vehicle ownership to LWLK. VLPA had more significant correlations to sociodemographic variables than LWLK and MLPA.

The results are consistent with some studies from HIC showing a positive association between male sex and TPA,[30] although other studies in HIC have shown no association.[31] Evidence from the US has also shown other sociodemographic correlates for TPA such as age (inverse relationship), being divorced (direct relationship) and motor vehicle ownership (inverse relationship), that were not seen in this study.[30] Evidence from different countries, such as China, Colombia, Australia, and others, have shown an inverse association for motor vehicle ownership and obesity.[32-35] Recent findings from Mexico showed a negative correlation between motor vehicle ownership and objectively measured MPA levels (Ref. IPEN-Mex accelerometry study). The present study complements and expands previous findings for Mexican adults by providing domain-specific results. Although an objective measure of PA in the same sample found a strong association between MVPA and MPA with motor vehicle ownership, in this study no association was found between motor vehicle ownership and TPA (Ref. IPEN-Mex accelerometry study). However, it was seen that motor vehicle ownership was negatively associated to LWLK. While in HIC settings transportation mode (private vehicle vs. public transport) seems to impact primarily TPA, with less TPA among motor vehicle owners and more TPA among public transit users,[30, 33, 35, 36] it is possible that for Latin American cities the relationship is also driven by LPA. This is evidenced by the present results showing no association of motor vehicle ownership with TPA, yet a significant and inverse association with LWLK, and by a recent study from Colombia showing that access to bus rapid transit stops is correlated to higher LPA levels.[37] Nevertheless, the possibility of misreporting of TPA among Mexican adults must also be considered. It is possible that motor vehicle owners are over reporting their TPA due to misperception of the duration of bouts of activity (e.g. time spent walking to a parked car or a nearby store may be over-estimated by motor vehicle owners). This seems plausible given the high strength of association between motor vehicle ownership and total (i.e. not domain-specific) objectively measured MPA and MVPA that has been previously reported (Ref. IPEN-Mex accelerometry study). Furthermore, the percentage of adults from Cuernavaca reporting at least ten minutes of TPA per week is very high (90.4%). More studies should address the associations between TPA and LPA with motor vehicle ownership and transportation mode among adults in Mexico and Latin America, and the validity of self-reported TPA among Mexican adults should be further addressed.

Another difference found with respect to the evidence from HIC was the null association between SES and MVLPA, in contrast to results from HIC studies.[38, 39] Our results are consistent with the previous analysis examining the correlates of objectively measured PA from the same Mexican sample, and showing no association with SES (Ref. IPEN-Mex accelerometry study). Moreover, while some studies in the US have reported that being divorced is positively correlated to LWLK and TPA, this was not found for Mexicans.[30] Instead, an inverse relationship was found for MLPA and for both being married or being divorced (versus being single). Further studies are needed to understand this association among Mexican adults.

Meanwhile, other associations found were consistent to those known for HIC, including the inverse association of age and overweight and LPA, and the positive correlation of male sex and LPA.[12, 30] The intensity-specific approach allows for a better understanding of the complexity of the relationships between PA and demographic variables. For example, among Mexican adults, sex and age are only associated with VLPA and not with LWLK or MLPA. The importance of studying intensity-specific leisure time PA outcomes has been recently identified, and this study reinforces that observation.[40] (Ref. Curitiba Study) Furthermore, the fact that we found more sociodemographic correlates for VLPA than for any other domain and intensity-specific variable studied is consistent with the knowledge from HIC, showing that VPA is more highly influenced by individual factors such as demographic or psychosocial variables, while MPA and walking may be more influenced by environmental factors.[40, 41]

Our findings also expand the understanding of the previously found positive association between male sex and total PA among Mexican adults (Ref. IPEN-Mex accelerometry study), showing that it is apparently driven by TPA and VLPA, but not by LWLK or MLPA. The results are consistent with the objectively measured PA data of the same sample, showing a strong positive association between education level and VLPA, independent to SES (Ref. IPEN-Mex accelerometry study).

Among the limitations of the study was the cross sectional design that did not allow for determining causality. The use of self reported data for physical activity may lead to over estimation and decreased precision.[42] Our study only examined the basic sociodemographic correlates of physical activity. Future studies should address the effect of psychosocial and environmental variables on physical activity among Mexicans. We were not able to study the independent associations of TWLK and TBKG due to a very small prevalence of TBKG among our sample. Finally, although the sample is representative of adults of Cuernavaca, it is not so for all Mexicans. Nonetheless, the overweight plus obesity rates are not different to those at the national level (72.6% vs. 71.3%),[5] suggesting that our results may be comparable to what is expected for the general Mexican urban population.

In spite of these limitations this study also has many strengths. It is the first Mexican study to describe domain and intensity specific PA levels among a representative sample of adults and the association of sociodemographic variables with domain-specific PA outcomes. Data collection as well as instrument selection, use, and cultural adaptations were part of a standardized international study protocol, and met all quality control requirements of the IPEN study.[18] We relied on the best available evidence from other Latin American countries to select only the TPA and LPA sections of the IPAQ for the purpose of obtaining high quality PA data for Mexican adults.[14] The use of linear instead of logistic models responds to the recognized need to study PA as a continuous outcome,[12] and thus avoids the loss of detail when studying the correlations of sociodemographic correlates to domain and intensity-specific PA outcomes. These variables represent minutes per week of self reported activity within bouts of at least ten minutes. Finally, by studying the associations of sociodemographic variables to intensity-specific LPA outcomes, we provided further insight to these relationships, given that each intensity represents a different behavior (LWLK, MLPA and VLPA).[40] (Ref. Curitiba Study) It is therefore important to understand which factors influence each of these behaviors to define public health priorities, as has been previously argued.[12, 40] (Ref. Curitiba Study)

9.7 CONCLUSIONS

This is the first Mexican study to describe domain and intensity-specific PA levels and its sociodemographic correlates among adults. In spite of the noted limitations, this study represents the best available evidence for sociodemographic correlates of PA among Mexican adults, and demonstrates that these differ from those known for HIC. Our findings suggest that interventions in Mexico to increase TPA may be promising if they target women, while those aiming to increase MVLPA may be promising if they focus on motor vehicle owners, married and divorced people and those with low education levels. More correlate studies are needed to confirm and better understand these relationships in Mexico and other LMIC.

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9.9 TABLES

Table 1: Socio-Demographic characteristics of study population (n=677).

Table 2: Proportion of leisure and transport physical activity among adults by sex, Cuernavaca, Mexico, 2011.

Table 3: Socio-demographic correlates of minutes per week of domain-specific physical activity among adults, Cuernavaca, Mexico, 2011.

Table 4: Socio-demographic correlates of intensity-specific leisure time physical activity among adults, Cuernavaca, Mexico, 2011.

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Table 1: Socio-Demographic characteristics of study population (n=677).

Variable	**n**	**Weighted %[a]**
Female	375	52.0
Age		
<=35 years	222	33.4
35<years<=50	263	39.0
50<years<=65	192	27.6
SES[b]		
Low	201	31.2
Medium	165	24.0
Medium-High	198	28.9
High	113	15.9
Education		
Less than high school	295	44.5
High school	162	23.2
More than high school	220	32.3
Motor Vehicle Ownership[c]	371	54.7
Marital Status		
Single	166	25.0
Married or living with someone	438	65.3
Separated, Divorced or Widower	73	9.8
Nutritional Status		
Overweight (25<=BMI<30)	278	40.9
Obese (BMI>=30)	212	31.7

[a] *Weighted for probability of selection and non-response by sex.*
[b] *SES: Classifications based on quartiles of SES-index. SES-index based on home characteristics such as floor, wall, ceiling materials, number of rooms, bathroom and kitchen facilities, and assets.*
[c] *Number of participants reporting ownership of at least one car or motorcycle in their household.*

Table 2: Proportion* of leisure and transport physical activity among adults by sex, Cuernavaca, Mexico, 2011.

Outcome	Overall		Sex			
			Male		***Female***	
	%	n	%	n	%	n
Transport Physical Activity						
Walking for transport						
>= 150 mins/week	46.7	302.0	51.6	148.0	42.2	154.0
Any at all**	90.4	609.0	88.9	267.0	91.8	342.0
Biking for transport						
Any at all**	1.5	8.0	1.8	5.0	1.2	3.0
Total transport physical activity						
>= 150 mins/week	46.8	303.0	51.8	149.0	42.2	154.0
Any at all**	90.4	609.0	88.9	267.0	91.8	342.0
Leisure Physical Activity						
Walking for leisure						
>= 150 mins/week	14.1	94.0	13.1	38.0	15.0	56.0
Any at all**	34.3	230.0	31.7	97.0	36.7	133.0
MPA for leisure (excl walking)						
Any at all**	23.3	157.0	21.7	67.0	24.7	90.0
VPA for leisure						
Any at all**	21.4	141.0	26.3	77.0	17.0	64.0
MVPA for leisure (excl walking)						
>= 150 mins/week	20.4	135.0	21.3	64.0	19.6	71.0
Any at all**	36.9	247.0	40.2	121.0	33.8	126.0
Total MVPA for leisure (incl walking)						
>= 150 mins/week	30.2	199.0	29.8	89.0	30.6	110.0
Any at all**	52.1	349.0	52.3	161.0	51.8	188.0

** All percentages were weighted for probability of selection and non-response by sex*
*** Only includes activity of at least ten minutes duration (10 minutes bouts)*

Table 3: Socio-demographic correlates of minutes per week of domain-specific physical activity among adults, Cuernavaca, Mexico, 2011.

Sociodemographic Variables	Mins/Wk of Transport PA		Mins/Wk of Total Leisure-MVPA	
	Unadjusted Correlation Coefficient (p value)	Adjusted Correlation Coefficient (p value)	Unadjusted Correlation Coefficient (p value)	Adjusted Correlation Coefficient (p value)
Sex				
Female	0.00	0.00	0.00	0.00
Male	**94.03±39.50** **(0.02)**	**115.09±44.19** **(0.01)**	28.33±26.31 (0.29)	21.11±25.09 (0.41)
Age				
20≤years≤ 35	0.00	0.00	0.00	0.00
35< years ≤ 50	-64.78±34.86 (0.07)	-62.23±38.21 (0.12)	-51.28±30.40 (0.10)	-35.13±29.16 (0.24)
50 < years ≤ 65	-36.65±35.08 (0.31)	-33.49±42.21 (0.43)	-53.34±27.52 (0.06)	-38.54±25.96 (0.15)
SES				
Low	0.00	0.00	0.00	0.00
Medium	-122.46±60.12 (0.05)	-115.82±61.64 (0.07)	-5.05±24.62 (0.84)	-14.53±20.75 (0.49)
Medium-High	**-133.52±63.19** **(0.04)**	-109.76±62.00 (0.09)	48.19±25.29 (0.07)	29.51±27.70 (0.30)
High	-104.20±70.19 (0.15)	-59.56±67.22 (0.38)	90.29±47.29 (0.07)	62.06±45.11 (0.18)
Education				
Less than Highschool	0.00	0.00	0.00	0.00
Highschool	-47.68±37.37 (0.21)	-29.36±36.84 (0.43)	**48.24±22.79** **(0.04)**	23.68±21.18 (0.05)
More than highschool	-79.82±45.28 (0.09)	-52.56±34.67 (0.14)	**93.37±31.00** **(0.01)**	**66.35±31.64** **(0.02)**
Motor vehichle ownership				
No	0.00	0.00	0.00	0.00
Yes	-50.07±39.34 (0.21)	-29.13±31.35 (0.36)	18.08±21.85 (0.42)	-16.08±20.74 (0.45)
Marital status				
Single	0.00	0.00	0.00	0.00
Married*	27.37±39.75 (0.50)	32.62±45.36 (0.48)	**-79.81±22.47** **(0.00)**	**-42.76±20.99** **(0.04)**
Divorced**	-39.26±43.70 (0.38)	-19.37±32.41 (0.56)	-50.35±43.13 (0.25)	-15.94±37.83 (0.68)

Sociodemographic Variables	Mins/Wk of Transport PA		Mins/Wk of Total Leisure-MVPA	
	Unadjusted	Adjusted	Unadjusted	Adjusted
	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)
Nutritional Status				
BMI < 25	0.00	0.00	0.00	0.00
25 ≤ BMI < 30	2.38±48.81 (0.96)	-8.79±50.54 (0.86)	**-67.14±20.90 (0.00)**	**-54.46±18.33 (0.01)**
BMI > 30	2.81±34.44 (0.94)	-7.60±40.29 (0.85)	**-57.99±27.34 (0.04)**	-41.24±25.90 (0.12)

NOTE: All models account for the multistage clustered design of the study.
** Also includes "living with someone"*
*** Also includes "divorced" and "widower"*

Table 4: Socio-demographic correlates of intensity-specific leisure time physical activity among adults, Cuernavaca, Mexico, 2011.

Sociodemographic Variables	**Mins/Wk of Leisure-Walking**		**Mins/Wk of Leisure-MPA**		**Mins/Wk of Leisure-VPA**	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)
Sex						
Female	0.00	0.00	0.00	0.00	0.00	0.00
Male	-1.08±11.86	2.73±12.82	1.96±16.19	-2.07±14.71	**27.46±8.40**	**20.44±8.20**
	(0.93)	(0.83)	(0.90)	(0.89)	**(0.00)**	**(0.02)**
Age						
20≤years≤ 35	0.00	0.00	0.00	0.00	0.00	0.00
35< years ≤ 50	1.10±12.95	1.23±13.23	-20.98±20.00	-9.53±19.76	**-13.40±11.50**	**-26.83±9.75**
	(0.93)	(0.93)	(0.30)	(0.73)	**(0.01)**	**(0.01)**
50 < years ≤ 65	13.47±11.37	11.00±15.09	-26.81±18.77	-12.86±18.01	**-40.00±14.35**	**-36.69±13.82**
	(0.25)	(0.47)	(0.16)	(0.48)	**(0.01)**	**(0.01)**
SES						
Low	0.00	0.00	0.00	0.00	0.00	0.00
Medium	-7.01±16.02	-0.01±16.33	-4.83±21.64	-11.64±18.36	6.79±8.52	-2.88±9.72
	(0.67)	(0.99)	(0.83)	(0.53)	(0.43)	(0.77)
Medium-High	20.92±15.88	33.11±19.19	-10.93±15.48	-18.75±11.99	**38.20±8.60**	15.16±7.93
	(0.20)	(0.10)	(0.49)	(0.13)	**(0.00)**	(0.07)
High	0.61±15.33	21.06±20.69	51.81±37.57	38.02±31.38	**37.87±16.31**	2.98±14.78
	(0.97)	(0.32)	(0.18)	(0.24)	**(0.03)**	(0.84)

Sociodemographic Variables	Mins/Wk of Leisure-Walking		Mins/Wk of Leisure-MPA		Mins/Wk of Leisure-VPA	
	Unadjusted Correlation Coefficient (p value)	Adjusted Correlation Coefficient (p value)	Unadjusted Correlation Coefficient (p value)	Adjusted Correlation Coefficient (p value)	Unadjusted Correlation Coefficient (p value)	Adjusted Correlation Coefficient (p value)
Education						
Less than Highschool	0.00	0.00	0.00	0.00	0.00	0.00
Highschool	12.76±12.75	14.06±11.42	13.81±17.79	1.94±14.79	**21.67±8.88**	7.68±7.75
	(0.33)	(0.23)	(0.44)	(0.90)	**(0.02)**	(0.33)
More than highschool	9.84±9.40	9.03±10.25	27.37±18.98	3.93±19.47	**56.18±17.53**	**37.39±16.28**
	(0.30)	(0.39)	(0.16)	(0.84)	**(0.00)**	**(0.03)**
Motor vehichle ownership						
no	0.00	0.00	0.00	0.00	0.00	0.00
yes	**-20.25±9.40**	**-37.20±12.81**	12.63±19.38	8.89±16.70	**25.70±9.10**	12.23±7.46
	(0.04)	**(0.01)**	(0.52)	(0.60)	**(0.01)**	(0.06)
Marital status						
Single	0.00	0.00	0.00	0.00	0.00	0.00
Married*	2.87±9.31	12.33±12.22	**-48.28±20.72**	**-41.28±19.11**	**-34.40±15.94**	-13.80±16.80
	(0.76)	(0.32)	**(0.03)**	**(0.04)**	**(0.04)**	(0.42)
Divorced**	25.16±21.81	22.29±23.75	**-55.92±20.13**	**-45.25±13.55**	-19.59±27.34	7.02±29.40
	(0.26)	(0.36)	**(0.01)**	**(0.00)**	(0.48)	(0.81)
Nutritional Status						
BMI < 25	0.00	0.00	0.00	0.00	0.00	0.00
25 ≤ BMI < 30	-20.87±11.97	-19.82±12.44	-24.77±18.84	-19.42±16.47	-21.50±11.56	-15.22±11.72
	(0.09)	(0.12)	(0.19)	(0.25)	(0.07)	(0.20)
BMI > 30	-22.52±13.26	-23.38±13.46	-12.36±19.28	-4.34±18.79	-23.11±13.50	-13.53±15.73
	(0.10)	(0.09)	(0.53)	(0.82)	(0.10)	(0.40)

NOTE: All models account for the multistage clustered design of the study
** Also includes "living with someone"*
*** Also includes "divorced" and "widower"*

10. Study IV

10.1 Title: Characteristics of the built environment associated with objectively measured physical activity among Mexican adults

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10.2 ABSTRACT

BACKGROUND: The built environment (BE) correlates of physical activity (PA) have been extensively documented in high income countries (HIC), but remain unstudied for Mexican adults. The objectives of this study were to calculate the correlations between characteristics of the BE and PA among Mexican adults from Cuernavaca, and to examine potential moderation by perceived safety.

METHODS: Cross sectional study of adults from Cuernavaca, Mexico (2011, n=677). Participants wore Actigraph GT3X accelerometers for seven days. Perceived neighborhood and park safety were self-reported. Geographic Information Systems (GIS) were used to generate buffer-based variables (500 meters and 1 kilometer) for net residential density, proportion of commercial land use, land use mix, connectivity, walkability index, number of transit routes and distance to nearest park (non buffer-based). Linear models were run to calculate the correlation between total weekly moderate-to-vigorous PA (MVPA) and MVPA within bouts with each BE variable. Likelihood ratio tests were used to identify interactions with perceived safety variables.

RESULTS: The walkability index and its components were negatively correlated to PA among Mexican adults. Number of transit routes per buffer were inversely associated to PA. Park safety perception moderated the association between having one park intersect the 500 meter buffer and PA.

CONCLUSIONS: This was the first study to examine the correlations of objectively measured BE and PA among Mexican adults. The findings contrast markedly with those

from HIC, suggesting that environmental programs and policies to increase PA in Mexico cannot be adapted from HIC without careful consideration of the Mexican context.

10.3 INTRODUCTION

Physical inactivity accounts for as many as 5.3 million deaths per year worldwide,[1] being a known risk factor for obesity, cardiovascular disease and diabetes.[1, 2] There is compelling evidence linking the built environment and physical activity (PA).[3-6] Yet, the vast majority of it is derived from studies in high-income countries (HIC), including the United States, Northern Europe and Australia.[6] In these settings, walkability (a concept that incorporates measures for residential density, commercial density, connectivity and land use mix) has been positively associated to PA.[7-11] While a few studies from lower-to-middle income countries (LMIC) have recently emerged,[6, 11-13] only two Latin American countries (Colombia and Brazil) are examining these associations.[6, 12, 13] Their initial findings suggest differences from what is known for HIC.[14-16]

Furthermore, few studies around the world have used objective measures to assess both PA and the built environment when examining their association.[6, 17] New technologies such as accelerometry and Geographic Information Systems (GIS), allow for a more precise estimation of both the PA outcome and the environmental independent variables.[6, 18] Although studies relying on self-reported data are valuable, since they can identify domains of activity (e.g. leisure vs. transport) and/or environmental perceptions,[6, 19] the use of objective measures may provide more credible evidence with a higher potential to influence policy makers and various non-health oriented decision-makers such as those in the fields of urban planning and transportation.[6, 20]

Furthermore, objective measures are especially important for clarifying the underlying relationships between PA and the BE due to increased precision and the possibility of using PA as a continuous variable.[6]

Mexico is currently facing the burden of a widespread obesity epidemic.[21, 22] The 2012 national health and nutrition survey reported that 71.2% of Mexican adults are either overweight or obese.[22] In 2004 it was estimated that physical inactivity accounted for 4.4% of total deaths and 1.2% of total DALYS among Mexicans.[23] Nationally representative data from 2012 shows that only 17.2% of adults reported being inactive.[22] No studies are available examining the associations of PA among adults and the built environment using representative data in Mexico.

In order to inform stakeholders and to design, implement and target appropriate environmental strategies to increase PA among Mexicans, local studies that take into consideration context-specific issues are needed.[6, 16, 20] Safety (from crime) perception is thought to be a factor that may influence PA and has been included in several studies from other countries, although inconsistent results have been found.[24-26] Given that Mexico has been undergoing higher crime rates than usual since 2006,[27-29] safety perception may potentially moderate the associations of PA with objectively measured environmental variables.

The main purpose of this study was to identify the associations between objectively measured PA and objectively measured built environmental features among adults from the city of Cuernavaca, Mexico. We also examined if these associations were moderated by perception of safety.

10.4 METHODS

Study design and site

This was a cross sectional, multistage clustered study in the city of Cuernavaca. It is in the central region of Mexico and is considered mid-sized, with 365,168 inhabitants. It has a Human Development Index of 0.86,[30] making it a relatively wealthy Mexican City. The crime rate in Cuernavaca has increased substantially over the past ten years, with a rise in homicides by 276.7% during this period.[28]

This study is part of the IPEN-Mexico project (IPEN: International Physical Activity Environment Network). IPEN is a collaborative network of researchers from twelve countries studying the associations between physical activity and the built environment for a study that will use pooled data collected via comparable high-quality methods in all sites. More details of the IPEN study are available elsewhere.[20] The main purpose of IPEN Mexico is to understand the associations between the built environment and physical activity in a Mexican urban setting, using objective and subjective measures for the dependent (PA) and independent variables (environmental). This study focuses on objectively measured data for both PA and the built environment, while also incorporating perceived safety from crime, and sociodemographic covariates.

Sampling

Data collection for IPEN-Mexico took place in 2011. A representative, multistage clustered sample was selected using census tracts as the primary sampling units (PSU). PSUs were stratified by socioeconomic status (SES; 4 levels, as categorized by the National Institute of Geography and Statistics[31]) and walkability[10] (2 levels, stratified by the median), having 8 strata derived from the combinations of SES and walkability levels. Seven blocks were randomly selected per census tract, and two to four households were selected per block. One eligible participant was selected per household.

Inclusion Criteria

Blocks immediately proximal to another census tract from a different SES-walkability strata were excluded from the study to avoid bias. Eligible participants were defined as adults between 20 to 65 years, with no disability to walk at the time of the study, that had been living in that household for at least six months, and that reported that it was their permanent household.

All participants signed informed consent forms and the study was approved by the IRB boards of Emory University and the Mexican National Institute of Public Health.

Physical activity measurement and outcomes

PA was measured objectively with GT3X Actigraph accelerometers using sixty second epochs. Although these devices record triaxial data, only vertical axis data (activity) was employed for analysis. Accelerometers are the most widespread tool to objectively measure PA, and have been extensively validated for adults.[32, 33]

Once recruited (through a home visit by trained field workers), participants were handed the meter and required to wear it for seven days, using them at all times except to sleep, shower or swim. They were instructed to wear them on their right hip with elastic belts that were provided with the device. Two monitoring phone calls throughout the week took place to assure the participant was following the protocol. After seven days, a second visit took place and wear time verification was done on site. If the meter recorded less than five valid days, the participant was asked to wear the device for more time, and a third home visit was scheduled to recover the device. A valid wear day was defined as having at least ten valid hours of wear time. Non-wear time was defined as having sixty or more consecutive zeros (one hour). Delivery and recovery dates were always considered non-valid. All accelerometry data was scored with MeterPlus 4.2 using Freedson's cut-points for adults, in accordance to the common IPEN-study protocol.[20, 34]

Outcome variables included minutes per week of total moderate-to-vigorous physical activity (TMVPA), and minutes per week of moderate-to-vigorous physical activity occurring within bouts (BMVPA). For this study, bouts were defined as having a minimum duration of ten minutes, with at least 80% of the bout corresponding to MVPA (i.e. break periods of <20% of the duration of the bout were allowed). In addition, if a single break had a duration of >2 minutes, the bout was interrupted. A similar approach to define has been used by other researchers in the field.[35] Bouts of activity were generated in MatLab 7.7 (The MathWorks Inc., Natick, MA, USA).

Objective measurement of the built environment

GIS-generated variables were used to assess the built environment. GIS makes it possible to precisely map and analyze spatial data, constituting a valuable tool allowing for objective assessment of the built environment.[36]

The location of each participant was manually marked on paper maps by trained fieldworkers upon recruitment, and manually geocoded in ArcGIS as a point shapefile, since the maps provided by INEGI did not allow for automated address matching. One kilometer and 500 meter network buffers (using the street network of Cuernavaca rather than a simple crow-fly radius) were generated around each participant's household location. These network buffer distances have been used by others[4, 37, 38] since a more proximal microenvironment surrounding the household (i.e. 500 meters) may yield stronger associations between certain built environment features, while for others a larger buffer (e.g. 1 kilometer) may have stronger correlations to PA.

The following variables were generated per buffer: net-residential density, commercial land use proportion, connectivity (intersection density), land use mix, the walkability index (as defined for the US[10] (derived from adding z-scored values of the four previously mentioned variables), number of parks intersecting the buffer and number of public transit (bus) routes intersecting the buffer. Distance to the nearest park (not a buffer-based variable) was also obtained using the street network. A detailed description of each GIS-generated independent variable, including their categorization for analysis and units, is found in Table 1. Data sources for GIS (shapefiles and data-base files) were provided by INEGI and the Land Use Registry Department of the City of Cuernavaca. All GIS variables were generated using ArcGIS 9.3 (ESRI, Inc., Redlands, CA, USA).

Perception of safety assessment

As part of the IPEN-Mexico study, perceived environment data was collected for all participants employing the Abbreviated Neighborhood Environment Scale (ANEWS).[39] The survey was applied in person by trained field workers during the second home visit, when they verified accelerometry data. For this analysis, only the ANEWS items pertaining to safety from crime were used. Two "perceived safety" independent variables were generated: overall neighborhood safety perception and parks safety perception. Both were coded as binary variables, with the categories of "safe" or "unsafe" neighborhoods or parks. The specific ANEWS items used to generate these variables and the scoring procedures are further described in Table 1.

Covariates

Self-reported sociodemographic variables including age, sex, education level, marital status, individual-level socioeconomic status (based on 25 questions on household characteristics and assets, as used by the National Health and Nutrition Surveys of Mexico[21, 22]) and motor vehicle ownership were used as covariates for the analysis. BMI was also used as a covariate and was objectively measured by trained field workers using Tanita® scales and fixed stadiometers, following standardized procedures.[40] BMI measurement and self-report of sociodemographic variables took place during the second home visit.

Statistical analysis

The statistical analyses were performed in 2012 and 2013. All analyses accounted for the complex multistage clustered design, and were performed using the survey procedures of SAS 9.3 (SAS Institute Inc., Cary, NC, USA).

The surveyreg procedure was used to perform the correlation analyses, allowing for linear regression of non-normal outcomes, due to its design-based approach in contrast to other model-based tools. Therefore, the correlation coefficients obtained through this analysis represent minutes per week of TMVPA or BMVPA. Unadjusted models for TMVPA and BMVPA were initially run using each GIS-variable as independent variables, as well as both safety perception variables. Then, models adjusting for all the covariates were run per PA outcome and GIS-variable. Likelihood ratio tests were used to detect potential interactions between each objectively measured built environment variable (GIS) and the two perceived safety variables. If an interaction was detected with either of the perceived safety variables (likelihood ratio test $p<0.05$), models for the association of the given GIS variable with each PA outcome per safety level were run to understand the moderation of the relationship by safety perception. Statistical significance was considered when $p<0.05$.

10.5 RESULTS

The response rate was 58.9%. Eight participants were excluded from this analysis due to missing valid accelerometry data, and seven more due to geocoding problems, leaving a final sample size for analysis of 662 participants. No differences in sociodemographic characteristics were found between the full sample (n=677) and the sample used for analysis (n=662). Table 2 shows the means and distribution of sociodemographic characteristics and environmental variables of the final sample for this study. The mean age was 41.98 years (weighted). 48.07% were male, 32.72% had education beyond high school, 55.81% were motor vehicle owners and 31.83 were obese. 41.34% of Mexican adults perceived their neighborhood as being unsafe, while 39.93% did so for parks (weighted percentages). On average, participants did 221.31±10.08 mins/wk of TMVPA and 63.35±4.31 mins/wk of BMVPA. If considering TMVPA, 58.53% met the 150 mins/wk of PA recommended by the World Health Organization (WHO),[41] while this figure drops to 13.34% if considering only BMVPA.

Tables 3 and 4 show the associations of environmental variables and objectively measured TMVPA and BMVPA. Since no public transit route intersected any 1 KM buffer without doing so for the corresponding 500 M buffer, a single variable was employed for the models. After adjusting for all covariates, having 8 or more public transit routes intersecting the 500M buffer was found to be negatively correlated to TMVP (-23.78±10.61, p=0.04), but not to BMVPA (-6.95±12.29, p=0.58). No association was found between distance to the closest park with TMVPA or BMVPA.

Participants with one park intersecting the 500 meter buffer achieved 27.87±14.90 (p=0.05) and 16.84±8.19 (p=0.03) minutes less per week of TMVPA and BMVPA, respectively, in comparison to participants with no parks intersecting the 500 meter buffer. No association was found for participants with two or more intersecting parks for both TMVPA and BMVPA, using "no parks" as the reference value. In addition, no association was found between number of parks intercepting the 1 KM buffer with TMVPA or BMVPA.

Walkability within the 500 meter buffer and TMVPA were not found to be significantly correlated. Meanwhile, having a high walkability index within the 1 KM buffer was associated with fewer weekly minutes of TMVPA (-46.91±20.04, p=0.03) in comparison to living in a low walkability area. Stronger inverse associations were found when examining BMVPA for both buffer sizes. For the 500 meter buffer, high walkability was associated to -31.49±12.93 minutes less per week of BMVPA (p=0.02). For walkability within the 1 KM buffer, quartiles two (medium: -22.25±10.22, p=0.04) and three (medium-high: -34.21± 10.01, p=0.00), but not four (high: -12.65±13.19, p=0.35), were negatively correlated to BMVPA after adjusting for all covariates.

The associations between the two PA outcomes with the individual components used to define walkability based on the U.S. definition of this concept[10] (net residential density, commercial land use proportion, land use mix and connectivity) showed similar inverse associations. The negative correlation of net residential density with both PA outcomes was stronger for the 1 KM buffer, for which medium and medium-high, but not high net residential density, were associated with less weekly TMVPA (medium: -39.88±18.20, p=0.04; medium-high: -40.42±22.61, p=0.08, marginal significance) and BMVPA (medium: -24.32±6.24, p=0.03; medium-high: -23.34±10.88, p=0.05). Having a high commercial land use proportion within the 500 meter buffer was inversely correlated both to TMVPA (-54.51 ± 15.53, p=0.00) and BMVPA (-33.96 ± 8.28, p=0.00), but this relationship was not found for the 1 KM buffer. On the other hand, medium-high and high land use mix within the 1 KM buffer were significantly correlated to BMVPA (medium-high: -22.33±9.64, p=0.03; high: -17.34±8.27, p=0.05), and no association was found for land use mix with TMVPA. For connectivity, medium-high and high levels within the 1 KM buffer were associated to less TMVPA (medium-high: -35.51±14.67, p=0.02, high: -32.07± 17.49, p=0.09). Although similar tendencies were found to BMVPA these were non-significant (medium-high: -18.33±10.37, p=0.09; -9.48±6.91, p=0.12). No associations were found for connectivity within the 500 meter buffer with either PA outcome.

Neighborhood safety perception was not correlated to TMVPA or BMVPA. Yet, unsafe park perception was marginally associated with fewer minutes per week of both TMVPA (-23.17±9.16, p=0.08) and BMVPA (-12.00±7.01, p=0.05) after adjusting for covariates. After testing for interaction by safety perception (neighborhood or park), it was found that the association between number of parks intercepting the 500 meter buffer with both TMVPA (p=0.04) and BMVPA (p=0.02) was moderated by park safety perception. When parks were perceived as unsafe, having one park intercept the 500 M buffer yielded

30.76±14.85 (p=0.05) and 19.24±7.17 (p=0.03) minutes per week less of TMVPA and BMVPA, respectively, while no association was found when parks were perceived as being safe.

10.6 DISCUSSION

This study describes the associations of objectively measured PA with objectively measured built environment features for a representative sample of adults from Cuernavaca, Mexico. Among the main findings of the study, perceived safety from crime was found to moderate the association between PA and having one park intersecting the 500 M buffer. High availability of transit routes was found to be associated with lower PA levels. Remarkably, our results showed that the association between PA and the accepted definition of walkability derived from HIC,[10] including each of its individual components, was significantly and inversely related to PA. Thus, in our representative sample of Mexican adults the walkability index and its individual components correlated to lower PA rather than the expected higher levels of PA.

In contrast to some studies in HIC,[42, 43] higher availability of public transit routes was found to be negatively associated to PA among Mexican adults. This may be reflective of the contextual characteristics of the Mexican public bus service. Although we didn't have exact location of bus stops in our maps, this reflects the reality of Mexican cities where it is common practice to signal a bus to stop anywhere along its route. In fact, our results are consistent with a study in Bogotá, Colombia for a similar transit system (feeder buses).[44] This may suggest that if strict enforcement took place of only using designated bus stops, PA levels among users may increase, or may at least have no negative association to PA levels. In fact, positive associations to PA have been found for proximity to bus rapid transit stops (with enforced bus stops) in Bogotá, Colombia.[12, 45]

In spite of the high crime rates in Mexico,[27, 29] overall neighborhood perception of safety was not associated with PA levels, nor did it moderate any of the relationships with GIS built environment variables. Yet, park safety perception helped elucidate the negative association between having one park within the 500 M buffer and achieving lower levels of weekly PA.

Our findings with respect to the walkability index, as defined in the US,[10] are surprising and have strong research and public health implications for LMIC. Given that several studies from the U.S., northern Europe and Australia have consistently shown a positive association with PA for intersection density (connectivity), land use mix and residential density to PA, [8, 46-48]and these elements have been found to be strongly correlated amongst each other, they were combined to build a walkability index.[10] This index is intended to be reflective of higher PA among the population residing in neighborhoods where the index is high.[10] Our findings for Mexican adults in Cuernavaca suggest the contrary, showing an association of the walkability index with lower minutes per week of PA.

A few studies have found different results from what is known for HIC in a study of the associations between GIS-based environmental variables and self-reported PA in Colombia.[12, 45] Nonetheless, their findings showed no association for residential density and land use mix with PA. Our findings, in addition to those from Colombia, stress the need for more studies using high-quality objective measures of the built environment to identify the environmental correlates of PA in Latin American and other LMIC, and highlight the fact that relying on knowledge from HIC may not be appropriate in these settings.[6, 16] For the case of Bogotá, Colombia, it was hypothesized that the null association of residential density and land use mix to PA in their study may be due to the fact that in Colombia most neighborhoods are highly dense and mixed, yielding a low variability and therefore not allowing for detection of differences in PA by these factors.[12, 45] Similar results as ours have been found in Hong Kong and Bangladesh, showing an inverse association of PA with walkability and particularly with residential density.[49] A possible explanation for our findings could be that what is classified as low density, connectivity or land use mix in a Mexican city such as Cuernavaca, may be equivalent to what for a US city is classified as a high density, connectivity or land use mix. If this were the case, it could be possible that neighborhoods that are too dense, mixed and connected may represent a barrier for PA, and that the association of what is known in the US as "walkability" with PA is not linear but U-shaped. Evidently, our data in itself does not provide enough information to prove our hypotheses, which should be further tested in future studies to elucidate the complex relationships between objectively measured environmental features and PA in Mexico and other LMIC.

Among other interesting findings that highlight the complexity of the relationships between built environment features and PA among Mexican adults is, for example, what was seen for net residential density in the 1 KM buffer, where medium and medium-high density were inversely and significantly associated to both TMVPA and BMVPA, yet no association was seen for high density levels. Similar findings occurred for other variables studied, for which only certain levels were significantly correlated to weekly minutes of PA. This may be reflective of curvilinear relationships or thresholds that need to be further examined. The same is true for the fact that some variables were more strongly associated to PA when they were within the 500 meter buffer (number of parks per buffer, commercial land use proportion), while for others the 1 KM buffer yielded more significant correlations (residential density, land use mix, walkability index). Similarly, some features were more strongly associated to BMVPA (residential density, land use mix, walkability, number of parks) while others were so to TMVPA (number of transit routes). Future studies should take place to elucidate these associations in Mexico and other countries.

Our study had various limitations. Its cross sectional design doesn't allow for the determination of causality. Self reported data was used for safety variables and covariates (except BMI), which may introduce some error. Objective neighborhood level data on crime rates was not provided by the Mexican government, for which we had to rely on safety perception. Parcel level land use data was not provided by the Mexican government, and only land use zones were available. This may have lead to decreased precision for certain variables, for which it was assumed that the over or underestimation of land-use coverage was balanced across the city. Although using objective measures provides the best available estimates of PA and of the built environment, it doesn't allow elucidation of certain associations for which self-reported tools may be useful, including domains of activity and neighborhood perceptions. This was demonstrated by the significant moderation by park safety perception on the association of number of parks per buffer and PA levels. An analysis using transport and leisure time PA may help better understand some of the relationships identified. Furthermore, GIS data on features such as sidewalk availability, among others, is not yet available for Mexico. More GIS data and higher accessibility of it is required to study these associations for Mexican cities.

Our study also had many strengths. To our knowledge, this is the first study in a Latin American city examining the association of PA and the built environment using objective measures for both the dependent and independent variables. As part of the IPEN study, strict methodological procedures and state of the art measures and instruments were used. Our approach using linear models for non-normalized weekly minutes of TMVPA and BMVPA responds to the recognized need for more studies treating PA as a continuous variable, given its known health benefits at various levels. By using quartiles for the environmental variables rather than dichotomizing or z-scoring them, we were able to identify more associations and to notice some of the complex relationships (potential curvilinear associations or thresholds) between PA and the built environment in Cuernavaca.

10.7 CONCLUSIONS

Our study is the first of its kind for a Mexican city, and in spite of its cross sectional nature, it is the best available evidence of the associations of activity levels and neighborhood built environment among Mexican adults. This study should be treated as an initial attempt to understand these complex relationships in a Mexican setting. Our findings have important public health implications for Mexico, since they show opposite associations of PA with walkability as defined for HIC[10]. As others have noted, caution should be taken when translating evidence from HIC to LMIC,[6, 12, 45, 50] and more studies should take place in Latin America and other LMIC to better understand these associations.

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Table 1: Definition of physical activity outcomes, environmental variables and covariates.

Variable	Type	Definition
Physical activity outcomes		
Total minutes of moderate-to-vigorous PA per week	Continuous	Total minutes per week of activity above or equal to 1952 counts per minute, regardless of bouts
Minutes of moderate-to-vigorous PA within bouts	Continuous	Minutes per week of activity above or equal to 1952 counts per minute, registered within MVPA bouts as defined for this study
MVPA bouts	------	All of the following characteristics were required for a MVPA bout: 1. Duration of at least ten minutes; 2. Intensity of activity: moderate-to-vigorous (>= 1952 counts per minute); 3. >= 80% of the bout consisted of moderate-to-vigorous intensity of activity (> 1952 counts per minute). Therefore <= 20% of the bout could correspond to breaks below or equal to 1952 counts per minute; 4. Each break below the cut point (1952 counts per minute) had a maximum duration of two minutes. If points 3 OR 4 were not met, the bout was interrupted.
Environmental Variables		
Net Residential Density (500M and 1 KM)	Categorical	Number of single family units per buffer / total squared kilometers of residential land use within the buffer. Categories[b] are defined as: Low (reference): < 1582.99, Medium: 1582.99<= NRD< 2174.19, Medium-High: 2174.19<= NRD < 2729.75, High: >= 2729.75
Commercial Land Use Proportion (500M and 1KM)	Categorical	Squared kilometers designated to commercial land use within the given buffer / total squared kilometers of buffer area. Categories[b] are defined as: Low (reference): 0.00, Medium: 0.00<Comm-Prop<0.15, Medium-High: 0.15<Comm-Prop<0.25 High:>=0.25
Connectivity (500M and 1 KM)	Categorical	Intersection Density. Defined as: number of 3-and 4-way intersections within the given buffer / Total buffer area in squared kilometers. Categories[b] are defined as: Low (reference): <111.03, Medium: 111.03<= Int. Den. <135.33, Medium-High: 135.33<= Int. Den.<166.59, High: >=166.59
Land Use Mix (500M and 1 KM)	Categorical	1 X ((∑(pi)(lnpi))/lnk) where p=proportion of total land uses, i=land use category, ln=natural logarithm, k=number or land uses. Range 0-1. Categories[b] are defined as: Low (reference): <0.25, Medium: 0.25<=LU-Mix<0.4, Medium-High: 0.5<= LU-Mix<0.5 High:>=0.5
Walkability Index	Categorical	Z-scored net residential density + Z-scored commercial land use proportion + 2(Z-scored connectivity) + Z-scored land use mix[c]. Categories[b] are defined as: Low (reference): Low: <-45, Medium: -45<=walkability<15, Medium-High: 15<=walkability<50, High:>=50
Distance to Closest Park	Categorical	Distance in meters to the nearest park. Categories[b] are defined as: Near (reference): <313.116, Medium: 313.116 <= m < 771.156, Far: 771.156 <= m <1356.51, Very far: >= 1356.51

Variable	Type	Definition
Number of parks (500M and 1 KM)	Categorical	Number of parks intersecting the given buffer (i.e. includes parks fully within and parks partially within the buffer). Categories are: 0 parks in buffer (reference), 1 park in buffer, 2 or more parks in buffer.
Public transportation routes	Categorical	Number of public transit routes (bus) intersecting the buffer. No difference was found between 500 M and 1 KM buffers (i.e. no transit rout intersected the 1 KM buffer for any participant, while not intersecting the 500 M buffer). Therefore, a unique variable was used. Categories are based on quartiles: 0 routes (reference), 1-2 routes, 3-7 routes, 8 or more routes.
Neighborhood Safety Perception	Categorical	Binary. 1=unsafe neighborhood, 0=safe neighborhood. Based on average score (score range 1-4) of five ANEWS[d] items (1 lowest agreement, 4 highest agreement): The crime rate in my neighborhood is high, the crime rate in my neighborhood makes it unsafe to walk during the day, the crime rate in my neighborhood makes it unsafe to walk during the night, the parks and plazas in my neighborhood are unsafe to visit during the day, the parks and plazas in my neighborhood are unsafe to visit during the night. "Unsafe" >=3, "Safe"<3 (reference).
Park Safety Perception	Categorical	Binary. 1=unsafe neighborhood, 0=safe neighborhood. Based on average score (score range 1-4) of two ANEWS[d] items (1 lowest agreement, 4 highest agreement): The parks and plazas in my neighborhood are unsafe to visit during the day, the parks and plazas in my neighborhood are unsafe to visit during the night. "Unsafe" >=3, "Safe"<3 (reference).
<u>Covariates</u>		
Sex	Categorical	Binary. Male=1, Female =0 (reference)
Age	Continuous	Range 20-65 years
Individual socio-economic status	Categorical	Low (reference), medium, medium-high, high. Based on quartiles of individual SES index, constructed using centralized z-scores from a set of twenty-five questions on household characteristics and assets per participant. The index excluded motor vehicle ownership and education.
Education level	Categorical	Binary. Highs chool or less (<= 12 years of education) = 0 (reference). More than high school (>12 years of education) =1.
Marital status	Categorical	Single (not living with a partner, reference); Married (includes living with a partner); Divorced (includes separated and widower).
Motor vehicle ownership	Categorical	Binary. Yes=1, No=0 (reference). Yes = owning at least one car or motorcycle.
BMI status	Categorical	BMI<25 (normal, reference); 25<= BMI < 30 (overweight); BMI >= 30 (obese).

[a] Based on Freedson et. al. (1998) (REF)
[b]Cut-points per category were defined based on city-wide quartiles using census tract level data from the entire city of Cuernavaca.
[c] Frank et. al. 2010(REF)
[d] ANEWS (REF)

Table 2: Means and prevalences of sociodemographic and environmental characteristics among Mexican adults from Cuernavaca, 2011

Environmental Variables	n (%[a]) / Mean[a] (SE[a])
Total[b]	662 (100.00)
Male	297 (48.07)
Age	41.98 (0.55)
<=35 years	217 (33.38)
35<years<=50	260 (40.04)
50<years<=65	185 (26.58)
SES[c]	
Low	196 (31.81)
Medium	163 (24.03)
Medium-High	192 (27.99)
High	111 (16.17)
Education	
More than highschool	216 (32.72)
Motor vehicle ownership	370 (55.81)
Marital status	
Single	162 (25.04)
Married[d]	434 (65.27)
Divorced[d]	66 (9.69)
Nutritional Status (BMI)	28.09 (0.22)
Overweight	275 (41.21)
Obese	210 (31.83)
Distance to closest park (meters)	1069.65 (126.24)
Very close: <313.116	165 (16.31)
Medum: 313.116 <= meters < 771.156	166 (25.62)
Far: 771.156 <= meters <1356.51	166 (30.90)
Very far: >= 1356.51	165 (27.17)
Number of public transportation routes per buffer	5.32 (0.83)
0 transit routes	81 (11.03)
1-2 transit routes	228 (35.80)
3-7 transit routes	172 (24.36)
8 or more transit routes	181 (28.81)
Neighborhood Safety perception (score 0-5)	2.77 (0.05)
Safe neighborhood: <3	387 (58.66)
Unsafe neighborhood: >=3	275 (41.34)

Park Safety perception (score 0-5)	2.71 (0.11)	
Safe parks: <3	382 (60.07)	
Unsafe parks: >=3	280 (39.93)	
	500M	**1KM**
	n (%) / Mean (SE)	**n (%) / Mean (SE)**
Net Residential Density	2498.61 (184.81)	2160.64 (88.37)
Low: < 1582.99	190 (27.91)	165 (23.64)
Medium: 1582.99<= NRD< 2174.19	115 (20.58)	173 (30.28)
Medium-High: 2174.19<= NRD < 2729.75	115 (20.56)	166 (24.96)
High: >= 2729.75	242 (30.95)	158 (21.12)
Commercial Land-Use Proportion	0.14 (0.02)	0.14 (0.02)
Low: 0.00	249 (37.82)	154 (24.95)
Medium: 0.00<Comm-Prop<0.15	119 (18.10)	183 (27.54)
Medium-High: 0.15<=Comm-Prop<0.25	132 (22.48)	162 (26.40)
High: >=0.25	162 (21.60)	163 (21.11)
Land Use Mix	0.32 (0.03)	0.38 (0.02)
Low: <0.25	224 (34.37)	135 (21.67)
Medium: 0.25<=LU-Mix<0.4	208 (31.77)	224 (29.13)
Medium-High: 0.5<= LU-Mix<0.5	135 (17.82)	169 (27.18)
High: >=0.5	95 (16.04)	134 (22.02)
Connectivity (Intersection Density)	171.25 (10.16)	143.44 (6.97)
Low: <111.03	166 (25.72)	166 (25.68)
Medium: 111.03<= Int. Den. <135.33	167 (26.15)	161 (22.09)
Medium-High: 135.33<= Int. Den. <166.59	166 (26.04)	166 (25.82)
High: >=166.59	163 (22.09)	169 (26.41)
Walkability Index	-4.02 (10.16)	-4.43 (9.78)
Low: <-45	148 (25.37)	155 (23.30)
Medium: -45<=walkability<15	231 (33.42)	174 (30.28)
Medium-High: 15<=walkability<50	135 (20.38)	187 (27.27)
High: >50	148 (20.83)	146 (19.14)
Number of parks per buffer	0.37 (0.08)	1.16 (0.23)
0 parks	415 (72.87)	236 (40.94)
1 park	165 (20.85)	231 (36.53)
2 or more parks	82 (6.28)	195 (22.52)

[a] All means and percentages are weighted for selection probability and non-response by sex
[b] The table shows data for the total sample for analysis, that excludes 15 participants for which accelerometry or GIS data was not available. No differences in sociodemographic characteristics were found between the full sample (677) and the sample for analysis in this study (662)
[c] Classifications based on quartiles of SES-index. SES-index based on household characteristics and assets
[d] Includes living with someone
[e] Includes separated and widowers

Table 3: Association of total minutes per week of MVPA with environmental variables among Mexican adults from Cuernavaca, 2011.

Environmental variables	Unadjusted Correlation Coefficient (p value)	Adjusted[a] Correlation Coefficient (p value)
Neighorbood Safety		
Safe	0.00	0.00
Unsafe	0.23 ± 16.38 (0.99)	-1.33 ± 18.50 (0.94)
Park Safety		
Safe	0.00	0.00
Unsafe	-17.19 ± 10.11 (0.11)	-23.17 ± 9.16 (0.08)
Distance to park		
Near	0.00	0.00
Medium	-2.43 ± 16.86 (0.87)	12.93 ± 16.18 (0.43)
Far	-4.81 ± 22.20 (0.83)	6.13 ± 16.61 (0.72)
Very Far	10.59 ± 24.19 (0.67)	15.56 ± 18.02 (0.40)
Number of transit routes		
0	0.00	0.00
1	-12.69 ± 19.50 (0.52)	-7.76 ± 20.02 (0.70)
2-7	-17.99 ± 19.43 (0.36)	-15.55 ± 23.82 (0.52)
>=8	-51.72 ± 15.62 (0.00) *	-23.78 ± 10.61 (0.04) *

	500 M Buffer		1 KM buffer	
	Unadjusted Correlation Coefficient (p value)	**Adjusted** Correlation Coefficient (p value)	**Unadjusted** Correlation Coefficient (p value)	**Adjusted** Correlation Coefficient (p value)
Residential Density				
Low	0.00	0.00	0.00	0.00
Medium	1.02±27.01 (0.87)	-4.72 ± 23.1 (0.84)	-37.60 ± 17.02 (0.04)	-39.88 ± 18.20 (0.04)
Medium-High	-9.75±26.88 (0.72)	-39.10 ± 22.65 (0.16)	-30.38 ± 21.45 (0.24)	-40.42 ± 22.61 (0.08)
High	-16.12± 23.56 (0.50)	-30.58 ± 18.69 (0.20)	6.20 ± 12.31 (0.81)	-15.99 ± 18.14 (0.49)
Commercial Land-Use Proportion				
Low	0.00	0.00	0.00	0.00
Medium	0.67 ± 21.47 (0.98)	-2.77 ± 20.55 (0.89)	-9.00 ± 25.80 (0.73)	-0.37 ± 24.17 (0.99)
Medium-High	-7.88 ± 24.93 (0.75)	-9.48 ± 21.06 (0.66)	-44.31 ± 20.64 (0.04)	-26.26 ± 20.43 (0.21)
High	-73.18 ± 16.92 (0.00) *	-54.51 ± 15.53 (0.00) *	-35.53 ± 22.13 (0.12)	-20.27 ± 20.85 (0.34)

Land Use Mix				
Low	0.00	0.00	0.00	0.00
Medium	11.03 ± 18.18 (0.55)	6.29 ± 18.55 (0.74)	10.92 ± 19.07 (0.57)	14.44 ± 19.32 (0.46)
Medium-High	-36.34 ± 24.06 (0.14)	-25.61 ± 20.89 (0.23)	-18.09 ± 15.34 (0.25)	-11.20 ± 15.24 (0.47)
High	-4.33 ± 26.73 (0.87)	-12.68 ± 19.76 (0.53)	-1.14 ± 24.20 (0.96)	-0.39 ± 21.75 (0.99)
Connectivity				
Low	0.00	0.00	0.00	0.00
Medium	-31.87 ± 29.88 (0.30)	-36.14 ± 22.05 (0.11)	-6.93 ± 21.90 (0.75)	-21.55 ± 16.94 (0.21)
Medium-High	-16.58 ± 30.20 (0.59)	-22.63 ± 31.40 (0.48)	-41.20 ± 18.82 (0.04)	-35.51 ± 14.67 (0.02)
High	-3.71 ± 18.49 (0.84)	-18.68 ± 18.25 (0.32)	-16.71 ± 20.40 (0.42)	-32.07 ± 17.49 (0.09)
Walkability				
Low	0.00	0.00	0.00	0.00
Medium	-23.78 ± 22.19 (0.29)	-24.35 ± 18.31 (0.20)	-8.35 ± 18.02 (0.65)	-20.42 ± 18.91 (0.29)
Medium-High	-19.92 ± 30.83 (0.52)	-27.11 ± 26.53 (0.32)	-36.07 ± 21.03 (0.10)	-12.89 ± 21.54 (0.55)
High	-25.88 ± 26.16 (0.33)	-34.30 ± 21.69 (0.13) *	2.59 ± 23.42 (0.91)	-46.91 ± 20.04 (0.03)
Number of parks				
0	0.00	0.00	0.00	0.00
1	-13.23 ± 14.96 (0.38)	-27.87 ± 14.90 (0.05)	-19.25 ± 19.03 (0.32)	-10.82 ± 16.98 (0.53)
>2	45.03 ± 43.78 (0.31)	31.61 ± 35.60 (0.38)	5.25 ± 18.58 (0.78)	-3.27 ± 17.73 (0.86)

[a] Adjusted models control for total wear time, sex, age, individual SES, education, marital status, motor vehicle ownership and BMI status.

* Significant test for linear trend (p<0.05)

Table 4: Association of minutes per week of MVPA within bouts[a] with environmental variables among Mexican adults from Cuernavaca, 2011.

Environmental Variables	Unadjusted Correlation Coefficient (p value)	Adjusted[a] Correlation Coefficient (p value)
Neighorbood Safety		
Safe	0.00	0.00
Unsafe	-5.00 ± 6.55 (0.45)	-2.61 ± 7.38 (0.73)
Park Safety		
Safe	0.00	0.00
Unsafe	-10.60 ± 6.56 (0.09)	-12.00 ± 7.01 (0.05)
Distance to park		
Near	0.00	0.00
Medium	5.17 ± 6.76 (0.45)	9.91 ± 7.00 (0.17)
Far	4.92 ± 8.68 (0.58)	8.16 ± 7.72 (0.30)
Very Far	4.44 ± 10.18 (0.67)	8.24 ± 11.51 (0.48)
Number of transit routes		
0	0.00	0.00
1	2.66 ± 0.26 (0.80)	-1.59 ± 11.09 (0.89)
2-7	-5.39 ± 8.13 (0.51)	-4.51 ± 11.42 (0.70)
>=8	-10.70 ± 11.29 (0.35)	-6.95 ± 12.29 (0.58)

	500 M Buffer		1 KM Buffer	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**
	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)	Correlation Coefficient (p value)
Net Residential Density				
Low	0.00	0.00	0.00	0.00
Medium	-3.87± 11.59 (0.74)	-7.97 ± 12.00 (0.51)	-21.28 ± 7.12 (0.04)	-24.32 ± 6.24 (0.03)
Medium-High	-15.87 ± 7.72 (0.17)	-22.87 ± 10.55 (0.05)	-16.95 ± 12.80 (0.15)	-23.34 ± 10.88 (0.05)
High	-10.46 ± 9.74 (0.40)	-21.68 ± 9.32 (0.04)	-1.55 ± 15.22 (0.91)	-8.92 ± 10.30 (0.50)

Commercial Land-Use Proportion				
Low	0.00	0.00	0.00	0.00
Medium	3.20 ± 10.70 (0.77)	-0.82 ± 10.50 (0.94)	-0.91 ± 9.92 (0.93)	1.56 ± 9.75 (0.87)
Medium-High	-4.12 ± 9.07 (0.65)	-8.59 ± 9.48 (0.37)	-7.46 ± 11.07 (0.51)	-5.70 ± 10.84 (0.60)
High	-32.64 ± 8.32 (0.00) *	-33.96 ± 8.28 (0.00) *	-16.35 ± 10.79 (0.14)	-20.31 ± 13.42 (0.11) *
Land Use Mix				
Low	0.00	0.00	0.00	0.00
Medium	0.73 ± 8.60 (0.93)	-5.49 ± 9.06 (0.55)	2.93 ± 10.34 (0.78)	1.03 ± 11.17 (0.93)
Medium-High	-19.58 ± 14.46 (0.19)	-20.65 ± 12.96 (0.12)	-20.72 ± 8.57 (0.02)	-22.33 ± 9.64 (0.03)
High	-16.44 ± 11.62 (0.17)	-19.17 ± 11.63 (0.11)	-12.42 ± 13.10 (0.35)	-17.34 ± 8.27 (0.05)
Connectivity				
Low	0.00	0.00	0.00	0.00
Medium	-8.79 ± 11.98 (0.47)	-8.68 ± 10.15 (0.40)	-6.58 ± 10.32 (0.53)	-9.24 ± 10.63 (0.39)
Medium-High	-8.33 ± 17.49 (0.64)	-11.54 ± 16.65 (0.49)	-13.75 ± 9.10 (0.14)	-18.33 ± 10.37 (0.09)
High	-7.95 ± 9.93 (0.43)	-10.35 ± 10.63 (0.34)	-5.95 ± 9.92 (0.55)	-9.48 ± 6.91 (0.12)
Walkability				
Low	0.00	0.00	0.00	0.00
Medium	-9.84 ± 12.18 (0.43)	-10.22 ± 11.47 (0.38)	-16.79 ± 9.48 (0.09)	-22.25 ± 10.22 (0.04)
Medium-High	-16.54 ± 12.23 (0.19)	-18.31 ± 12.94 (0.17)	-28.23 ± 9.31 (0.01)	-34.21 ± 10.01 (0.00)
High	-29.89 ± 11.96 (0.02) *	-31.49 ± 12.93 (0.02) *	-6.25 ± 12.47 (0.62)	-12.65 ± 13.19 (0.35)
Number of parks				
0	0.00	0.00	0.00	0.00
1	-11.96 ± 6.24 (0.07)	-16.84 ± 8.19 (0.03)	-0.02 ± 11.80 (0.99)	0.24 ± 12.38 (0.98)
>2	25.91 ± 27.18 (0.35)	20.51 ± 26.16 (0.44)	1.15 ± 10.44 (0.91)	-2.17 ± 11.13 (0.85)

[a] Only activity registered within MVPA-bouts of at least 10 minutes duration, with ≥80% corresponding to MVPA is reported.
[b] Adjusted models control for total wear time, sex, age, individual SES, education, marital status, motor vehicle ownership and BMI status.
* Significant test for linear trend ($p<0.05$)

11. Discussion

The results presented in the past four chapters provide valuable information for better understanding the environmental correlates of physical activity of adults in Latin American urban contexts, including the specific cases of Curitiba, Brazil, and Cuernavaca, Mexico. The common finding from the four analyses is that the results differ significantly from those reported for high income countries (US, Canada, Australia, Northern European countries). These results suggest that it may not be appropriate to target and design interventions for Latin American countries using only knowledge derived from high income countries. Our findings also highlight the need to assess context-specific associations of the built environment with physical activity, since the findings in Mexico vary from those found for Brazil. Although countries and cities within Latin America share certain urban design attributes, some relationships may be unique to a given country or city. Therefore, studies like ours (IPEN-Mexico) should be encouraged.

The contribution of the studies presented in this dissertation will be further discussed in this section.

11.1 Novel approach for understanding the association of combinations of environmental variables with physical activity outcomes

The secondary analysis study using data from Curitiba, Brazil, identified combinations of variables associated with intensity-specific leisure time physical activity outcomes. We used an exploratory approach (all-possible-models) to build best-fit models with independent NEWS items as independent variables. This analysis specifically responded to the need to (highlighted in the recently published Lancet series on physical activity[21]) move beyond studying only individual associations of built environment features with physical activity to identifying combinations of features that are associated with physical activity.

In spite of the limitations previously discussed in the manuscript for Study I, this analysis will hopefully lead to more of its kind for Brazil. Unlike Mexico, Brazil is one of the few Latin American countries where there is already a growing body of evidence depicting the associations of individual built environment variables with physical activity.

11.2 Importance of studying intensity-specific physical activity outcomes

The Curitiba study was novel for the global field of physical activity epidemiology, since we were the first to examine the associations of the perceived built environment to intensity specific leisure physical activity outcomes. Although it is well recognized that domains of activity represent distinct behaviors, few studies have addressed the importance of using intensity-specific physical activity outcomes when studying the sociodemographic and built environment correlates of activity[21,154-156]. It seems clear that walking, other moderate intensity physical activity and vigorous activity represent different behaviors, that may be influenced by different factors, and may occur in different places and at different times. Few studies that treat them as separate variables have been published[27,157]. Our findings from Curitiba show that the correlates of leisure time physical activity vary by level of intensity of physical activity, and that using a compound variable of moderate-to-vigorous physical activity may not be appropriate.

The initial analyses of the IPEN-Mexico data also support and highlight the importance of studying intensity-specific physical activity outcomes. As shown in studies 2 and 3, more sociodemographic correlates of objectively measured and domain specific physical activity are identified when using intensity-specific outcomes. Some examples include the positive association of education level to vigorous physical activity (accelerometer-based) and to leisure time vigorous physical activity (IPAQ), or the inverse association of motor vehicle ownership to leisure time walking but not to overall leisure time moderate-to-vigorous physical activity. For the case of objectively measured physical activity, while motor vehicle ownership was strongly inversely correlated to overall moderate-to-vigorous physical activity, when performing the intensity-specific analysis we found that the relationship was driven only by moderate physical activity, and no association was found for vigorous physical activity.

When thinking about interventions and programs to increase physical activity among a given population, and particularly if these will have an environmental component, it is important to define which type of activity is more likely to be impacted by which environmental changes. The interventions should be designed and evaluated accordingly. For instance, there is consensus that public health efforts should focus on the promotion of walking and moderate intensity activity at the population level, rather than on vigorous physical activity[136]. This is both because significantly increasing (and maintaining) levels of vigorous activity at a population level is more challenging, and it adds higher risk of injuries[136]. These intervention programs should be targeted and designed relying on findings specific to walking and moderate intensity physical activity, and not use a variable that also includes vigorous physical activity.

11.3 First study to address the sociodemographic and environmental correlates of physical activity in Mexico

The IPEN Mexico study, with the three initial analyses (Studies II, II and IV) presented in this dissertation, represents an important step for physical activity epidemiology in Mexico. It is the first large physical activity study in the country, using representative data of adults in a city (Cuernavaca). It is also the first attempt in Mexico to understand the associations between the built environment and physical activity among adults. In addition, this is the first study to measure physical activity objectively for a representative sample of Mexican adults. Other countries in Latin America (Brazil and Colombia) have studies underway using objective measures of physical activity, but their findings have not been published yet. This is the first time that a Mexican study uses domain specific physical activity data (the ENSANUT only uses IPAQ-short, which does not inlcude domain-specific physical activity).

First hand physical activity and built environment data was collected using state of the art procedures, and yielding a dataset with over two hundred variables. The study was strengthened by being part of the IPEN study. We received support from the IPEN coordinator center with trainings, consultations, quality-control and equipment (they provided the accelerometers for the study). The data were collected using standardized methods ensuring comparability with other IPEN countries. In fact, there is already an ongoing collaboration with the research groups of Colombia and Brazil. The results of this collaboration will provide important information for the Latin American region. It will allow us to understand to what extent the associations of physical activity with the built environment are similar across the region and in comparison to the commonly studied high-income countries (US, Canada, Australia and Northern European countries). We will also be able to identify relationships that are only true at the country level. The data from Mexico will be useful for many more country-level analyses beyond the three initial ones presented in this dissertation. These will contribute to better understand the the associations of the built environment with physical activity among Mexican adults. The findings resulting of such analyses should be used to help guide the local research and policy agenda to increase the activity levels of Mexican adults through environmental interventions.

11.4 Inverse association of the "walkability index" and its components with physical activity among Mexican adults

Our initial findings are encouraging, demonstrating the need of more correlate studies specific to our region and countries. As expected, the associations between physical activity and the built environment are different than those reported for the US, UK, Belgium, Canada and Australia. We had hypothesized to find no association between the walkability index and each of its components with physical activity among Mexican adults. The data from Curitiba showed that some of the components of the walkability are not correlated to physical activity among Brazilian adults. Contrastingly, the Mexican study revealed a more pronounced difference than expexted in comparison to the known correlates of physical activity for high income countries. We found a negative association between physical activity and walkability (US definition), and with each of its components.

These counter intuitive findings were surprising and, paired with our findings from Curitiba, show that the association of physical activity with the built environment may be context specific. Similar findings (inverse associations between physical activity and the walkability index) have been reported for Hong Kong and Bangladesh[158]. Caution should be taken when attempting to use knowledge derived from other contexts for interventions in lower-to-middle income countries such as Mexico[46].

In Study IV we hypothesized that if neighborhoods are too dense, connected and mixed, the association of walkability and its components with physical activity becomes negative. It may be possible that the neighborhoods categorized as highly dense, mixed and connected in countries like the U.S., have equivalent levels of density, land use mix and connectivity to what is categorized as "low" in Mexico. Up to now, studies addressing the relationship of walkability (as defined in the U.S.) with physical activity have only performed internal comparisons. This means that they have used their own data to establish points of reference (e.g. quartiles)[35,159,160]. Caution is needed when comparing results across cities and countries, since "high walkability" or "low walkability" (or "high density" versus "low density", etc.) may not represent the same concept across sites. This hypothesis requires further study. The IPEN study with data from twelve countries will play a crucial role to test this hypothesis, especially if a similar approach as ours is employed. In our analyses, we used unique cut-points per category based on city-wide data, and applied them to the 500 meter and 1 kilometer buffer variables.

Another possibility could be that in spite of using the same categorization criteria (specific cut-points) for walkability and its components accross countries, the associations with physical activity are context specific. It may be possible that in some contexts walkability is possitively correlated with physical activity, while in others it may have no association or an inverse association. This may be driven by cultural or psychosocial factors. Some of the psychosocial measures collected for this study may help elucidate some of these findings. With our data we will be able to identify if the identified associations are being mediated or moderated by psychosocial constructs such as self efficacy or social support.

The origins of the walkability index must also be taken into consideration when interpreting our findings. The walkbility index was developed by Frank et. al. using an urban planning and transportation perspective[98]. The variables considered for inclusion in the index derived from Cervero et. al.'s proposal of "the three D's", and their potential influence on walking for transportation[119]. "The three D's" refer to: Density (used in the walkability index by including net residential density), Diversity (used in the walkability index by including land use mix) and Design (used in the walkability index by including connectivity). Cervero et. al. used factor analysis to examine the association of these three constructs with active transportation. Frank et. al. based their index on these findings, but adjusted it to be entirely based on available GIS data, while accounting for the additive effect of the three constructs in association with physical activity[98]. The evidence supporting the importance of these variables instead of others such as aesthetics, neighborhood satisfaction, availability of public spaces or availability of sidewalks came primarily from studies aiming to solve traffic congestion and promoting transport-based physical activity, while favoring economic revenue (i.e. neighborhoods where walking to retail stores was a convenient choice)[119,161]. The three D's model is based on evidence from what can be refered to as "standard North American cities". These typically include a dense, diverse and mixed city center (downtown), with higher surburban sprawl and a car-oriented design in residential neighborhoods far from the downtown area[162-164]. The walkability index was found to be associated with walking for transportation when contrasting activity levels of participants living in downtown neighborhoods versus those in mainly residential, suburban neighborhoods further away from the city center[98]. These suburban residential neighborhoods in standard U.S. cities include features such as lack of sidewalks, low connectivity (exemplified by many cul-de-sacs), and limited access to retail[162-164]. The initial evidence supporting the three D's model used data from the San Francisco Bay Area[119]. Meanwhile, Frank et al.'s walkability index was based on data from Seattle and Washington D.C.-Baltimore[98].

After its publication, many researchers have studied the the walkability index in association with active transportation and with lesiure time physical activity. Studies from other U.S. cities like Atlanta and San Diego, as well as studies in Ottawa, Sydney, Melbourne and London, have found positive associations between walkability and physical activity[94,165-170]. These cities share a similar urban form with the "standard US city", where the index was developed.

Although it has been suggested that the walkability index may be applicable to many urban sites in different countries[153,171], we must be cautious. Our findings from Mexico are a clear example of how the association of the walkability index with physical activity may vary by context. Cities like Cuernavaca or Curitiba don't have the same urban design patterns as standard US cities. It is possible that context specific relationships of physical activity with the walkability index may exist in other cities around the world, as has been found for Colombia (no association)[104], Hong Kong and Bangladesh (inverse association)[158]. In spite of the positive associations identified between walkability and recreational physical activity in the US, Canada and Australia[172,173], we should keep in mind that the original purpuse of the index was to predict active transport[98].

In contrast to US cities, in Cuernavaca most neighborhoods are highly dense, connected and mixed. Although we did find enough variation by the walkability index across census tracts, the scale is likely to be different than that of a typical US city. Our findings stress the need for caution with regards to the generalizability of the walkability index for contexts that differ from a typicial US city's urban design. Finally, our results highlight the need for more studies examining the context specific associations of the walkability index with physical activity through correlate studies. These studies are essential before attempting to translate the evidence from high income countries for interventions and programs to increase physical activity through environmental changes in other settings, like Mexico or Brazil.

11.5 No association between socioeconomic status and physical activity

Another surprising finding relative to our hypotheses was that after adjusting for other sociodemographic variables, socioeconomic status was not significantly associated with physical activity among Mexican adults. This was true both for objectively measured and self reported activity (domain specific). The variable used to define individual level socioeconomic status derived from a set of questions referring to household characteristics and assets. It did not include education level or motor vehicle ownership, meaning that the variable is a proxy for wealth independent of education level and car ownership. Contrastingly, education was positively associated with vigorous physical activity. This was consistent in both the analysis using objectively measured physical activity, and for the domain specific analysis using self reported data from IPAQ.

11.6 Role of safety from crime for physical activity

We had also hypothesized that safety from crime and access to public spaces such as parks or plazas would be associated with physical activity among Mexican adults. No association was found between physical activity and neighborhood safety perception, while only a marginal inverse association was found between park safety perception and physical activity. Our results showed no association between physical activity and park/plaza availability when participants perceived the parks and neighborhoods to be safe. Yet, when participants perceived their parks as being unsafe, having one park within the 500 meter buffer was negatively associated with physical activity. Therefore, the association of close range park availability with physical activity was being moderated by park safety perception. Further studies are needed to verify these findings.

11.7 Motor vehicle ownership and public transit routes: inverse associations with physical activity among Mexican adults

Another of our hypotheses was to find associations between physical activity and transport related variables. Motor vehicle ownership showed a very strong inverse correlation with objectively measured physical activity, and specifically with moderate intensity physical activity, which is most likely reflective of walking. Yet, the self reported domain specific findings (IPAQ) showed that motor vehicle ownership was only associated with leisure time walking, and not with transport-related or overall leisure time physical activity. It is possible that part of the explanation for the strong correlation between objectively measured moderate physical activity (which includes walking) and motor vehicle ownership is that it was due to more leisure-time activities occurring among non-motor vehicle owners. Nevertheless, it was surprising not to find any associations with transport physical activity. The high prevalence of adults reporting any bouted (at least ten minutes) transport physical activity at all is consistent with disproportionate over reporting of transport physical activity among motor vehicle owners.

On the other hand, the GIS analysis showed a negative association between physical activity and having many transportation routes in a close range neighborhood environment (500 meters). This is likely due to the fact that it is common practice in Mexico to signal a bus to stop anywhere along its route, instead of walking to an official bus stop. This situation is common in Bogota too, where inverse associations between physical activity and neighborhood buses have been reported[104]. In contrast, positive associations of physical activity with bus rapid transit systems (that have formal stops and exclusive lanes) have been reported in Bogotá[16]. Among some of the extra questions that the Latin American IPEN countries added to the final survey, we collected data on "main transportation mode" per participant. An analysis using this variable in association with transport physical activity and accelerometer based activity may provide more information on these associations.

11.8 Self reported versus objectively measured physical activity

Our findings raise some concerns with regards to self reported physical activity. IPAQ is an internationally validated tool, and for our study we relied on the best available evidence of its use for a Latin American context, and followed standardized procedures with trained field workers to apply it in person. Nevertheless, it seems clear that the overestimation of physical activity with respect to accelerometry was very large among Mexican adults. For instance, 46.8 % reported meeting international recommendations (150 minutes per week of moderate to vigorous physical activity) just with transport physical activity, while 34.3 % did so when only considering leisure time physical activity. This contrasted with the prevalence of meeting recommendations when using objectively measured (accelerometer-based) total moderate to vigorous physical activity (58.6 % for total activity, and 13.9% for bouted activity). Given that only activity with a minimum of ten minutes duration is reported with IPAQ, the results obtained should be compared with bouted physical activity levels measured with accelerometers.

The problem may go beyond the excesive overestimation of physical activity using IPAQ. If over reporting occured non-differentially accross the studied sample, we could assume that the findings of IPAQ are still reflective of population physical activity levels, but at a different scale than accelerometer data. Yet, the the association of motor vehicle ownership with physical activity raise a more serious concern. In spite of being the strongest correlate for objectively measured physical activity, when analyzing domain specific (IPAQ-based) physical activity, motor vehicle ownership was only significantly associated to leisure time walking. This association wasn't strong enough to be reflected in the overall moderate-to-vigorous physical activity variable. Furthermore, no association was found between motor vehicle ownership and transport physical activity, while 90% of Mexican adults reported doing at least ten minutes of physical activity for transport. Although in general it is assumed that everyone overestimates when self reporting physical activity, it is possible that among Mexican adults, motor vehicle owners overestimate their transport physical activity in a greater measure than non-vehicle owners. This would explain why no correlation was found between these two variables in spite of the very strong association found with objectively measured physical activity. It seems unlikely that the relationship found for accelerometer-based physical activity and motor vehicle ownership is only driven by leisure time walking.

Although we considered performing a rank-based analysis to understand the validity of the IPAQ data with respect to accelerometry data for Mexican adults, it was decided this was not appropriate. After consultations with physical activity measurement experts we were advised against this. Our study initially assumed that the tool was valid since it had undergone validation studies in more than 12 countries, including Latin American countries. Latin American researchers with over ten years of experience with IPAQ recommend only using the transportation and leisure time domains in Latin American urban settings, and not the home and occupational ones. The main reason why a rank-based analysis or any other validation study would not be appropriate is because we only measured transport and leisure time physical activity. Hence, we don't have a measure for total physical activity, which is what accelerometer data provides. Activity beyond that which is reported is likely still taking place in home based and occupational domains, yielding a significant amount of activity unaccounted for by the self report tool. It is a well known fact that self reported physical activity is over estimated[45,174-176], and among some populations this may be more pronounced for some domains or intensities. For Latin America, the validity and reliability of IPAQ has been reported to be better for leisure time physical activity than transport physical activity, although acceptable levels have been reported for both[134,177]. The use of IPAQ in our study was primarily to understand the correlates, and not the levels, of domain specific physical activity among Mexican adults. An analysis using domain-specific data, as well as GIS and NEWS environmental variables still needs to take place, and may provide valuable information to design and target interventions to promote physical activity among Mexicans.

Although these issues may be specific to Mexico, they also raise some questions with regards to the future of self reported physical activity. Independently of the potential misclassification of transport physical activity among Mexican adults, which needs to be further verified, self reported physical activity levels show much higher variability than accelerometer based activity levels. This translates into larger standard deviations, which in turn make it harder to detect significant associations with sociodemographic and environmental variables. Issues such as these have been extensively discussed by others[43,44,134,178]. In addition, new technologies are emerging. It is possible that these may eventually substitute for self reported physical activity by providing more reliable measures of domain-specific physical activity. These include pattern recognition technologies, that have rapidly evolved over the past few years and are getting closer to being able to precisely estimate the type of physical activity a person is doing[179-181]. The use of Global Positioning Systems (GPS) for physical activity studies is becoming more common in high income countries[182-185]. These two technologies, if used in conjunction with accelerometry, could provide a complete and precise picture of participants' physical activity patterns. The use of these technologies would go beyond duration, intensity and time of activity (measured by accelerometers), but would also include location (start point and end point of bouts) and type (via pattern recognition technology). Nevertheless, these technologies may take a longer time to be available for studies in Latin American settings (and other low-to-middle income countries) due to costs and contextual field work challenges. For this reason self report instruments such as IPAQ will continue to provide the best available measures for domain-specific activity in these settings. Self reported physical activity tools will likely maintain their importance for surveillance and monitoring purposes. IPAQ and other self reported tools represent a valuable, low cost and efficient means to detect changes of levels of activity over time among populations (by being included in National Surveys).

11.9 Physical activity as a continuous variable

This dissertation responded to some of the research priorities highlighted recently by the Lancet series on physical activity[21]. These include performing more correlate studies in lower to middle income countries, having more studies that include objective measures of activity, and having more studies treating physical activity as a continuous variable.

It is generally thought that categorization of physical activity (eg. meeting the WHO recommendations of 150 minutes per week of moderate to vigorous physical activity) provides results that are easier to interpret from a public health perspective. Yet, given the fact that the sociodemographic and environmental correlates of physical activity for Mexican adults were unknown before this study, it was important to understand these relationships in detail[21]. The use of categories makes it more complicated to detect some of the associations with built environment and sociodemographic features. Furthermore, the benefits of physical activity do not occur only for those meeting 150 minutes per week of moderate to vigorous physical activity. Although these are the minimum recommended levels for health, it has been well established that some activity (e.g. 30 minutes per week), even while being below the recommended levels, is better than none[8,136]. Similarly, achieving more than the minimum recommended minutes of weekly physical activity (e.g. 300 minutes per week) yields greater benefits for health than doing 150 minutes per week of moderate to vigorous physical activity[8,134]. The health benefits of physical activity reflect its continuous nature, stressing the need to study it as such rather than categorizing it.

In order to treat physical activity as a continuous outcome we used linear rather than logistic regression models. This approach, although now encouraged[21], is still fairly uncommon. This is especially true for IPAQ data, that is many times treated as ordinal data (since only activity beyond ten minutes duration is reported). Nevertheless, we considered that the domain specific data provided by IPAQ could be treated a continuous variable, not representing total physical activity within the given domain and intensity, but instead, self reported bouted physical activity. In the same way as variables for bouted accelerometry data were used as continuous outcomes, we did so for IPAQ data. We determined this would be appropriate since participants could report any number of minutes of activity above 10. This means that they were not restricted to pre-set categories (e.g. choosing a duration such as 10 minutes, 20 minutes, 30 minutes, 1 hour, etc.). In fact, participants commonly reported values of minutes of activity that were non-divisible by 5 or 10, yielding a true continuous variable. We also ran logistic models for meeting international recommendations or not (150 minutes per week), both for IPAQ and accelerometry data. The results (data not shown) showed fewer significant relationships, which were consistent with the results shown for the linear models. Yet, the former identified more relationships at the significance level of $p<0.05$, highlighting the value of treating physical activity as a continuous outcome.

11.10 Bout analyses for accelerometer-based physical activity

Another contribution of our study was the approach used for the bout analysis. To our knowledge, we are the first to obtain minutes of intensity-specific physical activity occurring within bouts. Currently, software packages that allow for bout analysis (e.g. MeterPlus or Actilife 6.0) require a lower and upper limit of activity intensity expressed in counts per minute. For such reason, when using these software packages, it is only possible to obtain "bouted moderate-to-vigorous physical activity" (without distinguishing how much of it was moderate and how much was vigorous), "bouted moderate activity" (excludes vigorous physical activity, and, if the participant engages in vigorous physical activity during the bout and beyond the allowed break time maximum, the bout is interrupted), and "bouted vigorous activity" (excludes moderate physical activity, and, if the participant engages in moderate physical activity during the bout and beyond the allowed break time maximum, the bout is interrupted).

Our approach was to measure bouted physical activity within the moderate-to-vigorous intensity limits, but at the same time, to calculate how many minutes of moderate physical activity and of vigorous physical activity occurred within bouts. We also calculated how much time corresponded to break time, defined as being below moderate intensity activity. We did so by developing a code in MatLab specific for this purpose. Our analysis for Study II includes these results and shows the composition of bouts, which to our knowledge, has not been reported by others.

11.11 Limitations of using GIS data

It was interesting to find that when park safety perception was positive, the availability or proximity to parks was not significantly and positively associated with physical activity. An intensity and domain specific analysis may show significant associations between park availability and physical activity that were not detected by using a compound variable of total moderate to vigorous activity. Nonetheless, this may also be due to some of the inherent limitations of using GIS data. Although we have precise information on park size and location, GIS does not provide information on accessibility, availability of equipment, quality, cleanliness, aesthetics, or if recreational programs are being offered in a park. Data from both NEWS and from the park audits conducted will be useful to complement and better understand some of these associations. Further quantitative and qualitative information not collected for this study may be required to examine perceptions of park quality and affinity to parks. Although we are using the case of parks as an example to explain the limitations of solely relying on GIS-based data when examining the associations of the built environment with physical activity, similar situations occur with all the neighborhood features measured by GIS data.

11.12 Challenges of conducting this type of research in Latin America (Mexico)

This study also evidenced many of the challenges of conducting this type of research in lower to middle income countries such as Mexico. The quality and availability of GIS data was not always optimal. While several high income countries (US, Canada, Australia, Belgium, UK) are starting to have data on pedestrian enhanced road networks, which only include streets with sidewalks/pedestrian bridges/paths/etc. (i.e. walkable), this level of detail is still not available for Mexico or other lower-to-middle income countries.

Perhaps our biggest challenge was obtaining land use data. Unfortunately, the land use registry office of Cuernavaca refused to provide parcel level land use data in shapefile format, in spite of an institutional request by INSP. Only a shapefile of the parcels with no accompanying database file (attribute table containing data on each parcel) was provided. For land use information, we could only obtain an ArcCad file with land cover data (Appendix 17). This was over imposed and manually drawn into ArcGIS (ArcMap). Then, the proportion of land cover data per buffer was estimated. This was done instead of the standard procedure of obtaining the number of parcels per land use over the total number of parcels intersecting each buffer. This solution was suggested by the IPEN coordinating center and their GIS experts, and was adopted by other lower to middle income countries of IPEN with similar situations.

A similar situation occurred when trying to obtain an objective measure of safety from crime (e.g. number of reported crimes or homicides per census tract, or any other indicator of crime at the census tract level). The police department and other local authorities did not reply to any of our inquiries in spite of having institutional support from INSP.

Although in high income countries it is common practice to recruit participants and conduct research over the mail or through home surveys, this is not common in Mexico. In person recruitment and data collection was necessary, yielding higher complexity with respect to logistics during data collection. These are just some examples of the many challenges of conducting this type of research in Mexico and other lower to middle income countries.

11.13 Further studies with our dataset

Future analyses of the IPEN Mexico dataset will help elucidate many of the initial results reported in Studies II, III and IV. These should include correlation analyses for the association of intensity and domain specific physical activity (accelerometry and IPAQ) with perceived environmental features (NEWS), psychosocial measures and transportation mode. The correlations between perceived and objective environmental data should also take place. More potential interactions and their association with physical activity outcomes should be studied. These should include interactions between perceived and objective environmental features. Potential moderations of the association of environmental features by sex and BMI should also be studied. Multilevel models incorporating the block level audit data could provide information on the associations between the food environment and physical activity outcomes or BMI. The analyses of the audit data of parks, plazas, shopping malls and sports fields may help us better understand the findings of the initial studies and provide evidence to design interventions to promote physical activity.

This was our first attempt to describe the associations of GIS based data and physical activity among Mexican adults. Our findings revealed complicated relationships that may involve thresholds and/or curvilinear associations. New analytical approaches that allow detecting the shapes of the associations (such as generalized linear additive models) may be useful for our data and should be pursued in the near future.

In our initial analysis of the GIS data in association with objectively measured physical activity, we didn't run fully adjusted models (i.e. we adjusted for sociodemographic variables but not for the other environmental variables). This was mainly due to collinearity issues. Fully adjusted models (best-fit) should be attempted in future studies to determine which environmental variables remain strongly associated with physical activity after controlling for others. This would also allow us to eventually develop a context specific "walkability" construct for Mexico. These are just some of the various studies that could take place using this dataset.

11.14 Future studies beyond the scope of our dataset

The IPEN Mexico study provided a rich initial dataset to examine the associations of the built environment with physical activity among Mexican adults from Cuernavaca. Nevertheless, there are many questions that require further data collection to be answered.

The possibility of physical activity not happening for the most part in the home neighborhood environment should be explored. People may go to other neighborhoods to practice leisure time physical activity, and, if they don't work or study in their neighborhood transport related physical activity may be limited.

In the US, Australia and Northern Europe, research is now being conducted studying the association of physical activity with the environment around work, and using GPS and SenseCam techniques to track participants and understand where physical activity takes place[180,182,184-190]. Pattern recognition tools are also emerging and will likely be widespread in the years to come. Longitudinal studies that will allow determination of causality are starting to take place in spite of the many challenges they entail[191-196]. Mexico is still several years or even decades behind in producing evidence on the environmental correlates of physical activity, and it may take more time to start conducting longitudinal studies to determine causality. Other countries in Latin America such as Colombia and Brazil, where more correlate studies have been published, should start conducting this type of research. In Mexico we should start considering using tracking technology such as GPS, and incorporating other new technologies to measure physical activity, while acknowledging that it may present various challenges, particularly due to safety concerns. The majority of participant phone calls received by the IPEN Mexico data collection office were related to inquiries to make sure that the device (accelerometer) was not tracking their location. In spite of this, the successful data collection of high quality data of Mexico, Brazil and Colombia prove that there is a growing network of researchers in the region willing to take on these challenges.

11.15 Policy implications

Our findings showed that, as expected, the walkability concept as defined for standard US cities is not translatable to Mexican cities like Cuernavaca. The inverse association of walkability and its components to physical activity needs further examination before formal policy recommendations for Mexico can take place. Yet, it is clear from our findings that the evidence from high income countries (US, UK, Australia, Canada) is inadequate to guide local programs and policies to promote physical activity through environmental changes in cities like Cuernavaca[21,46].

In spite of the limitations and cross sectional nature of the data, ours is the best available evidence of the associations of the built environment with physical activity among Mexican adults. The availability of longitudinal studies to determine causality for a Mexican urban context will likely take many years to emerge.

While being cautious in our interpretations of the findings, our data does suggest that certain changes may result in beneficits for Mexican adults of Cuernavaca. It seems possible that if park and neighborhood safety perception were improved we could avoid the inverse association of park availability at close neighborhood range with physical activity. Although currently no positive association was found between park availability and physical activity among participants with a positive safety perception, parks represent an opportunity for intervention programs since these facilities are already present in the neighborhoods. Future analyses using the park audits and NEWS data may help us to understand if park accessibility, equipment, aesthetics and quality need to be improved, and/or if programs to promote park use should take place.

Our data showed that women are engaging in significantly lower levels of physical activity than men. Interventions to increase physical activity targetting Mexican women should take place.

Motor vehicle ownership was the strongest correlate of objectively measured physical activity, after controlling for socioeconomic status and all other covariates. This is concerning since car ownership is commonly associated to status in Mexico, while public transit use tends to be stigmatized. When people improve their socioecononomic status it is likely that they will seek to buy a car. Measures to disincentivize car ownership (taxation, etc.) may be considered. Nevertheless, confirmatory studies are needed to provided stronger evidence to convince stakeholders to move in this direction. It will also result instrumental for to provide more convenient alternatives for mobility. These could include an improved transportation system that is safe, modern, and where the use of official transit stops at a reasonable distance from each other is enforced. Bus rapid transit has proven to be associated with higher activity levels in Colombia, and may be part of the solution[16,177]. In Mexico City and Guadalajara bus rapid transit is in place, but its impact on physical activity has not been properly evaluated. Furthermore, the feasibility of using a similar system in medium and small cities in Mexico needs to be examined. Any change to the transportation system, including the enforcement of official stops for public transit would require the provision of appropriate pedestrian infrastructure (sidewalks). The association of sidewalk availability will be available through future analyses of the NEWS data, as is the case for many other variables likely to contribute more information to formulate more and better documented recommendations for Mexican medium sized cities such as Cuernavaca. Finally, the dissemination of this data in outlets beyond scientific journals, but in forums more likely to reach stakeholders and public awareness is important.

12. Conclusion

This dissertation identifies many complicated relationships between the built environment and physical activity from Brazil and Mexico. The environmental correlates of physical activity for adults in Curitiba and Cuernavaca clearly vary in important ways from those known for the "standard US city", from which most of the evidence of the field is derived. This has important policy implications. Our results suggest that interventions and programs in Mexico and Brazil should be based on evidence specific to these contexts. Our study affirms the recommendation by experts in the field that more physical activity correlate studies of this type are needed in middle to lower income countries.

The study in Cuernavaca, Mexico was the first to assess the association between the built environment and physical activity in a representative sample of Mexican adults, and the first to objectively measure physical activity in a representative sample of adults from a Mexican city. This represents an important step towards the development of a strong physical activity epidemiology research field in Mexico. Our study used state of the art methods and was part of the twelve country IPEN study. The data derived from IPEN Mexico will continue to generate valuable evidence towards the advancement of the field, and hopefully, will contribute to the design of interventions, programs and policies to promote environments conductive to higher levels of activity among Mexicans. With this study, Mexico is now part of a select group of Latin American countries along with Brazil and Colombia that are conducting high quality research on the associations between the built environment and physical activity.

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Appendix 1: Map showing location of Cuernavaca, Mexico

Appendix 2: Methods and Measures for The International Physical Activity and Environment Network (IPEN) Study *(IPEN coordinating center document, provided to all IPEN researchers)*

Background

Most studies of built environments have been conducted in the USA, Australia and Western Europe, with recent studies extending findings to Japan (Inoue et al. 2010), Colombia (Gomez et al. 2010) and Brazil (Salvador et al 2012) (Int revs: Owen et al 2010, Sallis et al 2010). Though the results have been mostly consistent, common methods were not employed, self-report measures of physical activity and environmental attributes dominated, and the limited variability in environmental exposures and physical activity within countries may have underestimated the strength of association.

The 11-country International Prevalence Study that included common methods and a wide range of environments (Sallis et al.2009) found stronger associations with physical activity, compared to single-country studies that have limited variability (Sallis et al. 2006; Sallis & Kerr 2006). Despite the strengths of the 11-country study, it was limited by not having objective measurement, the brevity of its self-report measures of physical activity and environmental factors, and by a design that did not maximize environmental variability within and across countries.

Methodological and technical advances now make it possible to conduct significantly improved international studies that allow comparisons across countries. Objective GIS measures of environments and accelerometer-based measures of physical activity are feasible for large-scale application in many countries.(Hagstromer et al. 2010; Riddoch et al. 2004; Martinez-Gomez et al. 2010). By 2004, the use of a common protocol, with state-of-the-science measures and methods to maximize variability in environments was shown to be feasible in the USA (Sallis et al. 2009), Australia (Owen et al. 2007), and Belgium (Van Dyck et al. 2010). These methodological advances set the stage for a coordinated international study with high quality measures.

International evidence about the built environment and physical activity could inform international and national policies and guide the implementation of international health strategies, such as those from the World Health Organization (WHO 2004). An international study design which maximizes variance within countries allows countries to present robust evidence at the national level that could inform local policies. Because some environment and policy associations could generalize across countries and others may depend on each country's context, only international studies using comparable methods can identify the relevant differences. Such findings could inform evidence-based international and country-specific interventions to increase physical activity that could help prevent obesity and other chronic diseases that are high in developed countries and growing rapidly in developing countries (Popkin et al. 2010).

The International Physical Activity and Environment Network (IPEN) Study was funded by the National Cancer Institute (2010-2013) of the National Institutes of Health. In order to accurately assess the strength of association of the built environment with physical activity and weight status, greater environmental variability is required than any one country can provide. Thus, the IPEN Study uses common methods to collect physical activity and built environment data in environmentally- and culturally-diverse countries and to maximize the variance in the built environment within and across countries.

Study Design

The IPEN study is an observational epidemiologic multi-country cross-sectional study. Twelve countries participated: Australia, Belgium, Brazil, Colombia, Czech Republic, Denmark, Hong Kong, Mexico, New Zealand, Spain, the United Kingdom and the United States. Study participants were selected from neighborhoods chosen to maximize variance in neighborhood walkability and SES (in all countries but two). The goal of the study design was to have equal numbers of neighborhoods stratified as follows: high walkable/higher SES, high walkable/lower SES, low walkable/higher SES, and low walkable/lower SES. For selection of study neighborhoods, all countries but one used a neighborhood walkability index that was measured objectively with GIS data at the smallest administrative unit available. A neighborhood walkability index for the whole area of study was first developed (Frank et al. 2010). Then, neighborhoods with lower and higher index scores were selected. (See neighborhood selection below). In nine countries participants were recruited across the seasons to control for variations in weather that may affect PA. In six countries participants were recruited equally across the neighborhoods by season.

Neighborhood definitions and selection

The smallest administrative unit that represented a neighborhood-level geographic scale was selected for the development of the walkability measures for neighborhood selection. The details for each country can be found elsewhere (Kerr et al. 2012). For every administrative unit across the study cities or regions, a walkability index was derived as a function of at least two variables: (a) net residential density (ratio of residential units to the land area devoted to residential use); (b) land use mix (diversity of land use types per block; normalized scores ranged from 0 to 1, with 0 being single use and 1 indicating an even distribution of area across several types of uses – e.g., residential, retail, entertainment, office, institutional); and (c) intersection density (connectivity of street network measured as the ratio of number of intersections with three or more legs to land area of the administrative unit). In five countries, retail floor area ratio (FAR) was also employed as a proxy for pedestrian-oriented design. The walkability index is described in more detail elsewhere (Frank et al 2010, Cerin et al. 2008)

For neighborhood selection, standardized scores for each measure were calculated separately for each city in each country, so that residential areas could be selected to maximize the variability within countries. In the USA, the walkability index used for block group selection was a weighted sum of z-scores of the four normalized urban form measures as stated in the following expression (some countries did not double-weight intersection density):

Walkability = [(2 x z-intersection density) + (z-net residential density) + (z-retail floor area ratio) + (z-land use mix)].

Administrative units were ranked and divided into deciles on the normalized walkability index for each city and household-level income data from the census. Four groups of residential areas were determined: high walkability- high income; high walkability-low income; low walkability-high income; low walkability-low income. Administrative units in the bottom four and top four deciles represented "low-" and "high-walkable" categories, respectively. In the USA, the 2nd, 3rd, and 4th deciles constituted the ‘‘low income” category and the 7th, 8th, and 9th deciles made up the ‘‘high income” category. The 5th and 6th deciles were omitted to create separation between the categories. The neighborhood-selection techniques employed in each country can be found elsewhere (Kerr et al. 2012).

Four countries used the decile approach to create variability in walkability, three employed a median split, and the remaining countries used quintiles, quartiles or tertiles.

Participant Recruitment

The required recruitment strategy was systematic selection of participants with addresses in the chosen neighborhoods. Adults living in the selected neighborhoods were contacted and invited to complete surveys on their physical activity and perceptions of the environment. Study dates ranged from 2002 to 2011. Age ranges for recruitment ranged from 16-94. Only 3 countries had a wider age range, so analyses were performed on those aged 18-66, the majority of the study population. Four countries recruited and conducted data collection by phone and mail, and seven of the studies contacted households in person. Databases of resident addresses from commercial and government sources were used for the phone and mail recruitment. For the in-person recruitment, standard procedures for identifying households and participants within a household were employed; e.g. every *n*th house was selected and residents with the most recent birthday were recruited (Kish, 1949). In Hong Kong, intercept interviews were conducted in residential areas where individual addresses were not available, for example in large apartment buildings. Six countries used monetary incentives, and four countries provided non-monetary incentives including feedback on physical activity (Mitas et al. 2007). Further details for the participant recruitment techniques and response rates across countries can be found elsewhere (Kerr et al. 2012).

<u>Participant Assessment</u>
Seven countries met with participants in person to deliver study materials, the others employed mail and online surveys. Five countries employed interviews to collect survey data. Participants from five countries completed the survey after wearing the accelerometer, the others before. One country did not collect accelerometer data. Sample sizes per country for surveys ranged from 600 to over 2000 and almost 200 to over 2000 participants wore accelerometers.

Quality control and comparability

All investigators completed the San Diego State University Institutional Review Board training, the NIH Fogarty International Center ethical requirements, and their own country's ethics requirements. All participants provided informed consent for participation in their country-level study. Participant confidentiality for pooled data was maintained by de-identification using numeric identification codes rather than names. Address-based variable creation was conducted in each country and no address information was transmitted to the coordinating center. All data transfer utilized a secure file sharing system.

All survey data was assessed for completeness by sites and double checked by the coordinating center. Countries provided back translations of surveys and comparability of item wording, response options, and number of items was assessed by two independent raters, who were experts in the area. Only comparable items were included in the scales created below.

All accelerometer data was provided in pre-processed format (i.e., DAT or CSV files). Trained researchers at the coordinating center checked every participant day for valid data and wearing time using MeterPlus software version 4.3 (www.meterplussoftware.com). Protocols for screening data were developed for different accelerometer models, methods of deployment, available documentation of wearing time, and cultural differences in activity patterns (MANUAL REF forthcoming). All data were scored using common parameters.

GIS data was collected according to a written protocol provided by the coordinating center (Adams et al. 2012). Content validity of the data sources, constructs, and final variables was checked by two independent expert raters.

Demographic variables [to be used as covariates in all analyses]

Demographic items taken from national surveys were used to assess age, gender, education, marital status. All countries collected these data. Other data were collected but they were not comparable across countries. While types of education varied by country, all country data could be categorized into "university degree", "high school diploma", or "less than high school diploma". Other variables not collected in all countries included annual household income, number of people in the household, race/ethnicity, automobile ownership, and number of years living at this address. The format of demographic variables was often country-dependent and based on legislative requirements or established local standard formats (e.g. census race groupings). Some countries did not collect individual income data as this is not considered an appropriate question. 'Education' is most commonly used in international studies as a proxy for SES and was required as a minimum for the demographic variables in the IPEN study. Common demographic variables were employed in all models as covariates.

Physical Activity Outcome Measures
<u>Accelerometers</u>

The outcome variables "total minutes in moderate-to-vigorous intensity physical activity" (MVPA) and "total minutes in sedentary behavior" were measured objectively with accelerometers. Accelerometers are small tamper-proof electronic devices, about the size of a pager, worn on a belt around the waist. Reliability and validity have been extensively documented (Freedson & Miller, 2000; Welk, 2002). In three countries accelerometers were mailed to participants and in others they were hand-delivered and retrieved. Country participants were asked to wear an accelerometer with the belt oriented above the right hip for 7 days during waking hours when not engaged in water activities (e.g., swimming, showering). Different accelerometer models were used in the study. All countries but one used an ActiGraph accelerometer [Pensacola FL]. New Zealand used the Actical accelerometer [Philips Respironics]. Of the devices manufactured by ActiGraph, there were several models employed including the older generation 7164 and 71256 models, and some newer generation devices such as the GT1M, the ActiTrainer and the GT3X. Although some of these devices allow data collection on 3 axes, only single, vertical axis data were included in analyses. Previous studies (Kozey et al. 2010) and our own analyses revealed that the data collected from these devices are not exactly comparable so 'model' was included as a covariate in all analyses using accelerometer data.

Accelerometer data were either collected with or aggregated to 1-minute epochs. Data were processed using MeterPlus version 4.3. Non-wear time was defined as 60 or more minutes of consecutive '0' activity counts and daily wear time was defined as total possible time (i.e., 24 hours) minus non-wear time. Although all wear days were scored, only days consisting of at least 10 wearing hours were coded as valid days. Each day of data was examined for anomalies that could indicate device malfunction as well as days spent in the mail. Mail days and participants with data indicating device malfunction were excluded. Minute-by-minute activity counts were converted to minute estimates of sedentary (activity count <101), light (101-1951), moderate (1952-5724), and vigorous (5725+) intensity physical activity (Matthews, Freedson 1998). For each activity category, the total number of minutes was summed across valid wearing days and divided by the number of valid days to compute the average minutes per valid day in each activity category.

Additional steps were taken to ensure the data were comparable. Details can be found here [Manual in progress] but briefly, all data were screened and scored by trained and certified researchers at the Coordinating Center using a written protocol. Certification required reliable determinations of wearing days, mail days, other non-wearing days, and abnormal data patterns across a range of accelerometer models and deployment methods compared to a gold standard rater. An in-house study demonstrated that 32.7% of mail days recorded 10 or more 'valid' hours in the 7164/71256 models. Therefore, particular attention was paid to the accurate identification of mail days. Attention was also paid to data patterns that may have reflected different cultural patterns (e.g. shift work and night time physical activity) or wearing patterns (e.g., sleeping with the accelerometer) and protocols were developed to process these files [Manual ref forthcoming].

IPAQ

To test hypotheses about the relation of specific environmental variables to physical activity for recreational and transportation purposes, the International Physical Activity Questionnaire (IPAQ) self-administered long version was used, because it assesses activities done for multiple purposes (Craig et al., 2003). Over the past seven days, participants reported the days per week and minutes per day of various categories of occupational, household, transportation, and recreation physical activity. Daily hours of sitting were reported as well. The IPAQ was evaluated in 14 studies in 12 countries on five continents and found to have good test-retest reliability. Validity was tested by correlations with ActiGraphs, and the results (median Spearman correlation of .30) were comparable to other self-reports (Craig et al., 2003).

Items from the long version of the International Physical Activity Questionnaire (IPAQ; http://www.ipaq.ki.se), were used to assess transportation and leisure walking. The transportation walking items queried number of days during the last week spent walking at least 10 min from place to place and the typical minutes per day. Similarly structured items queried time in leisure walking. Total minutes per week (days X minutes per day) were calculated.

Seven countries collected the IPAQ using interview techniques. Three countries provided an online version in addition to or instead of mailing out paper copies. Differences in administration mode were adjusted for in analyses. Seven countries used techniques to probe participants for realistic responses. This was also included as a covariate.

Built Environment Survey Measures

Perceived Environment – NEWS-A

Many studies have established the importance of resident perceptions of the neighborhood environment (Saelens & Handy, 2008) including the ability to assess concepts not included in common GIS databases, such as aesthetics and safety. Studies also demonstrated that objective GIS measures were not always correlated with residents' perceptions (Adams, et al 2009). The Neighborhood Environment Walkability Scale (NEWS) and an empirically derived abbreviated version (NEWS-A) (Cerin, et al., 2006) assess perceived residential density, land use mix (diversity and access), street connectivity, walking/biking infrastructure, aesthetics, traffic safety, and crime safety. Proximity to both public and private recreation facilities is also measured by the NEWS. Reliability and validity have been documented in several countries (Cerin et al., 2007; De Bourdeaudhuij, Sallis & Saelens, 2008; Leslie et al., 2005; Malavasi et al., 2007; Saelens et al., 2003). Most scales had test-retest reliability ICC's > .75.

The original versions of the NEWS and its abbreviated form (NEWS-A) comprise 67 and 54 items, respectively (Saelens et al., 2003; Cerin et al., 2006). They gauge the following perceived neighborhood attributes: (1) residential density; (2) land use mix – diversity; (3) land use mix – access; (4) street connectivity; (5) infrastructure and safety for walking; aesthetics; (6) traffic safety; (7) safety from crime; (8) streets not having many cul-de-sacs; (9) physical barriers to walking; (10) parking difficult in local shopping areas; and (11) hilly streets in the neighborhood. Two study sites employed the original NEWS (USA – Baltimore; USA – Seattle); another site used the original NEWS-A (New Zealand); while the remaining 10 sites used various combinations of NEWS/NEWS-A items, in their original or slightly modified form. All study sites included at least some items gauging the first nine neighborhood attributes listed above. All non-English versions of the instrument were forward-translated from English into the local language and back-translated into English. A panel of experts reviewed all versions of the NEWS/NEWS-A and evaluated item content equivalence.

Details of the items and response scales for each country can be found in a paper under development by Dr Cerin. Individual-level, site-specific measurement models of the NEWS/NEWS-A were derived by conducting separate confirmatory factor analyses (CFA) for each site on the responses to factor-analyzable items (all items except for those measuring Residential density and Land use mix – diversity). Area-level clustering effects arising from the two-stage sampling procedures used in all studies were accounted for by conducting CFAs on within-area variance/covariance matrices quantifying estimates of individual-level relationships between the items (Cerin et al., 2010). Details of the scales and scoring can be found in the paper under development by Dr Cerin. Please check with coordinating center for latest version of scoring when finalized.

Other built environment variables (available for at least 4 countries)

Social cohesion was adapted from studies of collective efficacy (Sampson et al 1997). Participants rated 5 items on a 5 point scale (strongly disagree to strongly agree). Items included "people around my neighborhood are willing to help their neighbors", this is a close-knit neighborhood". No definition of "neighborhood" was provided.

The Home Environment Scale lists 15 supplies or pieces of equipment that can be used for physical activity; for example a bicycle or weight lifting equipment. Participants check whether the equipment was available in their home, yard or apartment complex. (Kerr et al. 2008)

The Convenient Facilities Scale lists 18 places where one could exercise and asks whether they are on a frequently traveled route or convenient to home or work ie. within a 5 minute drive or a 10 minute walk. (Sallis et al. 1997)

Reasons for Moving here

To adjust for walkability-related self-selection of neighborhoods, a scale (internal consistency alpha = 0.76) of ''reasons for moving'' to the current home was computed by averaging ratings of importance of three items; ''desire for nearby shops and services,'' ''ease of walking,'' and ''closeness to recreational facilities'' (adapted from Frank et al., 2007).

Neighborhood Satisfaction has been shown to be a mediator of the relationship between physical activity and walkability (Van Dyck 2011). It was measured with a 17 item scale. Participants rated whether they were satisfied or dissatisfied on a 5 point scale. Example items include whether you are satisfied with “the highway access from your home”, “the quality of schools”, “the noise from traffic”. (Zaleski 2003)

Other Survey Measures (in at least 4 countries)

Self-reported sedentary behavior.

Two questions about time spent sitting were taken from the International Physical Activity Questionnaire (IPAQ), which was developed to measure various types of physical activity and has been shown to have good test-retest reliability and validity that are comparable to other measures (Craig et al., 2003). Test-retest reliability of total sitting time was good, with 17 of 22 Spearman correlations greater than .70. Validity assessed by correlations with minutes of accelerometer scores <100 counts per minute ranged from .17 to .49 (Craig et al., 2003; Rosenberg, Bull, Marshall, Sallis, & Bauman, 2008). The two questions were, “During the last 7 days, how much time did you usually spend sitting on a *weekday*?” and “During the last 7 days, how much time did you usually spend sitting on a *weekend* day?” Participants indicated the number of hours and minutes per day they spent sitting. The minutes sitting per weekday were multiplied by 5 and added to the minutes sitting per weekend day multiplied by 2, to yield total minutes per week sitting. Twelve countries including the IPAQ sitting measure in their survey

Seven sitting-related behaviors were assessed by survey. Participants indicated how often during the “past 7 days” (not including while at work) they did the following activities: used computer/internet for leisure; played video games; spent time reading; sat and talked with friends (not on the phone); listened to music or talked on the phone; watched television or videos; and drove or rode in a car. For each behavior, participants reported both the number of days and the typical minutes per day. The product indicated the total minutes per week they participated in each sedentary behavior. A very similar 9-item survey was found to have good test-retest validity (ICC’s ranged from .67 to .86 for the 7 items that were the same or similar to those used in the present study), and validity was supported by correlations with IPAQ-measured sitting time, accelerometer-measured sedentary time, and measured body mass index (Rosenberg et al., 2010). Seven countries collected sedentary behavior measures.

Body mass index

Several studies have documented higher prevalence of overweight in people living in low-walkable neighborhoods (Frank et al., 2004; Saelens et al., 2003 AJPH), so self-reported height and weight were assessed. Self-reported heights and weights are strongly correlated with measured variables (Black et al., 1998; Stewart, 1982). Adults’ self-report of weight and height is routinely used in epidemiological research, with high reliability of such reports (Stewart, 1982; Smith et al., 1989). Self-reported weight and height and corresponding measured weight and height correlations are routinely greater than .90 (Stewart, 1982; Wing et al., 1979). Although underreporting of absolute weight is common particularly among heavier individuals, a recent study documented an average difference of less than 5 lbs. between adults’ measured and self-reported weights, with approximately 95% of the sample reporting within 13 lbs. of their measured weight (Black et al., 1998).

In all 12 countries, participants reported their height and weight or were measured in person using standard techniques, in order to calculate BMI [kg/m^2]. Measurement mode will be included as a covariate in analyses.

Quality of life

Maximizing quality of life is often considered to be the ultimate goal of health professions, and this outcome is relevant for the planning field as well. *Quality of life (QoL)* was measured as an exploratory outcome with most countries employing standard items from the SF12 (Brazier & Roberts, 2004) or WHO Quality of Life scale (WHO, 1996). The QoL measures were 1) How would you describe your general health? And, 2) How satisfied are you with your life as a whole? Eight countries collected QoL data.

Psychosocial Measures

Ecological models look at all levels so both environmental and psychosocial variables need to be studied. In the health field, variables such as self-efficacy, social support, benefits and barriers, enjoyment, and stage of change are among the most consistent psychosocial correlates of physical activity (Sallis & Owen, 1999).

Three psychosocial variables were included to allow exploration of potential cultural differences related to physical activity that may have independent associations with outcomes or may interact with built environment variables. Self-efficacy, barriers, and social support may reflect cultural differences in beliefs and social behaviors (Hovell et al, 2009; Sallis et al., 1989; Sallis et al., 1988; Sallis et al., 1987; Calfas et al., 1994).

<u>Self-efficacy for physical activity (PA)</u>

Self-efficacy or confidence in one's ability to be physically active was assessed by 3-item self-report. Items included "*I do moderate physical activity even though I am feeling sad or highly stressed*". This measure of physical activity self-efficacy has good test-retest reliability (Sallis et al., 1998) and has been shown to be highly correlated with both vigorous physical activity and explained significant, albeit small amounts of, variance in walking behavior (Sallis et al., 1998).

<u>Social support for PA</u>

Social support for exercise was measured with a previously validated 6-item scale. Participants separately rate how often over the last three months their friends and family have done supportive behaviors such as, "did physical activities with me." Retest reliability is high (Hovell et al., 1989), and validity has been repeatedly supported by correlations with walking (Hovell et al., 1989) and vigorous physical activity (Sallis et al., 1989).

<u>Barriers to PA</u>

Participants were asked to rate how often 15 barriers prevent them from being active. Items include "lack of time," "lack of good weather," and "fear of injury". Concurrent validity for this scale was demonstrated by significant correlations between the barriers score and vigorous physical activity (Sallis et al., 1989; Calfas et al., 1994). This measure of barriers has good internal consistency within specific factors (Calfas et al., 1994).

<u>OBJECTIVE ENVIRONMENT - GIS VARIABLES</u>

[Note: this is a draft that will be expanded upon in the IPEN GIS Methods paper in preparation, please reference this in future]

Buffers

Two neighborhood buffers defined as 500 and 1000 meters were developed in GIS around each individual's home address in each country. Two sizes were examined because the optimal buffer size has not been clearly established in the literature. Additionally, while all countries had the capacity to create street-network buffers 4 other countries had spatial data to develop street-network buffers that included pedestrian pathways. Two buffer types were created and labeled as "street network" and "pedestrian-enhanced" buffers. Environmental variables were computed in GIS around each individual's home address for both the street network and pedestrian-enhanced buffers defined by 500 and 1000 meters.

Required/desired variables

Some countries had access to detailed GIS data while others had access to less detailed data. This difference in access was not limited to specific countries but was more related to specific variables. Thus, IPEN needed an organizing framework to arrive at a common protocol across GIS variables. A solution was to arrive at a "least common dominator" approach for each GIS variable. In some cases, GIS teams with more detailed datasets for a variable were asked to develop basic versions of variables to be more comparable to other countries. In other cases, teams with more basic data were asked to find alternative ways to improve the detail for a specific variable by using another data source or supplementing the dataset. Additionally, the IPEN coordinating center needed to provide common guidance on GIS definitions and procedures across countries, and record several possible choice points for organizing and processing GIS data during variable creation. The solution was to develop a set of GIS Templates for 11 core built environment concepts considered a priority for IPEN.

The IPEN GIS Templates aimed to provide GIS teams with specificity for common concepts, clear and consistent definitions, guidance on preferred variables and procedures and a place to document necessary deviations the protocol. IPEN Templates have been packaged and made available for public use (Adams et al. 2012). Briefly, core GIS Templates included: 1) Street Network Buffers, 2) Residential Land Use 3) Retail Land Use, 4) Civic and Institutional Land Use, 5) Entertainment Land Use, 6) Recreation Land Use, 7) Food-related Land Use, 8) Street Connectivity, 9) Public Transit Access, 10) Private Recreation Facility Access Access, and 11) Park Access. Templates are available at:
www.ipenproject.org/documents/methods_docs/IPEN_GIS_TEMPLATES.pdf

Specific nomenclature was developed for the Templates to aid in the GIS variable creation process. Templates provided guidance on required, desired, and speculative GIS variables and procedures. A Required variable meant that this variable had been judged by the Coordinating Center to be the lowest common denominator (most likely to be completed) across all countries. All countries were asked to attempt to produce required variables, if information on that built environment factor was available. Desired variable meant that this variable had been judged to be of greater importance or higher quality. Desired variables were calculated *in addition* to the required variables. Speculative variable meant that it was unknown whether this variable could be completed by a subset of countries. Speculative variables were calculated but considered exploratory. However, these variables may be very important for future consideration.

The Coordinating Center also provided a hierarchy and nomenclature for procedures. These recommendations for procedures were not enforced as strictly as the definitions because GIS analysts made decisions that were appropriate given the unique nature of their datasets. Recommended procedures were promoted over acceptable procedures. Recommended procedures were judged to be more precise methods of calculating the variables. Acceptable procedures were used if recommended procedures could not be used, or if recommended procedures had been deemed inappropriate for country-specific reasons. Acceptable procedures were judged less accurate than desired procedures, but acceptable to use. Speculative procedures should have only be used if required or desired procedures could not be accomplished.

Each country's GIS team was instructed to adhere closely to the set of Templates and teams documented their decisions during the variable creation process by answering a series of questions at the end of each template for each variable, after they completed the work to create a variable or set of variables. These questions were designed to ensure a transparent GIS variable creation process and to make explicit specific areas were GIS analysts deviated from IPEN operational definitions during variable creation. For example, for each GIS variable we asked whether the GIS analyst adopted the definition provided in the template and whether they deviated from it in any way, either voluntarily or because of their dataset attributes were not suitably specific. Further, because it is possible to use different procedures in GIS to create similar variables, we asked analysts to document their specific procedures (e.g. selecting parcels if the parcel centroid fell completely within a buffer vs if any area of the parcel fell within the buffer). Sometimes these procedural differences were unavoidable because of limitations in attribute information available in each country. Nonetheless, such decisions were documented to make them explicit for the IPEN comparability evaluation.

Comparability evaluation

IPEN used a two-step process to ensure quality control of the GIS datasets. As each country provided the coordinating center with their answers to template questions and computed GIS variables, a preliminary check was preformed by the coordinating center to ensure completeness and resolve obvious comprehension errors. The coordinating center provided feedback to the individual countries on template completeness, and any additional requests were made of the countries to clarify or provide more information on the data, definitions, or processes used. Once all countries provided their final templates and GIS data, the coordinating center initiated a cross-country comparability evaluation. Two raters examined template answers across countries for each GIS construct, and compared template answers to the definitions and required and desired variable requests. Additionally, the two raters highlighted any deviations in responses to template questions from one or a subgroup of countries and noted any concerns about comparability. The raters also provided their suggestions to minimize the comparability concerns. Their evaluations and solutions were combined and discussed with the IPEN co-investigators and coordinating center staff to ensure they aligned with other components of the study. Solutions required that a country or subset of countries recalculate their GIS variables or further clarify their work to ensure comparability across countries.

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Appendix 3: Final survey used for IPEN-Mexico study

COMPRENDIENDO LOS FACTORES AMBIENTALES CORRELACIONADOS A LA ACTIVIDAD FÍSICA EN ADULTOS (20-65 AÑOS) EN UNA CIUDAD MEXICANA (CUERNAVACA)

Formulario No. **CÓDIGO** __ __ __ __ __ __ __ __ __ __ __ __
Acelerómetro No. ___________________________
Fecha (dd/mm/aa): ___/___/___ **Encuestador** ___ ___
Supervisor ___ ___
Nombre de la colonia__________________________ **Número de manzana** _________________
Número de casa _____________________________ **Número interior** _____________________
Nombre del entrevistado _____________________
Hora de inicio: (**Hora/minutos**): ____/___
Hora de finalización: (**Hora/minutos**): ____/___

A. IDENTIFICACIÓN DE LA VIVIENDA

1. ¿Cuál es la dirección actual de su casa?
____

B. TRANSPORTE

Parte 1: Transporte motorizado

2. De los siguientes vehículos, ¿Cuáles usó con mayor frecuencia en la última semana? (**Leer**: puede responder más de uno)

Transporte	Días a la semana	Horas al día	Minutos al día
a. Camión/Ruta	__ __	___ ___	___ ___
b. Taxi	__ __	___ ___	___ ___
c. Coche	__ __	___ ___	___ ___
d. Moto	__ __	___ ___	___ ___
e. Otro ¿Cuál?	__ __	___ ___	___ ___

3. ¿Cuántos días utiliza el transporte público?
0 ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) Algunas veces al mes ( )

4. ¿Cuántos días utiliza transporte particular (coche o moto)?
0 ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) Algunas veces al mes ( )

5. Cuando sale de su casa, ¿Cuál es el primer medio de transporte motorizado que utiliza?
____

6. ¿Cuánto tiempo debe caminar para llegar hasta su primer medio de transporte motorizado?
___ ___ Minutos ___ ___ Horas

7. ¿Cuál es el último medio de transporte motorizado que utiliza antes de llegar a su destino final? __________________________

8. ¿Cuánto tiempo debe caminar desde su último medio de transporte motorizado hasta su destino final?
___ ___ Minutos ___ ___ Hora

C. ACTIVIDAD FÍSICA

Parte 1: Actividad física relacionada con el transporte

9. **Lea**: Ahora piense cómo se desplazó de un lugar a otro, en los últimos 7 días. Por ejemplo ida y regreso del colegio, del trabajo, hacer mandados, pagar cuentas, entre otros.

10. Durante los últimos 7 días, ¿Se transportó en un vehículo motorizado como ruta, taxi, automóvil o moto?

Si.................................... ( ) 1
No.................................. ( ) 2
Pase a pregunta 13
No sabe/ no responde..... ( )
Pase a pregunta 13

11. ¿Cuántos días se transportó en un vehículo motorizado como ruta, taxi, automóvil o moto?

____ ____ Días por semana [Si la persona entrevistada responde 0, pase a la pregunta 19]
____ No sabe/No está seguro (a)
____ Se rehúsa contestar

12. ¿Cuánto tiempo pasó normalmente en uno de estos días viajando en ruta, taxi, automóvil o moto**?**

____ ____ Horas por día
____ ____ ____ ____ Minutos por día
____ No sabe/No está seguro (a)
____ Se rehúsa contestar

[**Guía del entrevistador:** Se necesita un promedio de tiempo al día. Si la persona entrevistada no puede responder porque la cantidad de tiempo empleado varía ampliamente día a día, pregunte ¿Cuál es la cantidad total de tiempo que usted empleó en los últimos 7 días viajando en un vehículo de motor?]

____ Horas por semana
____ ____ ____ ____ Minutos por semana
____ No sabe/No está seguro (a)
____ Se rehúsa contestar

13. ***Lea***: Ahora vamos a hablar únicamente de las caminatas que usted hizo para ir hacia y desde su trabajo, para hacer mandados o ir de un lugar a otro, por lo menos durante 10 minutos seguidos.

14. Durante los últimos 7 días, ¿Caminó por lo menos 10 minutos seguidos para ir de un lugar a otro, para a hacer mandados, ir al colegio o universidad o ir y venir de su trabajo?

Si.................................... ( ) 1
No.................................. ( ) 2
Pase a la PARTE 2 Pregunta 16.B1
No sabe/ no responde..... ( ) 3
Pase a la PARTE 2 Pregunta 16.B1

15. ¿Cuántos días caminó por lo menos durante 10 minutos seguidos para ir de un lugar a otro?

____ Días por semana [Si la persona entrevistada responde 0, pase a la pregunta 16.B1]
____ No sabe/ No está seguro (a) [Pase a la pregunta 16.B1]
____ Se rehúsa contestar [Pase a la pregunta 16.B1]

[**Clarificación del entrevistador:** piense únicamente en la caminata que usted hizo por lo menos durante 10 minutos continuos].

16. ¿Cuánto tiempo caminó normalmente en uno de esos días para ir de un lugar a otro, por lo menos durante 10 minutos seguidos?
____ ____ Horas por día
____ ____ ____ Minutos por día
____ No sabe/ No está seguro (a)
____ Se rehúsa contestar

[**Clarificación por parte del entrevistador:** Piense únicamente en la caminata que usted hizo por lo menos durante 10 minutos continuos].
[**Guía del entrevistador:** Se necesita un promedio de tiempo al día. Si la persona entrevistada no puede responder porque la cantidad de tiempo empleado varía ampliamente día a día, pregunta, ¿Cuál es la cantidad total de tiempo que usted empleó en los últimos 7 días caminando de un lugar a otro?].
____ ____ Horas por semana
____ ____ _____ _____ Minutos por semana
____ No sabe/ No está seguro (a)
____ Se rehúsa a contestar

LEER: Las siguientes preguntas se refieren al tiempo que invirtió desplazándose en bicicleta hasta y desde su trabajo, para hacer mandados o para ir de un lugar a otro. Únicamente inclúyalo si lo hizo durante por lo menos 10 minutos seguidos.

16.B1 Durante los últimos 7 días, ¿<u>Cuántos día</u>s anduvo en bicicleta por lo menos durante 10 minutos seguidos para ir de un lugar a otro, <u>sin propósitos de recreación y deporte</u>? Incluya ir a lugares como su trabajo, supermercados, cines, bancos, sitios de estudio, entre otros.

____ ____ Días por semana (0-7 días) **(Si la respuesta es 0, pase a la pregunta 17)**
____ No sabe/No está seguro(a) / variable **(pase a la pregunta 17)**
____ Se rehúsa contestar **(pase a la pregunta 17)**

LEER: Por favor piense únicamente en el tiempo en que anduvo en bicicleta por lo menos durante 10 minutos seguidos

16.B2 ¿Cuánto tiempo dedicó normalmente en uno a andar en bicicleta por lo menos durante 10 minutos seguidos para ir de un lugar a otro <u>sin propósito de recreación y deporte</u>?

____ ____ Horas por día **(pase a la pregunta 17)**
____ ____ ____ Minutos por día **(pase a la pregunta 17)**
____ No sabe/No está seguro(a) /Variable **(pase a la pregunta 17)**
____ Se rehúsa contestar **(pase a la pregunta 17)**

LEER: Por favor piense únicamente en el tiempo en que anduvo en bicicleta por lo menos durante 10 minutos seguidos

[**Guía del entrevistador:** Se necesita un promedio de tiempo al día. Si la persona entrevistada no puede responder porque la cantidad de tiempo empleado varía ampliamente día a día, pregunte:]

¿Cuál es la <u>cantidad total</u> de tiempo que usted empleó andando bicicleta <u>en los últimos 7</u> días para viajar de un lugar a otro?
_____ ____ ____ Horas por semana
____ ____ ____ Minutos por semana
____ No sabe/No está seguro (a)

____ Se rehúsa contestar

Parte 2: Actividad física relacionada con la recreación, el deporte y el tiempo libre

17. ***Lea*:** Vamos a hablar sobre las actividades físicas que usted hizo en los últimos 7 días únicamente durante su tiempo libre por recreación, deporte, ejercicio o pasatiempo. Le recuerdo que tiempo libre es el tiempo que se tiene para uno mismo, el tiempo en el que usted define voluntariamente que hacer. Por favor, no incluya las actividades que usted ya haya mencionado.
18. Sin incluir caminatas que usted ya haya mencionado, durante los últimos 7 días, ¿Caminó por lo menos durante 10 minutos seguidos, por recreación, deporte, o en su tiempo libre?

Si.................................... ( ) 1
No.................................. ( ) 2 ***Pase a la pregunta 21***
No sabe/ no responde..... ( ) 3 ***Pase a la pregunta 21***

¿Cuántos días caminó por lo menos durante 10 minutos seguidos, por recreación, deporte, o en su tiempo libre?
___ Días por semana [Si la persona entrevistada responde 0, pase a la pregunta 21]
___ No sabe/ No está seguro (a) [Pase a la pregunta 21]
___ Se rehúsa contestar [Pase a la pregunta 21]

[**Clarificación por parte del entrevistador**: Piense únicamente sobre la caminata que usted hizo por lo menos durante 10 minutos continuos.]

19. ¿Cuánto tiempo caminó normalmente en uno de esos días por recreación, deporte, o en su tiempo libre por lo menos durante 10 minutos seguidos?

___ ____ Horas por día
___ ____ ____ Minutos por día
___ No sabe /No está seguro (a)
___ Se Rehúsa contestar

[**Clarificación por parte del entrevistador**: Piense únicamente sobre la caminata que usted hizo por lo menos durante 10 minutos continuos.]
[**Guía del entrevistador**: Se necesita un promedio de tiempo al día. Si la persona entrevistada no puede responder porque la cantidad de tiempo empleado varía ampliamente día a día, pregunte: ¿Cuál es la cantidad total de tiempo que usted dedicó en los últimos 7 días a caminar en su tiempo libre?]
___ ___ Horas por semana
___ ___ ___ ___ Minutos por semana
___ No sabe/No está seguro(a)
___ Se rehúsa contestar

20. ***Lea*:** Ahora piense sobre <u>actividades vigorosas</u> que requieren un gran esfuerzo físico que usted haya hecho en su tiempo libre. Recuerde que las actividades vigorosas hacen que usted respire mucho más fuerte de lo normal y pueden incluir: hacer aeróbicos, correr, nadar rápido, jugar fútbol, jugar basketball, voleyball, escalar, deportes de combate y hacer spinning, entre otros.

21. Durante los últimos 7 días, ¿Realizó actividades físicas vigorosas en su tiempo libre, por lo menos durante 10 minutos seguidos? No incluya actividades que usted ya haya mencionado.

Si.................................... ( ) 1
¿Cuáles?, ***indague un poco más acerca de cada actividad reportada***
No.................................. ( ) 2
Pase a la pregunta 25

No sabe/ no responde..... ( ) 3
Pase a la pregunta 25

22. ¿Cuántos días realizó actividades físicas vigorosas en su tiempo libre por lo menos durante 10 minutos seguidos?
___ Días por semana [Si la persona entrevistada responde 0, pase a la pregunta 25]
___ No sabe/ No está seguro (a) [Pase a la pregunta 25]
___ Se rehúsa contestar [Pase a la pregunta 25]

[**Clarificación por parte del entrevistador**: Piense únicamente sobre esas actividades físicas vigorosas que usted hizo por lo menos durante 10 minutos continuos.]

23. ¿Cuánto tiempo realizó actividades físicas vigorosas normalmente en uno de esos días por lo menos durante 10 minutos seguidos en su tiempo libre?
___ ___ Horas por día
___ ___ ___ Minutos por día
___ No sabe/No está seguro(a)
___ Se rehúsa contestar

[Clarificación por parte del entrevistador: Piense únicamente sobre esas actividades físicas que usted hizo por lo menos durante 10 minutos continuos.]

[**Guía del entrevistador**: Se necesita un promedio de tiempo al día. Si la persona entrevistada no puede responder porque la cantidad de tiempo empleado varía ampliamente día a día, pregunte: ¿Cuál es la cantidad total de tiempo que usted dedicó en los últimos 7 días a hacer actividades físicas moderadas en su tiempo libre?]

___ ___ Horas por semana
___ ___ ___ ___ Minutos por semana
___ No sabe/No está seguro(a)
___ Se rehúsa contestar

24. ***Lea***: Ahora, piense en actividades físicas que usted haya hecho en su tiempo libre, que requieren un <u>esfuerzo físico moderado</u>. Recuerde que las actividades moderadas hacen que usted respire algo más fuerte de lo normal y pueden incluir: trotar a un ritmo suave, bailar, practicar yoga o tai chi, entre otras.

25. Durante los últimos 7 días, ¿Realizó actividades físicas moderadas en su tiempo libre, por lo menos durante 10 minutos seguidos?
Si.................................... ( ) 1
¿Cuáles?, ***indague un poco más acerca de cada actividad reportada***
No.................................. ( ) 2
Pase a la parte 3 pregunta 29
No sabe/ no responde..... ( ) 3
Pase a la parte 3 pregunta 29

26. ¿Cuántos días realizó actividades físicas moderadas en su tiempo libre, por lo menos durante 10 minutos seguidos?
___ Días por semana *[Si la persona entrevistada responde 0, pase a la pregunta 29]*
___ No sabe/No está seguro(a) *[Pase a la pregunta 29]*
___ Se rehúsa contestar *[Pase a la pregunta 29]*

[**Clarificación por parte del entrevistador**: Piense únicamente sobre esas actividades físicas que usted hizo por lo menos durante 10 minutos continuos.]

27. ¿Cuánto tiempo realizó actividades físicas moderadas en su tiempo libre, en uno de esos días, por lo menos durante 10 minutos seguidos?

___ ___ Horas por día
___ ___ ___ Minutos por día
___ No sabe/No está seguro(a)
___ Se rehúsa contestar

[Clarificación por parte del entrevistador: Piense únicamente sobre esas actividades físicas que usted hizo por lo menos durante 10 minutos continuos.]

[**Guía del entrevistador**: Se necesita un promedio de tiempo al día. Si la persona entrevistada no puede responder porque la cantidad de tiempo empleado varía ampliamente día a día, pregunte: ¿Cuál es la cantidad total de tiempo que usted dedicó en los últimos 7 días a hacer actividades físicas moderadas en su tiempo libre?]

___ ___ Horas por semana
___ ___ ___ ___ Minutos por semana
___ No sabe/No está seguro(a)
___ Se rehúsa contestar

Parte 3: Tiempo que permaneció sentado(a)

28. **Lea:** Esta pregunta es acerca del tiempo que usted dedicó a estar sentado(a). Incluya el tiempo que permaneció sentado(a) en el trabajo, en la casa, mientras estudia y durante su tiempo de descanso. Esto puede incluir el tiempo que permaneció sentado(a) en un escritorio, visitando a unos amigos, leyendo, sentado, comiendo o acostado viendo televisión. Por favor **no incluya** el tiempo que permaneció sentado(a) en un vehículo automotor que usted ya haya mencionado.

29. Durante los últimos 7 días, ¿Usted permaneció sentado(a)?

Si.................................... ( ) 1
No.................................. ( ) 2
Pase a la pregunta 33
No sabe/ no responde..... ( ) 3
Pase a la pregunta 33

30. ¿Cuántos días permaneció sentado(a)?

___ Días por semana *[Si la persona entrevistada responde 0, pase a la pregunta 34]*
___ No sabe/No está seguro(a) *[Pase a la pregunta 33]*
___ Se rehúsa contestar *[Pase a la pregunta 33]*

31. A. ¿Cuánto tiempo en total usted permaneció sentado(a), durante un día normal entre semana?

___ ___ Horas por día
___ ___ ___ Minutos por día
___ No sabe/No está seguro(a)
___ Se rehúsa contestar

B. ¿Cuánto tiempo en total usted permaneció sentado(a), durante un día normal en fin de semana?

___ ___ Horas por día
___ ___ ___ Minutos por día
___ No sabe/No está seguro(a)

___ Se rehúsa contestar

D. LUGARES PARA LA PRÁCTICA DE ACTIVIDAD FÍSICA

32. **Lea:** ésta sección se trata sobre los lugares que usted frecuenta para realizar actividades físicas (caminar, actividades físicas moderadas o vigorosas). [**Guía del encuestador**] Por favor, realice las siguientes preguntas en caso de que el participante haya respondido afirmativamente a las preguntas relacionadas con práctica de actividad física. De lo contrario, pase a la siguiente sección de la encuesta.

33. ¿Generalmente, en qué lugares realiza actividad física, qué tipo de actividades realiza y con qué frecuencia? (**Lea**: actividades como caminar, hacer deporte, bailar, entre otras. Puede marcar varias opciones)

Lugar	**Actividad**	**Frecuencia (Días/semana)**
a. Centros comerciales		
b. Parques		
c. Plazas públicas		
d. Calles		
e. Ciclopista		
f. Canchas al aire libre (fútbol, basketball, etc.)		
g. Canchas cubiertas (fútbol, basketball, etc.)		
h. Gimnasio		
i. Universidad/Escuela		
j. Trabajo		
k. Museos		
l. En casa		
m. Al aire libre, de paseo		
n. Bares		
o. Discotecas		
p. Deportivo		
q. Otros ____________		

E. SEDENTARISMO

34. **Lea:** esta sección de la encuesta se trata sobre las actividades que usted realizó en los últimos 7 días, sin incluir el tiempo que pudo tomarle hacer estas actividades en el trabajo. No hay preguntas correctas o incorrectas. Por favor sea lo más exacto y honesto que pueda. Para cada actividad mencionada, responda las siguientes dos preguntas:

a. ¿Cuántos días realizó esa actividad, en los últimos 7 días? (cero (0) en caso de no haber realizado la actividad ningún día)
b. En promedio, ¿Cuántos minutos le tomó realizar esta actividad en los días anteriormente mencionados por usted?

Actividades	¿Cuántos días en los últimos 7 días?	¿Cuántos minutos al día?
1. Computadora/internet como descanso	__ días	__ __ minutos por día
2. Juegos de video	__ días	__ __ minutos por día
3. Leer	__ días	__ __ minutos por día
4. Sentarse y hablar con amigos (No por teléfono); o escuchar música	__ días	__ __ minutos por día
5. Hablar por teléfono	__ días	__ __ minutos por día
6. Ver televisión o películas	__ días	__ __ minutos por día
7. Manejar o ir en un carro	__ días	__ __ minutos por día

F. CARACTERÍSTICAS DE LA COLONIA (NEWS)

35. **Lea:** A continuación nos gustaría hacerle unas preguntas acerca de la forma en la que usted percibe su colonia.

Tipos de viviendas en su colonia

Por favor, escoja la respuesta que lo represente a usted y a su colonia.

36. ¿Qué tan comunes son las <u>viviendas unifamiliares (casas)</u> en su colonia?

( )1	( )2	( )3	( )4	( )5
Ninguna	Pocas	Algunas	Muchas	Todas

37. ¿Qué tan comunes son los <u>condominios horizontales (1 a 3 pisos) o vecindades</u> en su colonia?

( )1	( )2	( )3	( )4	( )5
Ninguna	Pocas	Algunas	Muchas	Todas

38. ¿Qué tan comunes son los <u>edificios de departamentos de 1 a 3 pisos</u> en su colonia?

( )1	( )2	( )3	( )4	( )5
Ninguna	Pocas	Algunas	Muchas	Todas

39. ¿Qué tan comunes son los edificios de departamentos de 4 a 6 pisos en su colonia?

( )1	( )2	( )3	( )4	( )5
Ninguna	Pocas	Algunas	Muchas	Todas

40. ¿Qué tan comunes son los edificios de departamentos de 7 a 12 pisos en su colonia?

( )1	( )2	( )3	( )4	( )5
Ninguna	Pocas	Algunas	Muchas	Todas

41. ¿Qué tan comunes son los departamentos o casas más de 13 pisos en su colonia?

( )1	( )2	( )3	( )4	( )5
Ninguna	Pocas	Algunas	Muchas	Todas

Tiendas establecimientos y otras facilidades en su colonia

42. ¿Aproximadamente cuánto tiempo tarda caminando desde su casa hasta el negocio o establecimiento más cercano de los listados a continuación? Por favor marque solo una respuesta en cada una de las opciones mencionadas.

	1-5 min	**6-10 min**	**11-20 min**	**21-30 min**	**+30 min**	**No sabe**
Ejemplo: Estación de gasolina	1. ____	2. ___	3.__√__	4. ____	5. ___	6.____
1. Tienda de abarrotes	1. ____	2. ____	3.___	4. ____	5. ___	6.____
2. Supermercado	1. ____	2. ____	3.___	4. ____	5. ___	6.____
3. Ferretería	1. ____	2. ____	3.___	4. ____	5. ___	6.____
4. Tienda de Frutas/verduras	1. ____	2. ____	3.___	4. ____	5. ___	6.____
5. Lavandería	1. ____	2. ____	3.___	4. ____	5. ___	6.____
6. Tienda de ropa	1. ____	2. ____	3.___	4. ____	5. ___	6.____
7. Oficina de correo	1. ____	2. ____	3.___	4. ____	5. ___	6.____
8. Biblioteca	1. ____	2. ____	3.___	4. ____	5. ___	6.____
9. Colegio/Escuela	1. ____	2. ____	3.___	4. ____	5. ___	6.____
10. Otros centros educativos	1. ____	2. ____	3.___	4. ____	5. ___	6.____
11. Librería	1. ____	2. ____	3.___	4. ____	5. ___	6.____
12. Restaurante de comida rápida o puestos	1. ____	2. ____	3.___	4. ____	5. ___	6.____
13. Cafetería	1. ____	2. ____	3.___	4. ____	5. ___	6.____
14. Banco	1. ____	2. ____	3.___	4. ____	5. ___	6.____
15. Restaurante (No incluye comida rápida ni cafetería)	1. ____	2. ____	3.___	4. ____	5. ___	6.____
16. Tienda de videos	1. ____	2. ____	3.___	4. ____	5. ___	6.____

17. Farmacia	1. ____	2. ____	3.___	4. ____	5. ___	6.____
18. Peluquería	1. ____	2. ____	3.___	4. ____	5. ___	6.____
19. Su trabajo o colegio/escuela (Marque si no aplica ___)	1. ____	2. ____	3.___	4. ____	5. ___	6.____
20. Parada de transporte público	1. ____	2. ____	3.___	4. ____	5. ___	6.____
21. Parque	1. ____	2. ____	3.___	4. ____	5. ___	6.____
22. Plaza Pública	1. ____	2. ____	3.___	4. ____	5. ___	6.____
23. Gimnasio o instalaciones deportivas	1. ____	2. ____	3.___	4. ____	5. ___	6.____

Acceso a servicios

43. Lea: Por favor, elija la respuesta que mejor lo represente a usted y a su colonia. Las palabras “en el área” y “se puede ir caminando” implican una caminata de 10 a 15 minutos desde su casa.

44. Se puede ir caminando fácilmente a las tiendas desde mi casa

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

45. Se puede ir caminando fácilmente la parada del transporte público

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

46. Es difícil estacionarse cerca de las tiendas en el área

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

47. Hay muchos lugares a los que puedo ir caminando fácilmente desde mi casa

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

48. Las calles de mi colonia tienen pendientes o subidas inclinadas, lo que dificulta su acceso caminando

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

49. Hay muchos obstáculos en mi colonia que dificultan ir de un lugar a otro (como avenidas grandes, calles sin salida, ríos, cañones, etc.)

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

Las calles de mi colonia

Por favor, escoja la respuesta que mejor lo represente a usted y a su colonia.

50. Las calles de mi colonia <u>no tienen</u> muchos callejones sin salida o calles cerradas

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

51. En mi colonia La distancia entre las intersecciones para cruzar la calle habitualmente es corta (100 metros o menos; la distancia de una cancha de futbol o menos).

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

52. En mi colonia, hay muchas rutas alternativas para ir de un lugar a otro (No tengo que tomar el mismo camino todas las veces)

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

Lugares para caminar o andar en bicicleta

Por favor, escoja la respuesta que lo represente mejor a usted y a su colonia.

53. Hay banquetas en la mayoría de las calles de mi colonia

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

54. Las banquetas de mi colonia están separados de la calle/tráfico por carros estacionados

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

55. Las banquetas de mi colonia están separados de la calle/tráfico por pasto o tierra

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

Los alrededores de la colonia

Por favor, escoja la respuesta que mejor lo represente a usted y a su colonia

56. Hay árboles a lo largo de las calles de mi colonia

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

57. Hay cosas interesantes para ver mientras camina por las calles de mi colonia.

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

58. Hay paisajes bonitos en mi colonia

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

59. Hay casas y/o edificios bonitos en mi colonia

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

La seguridad de la colonia

Por favor, escoja la respuesta que mejor lo represente a usted y a su colonia

60. Hay mucho tráfico en las calles cercanas a mi colonia, lo cual dificulta o hace desagradable caminar por ellas

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo | En desacuerdo | De acuerdo | Totalmente de acuerdo

61. La velocidad del tráfico en la mayoría de las calles cercanas a mi colonia usualmente es lenta (50 km/hora o menos).

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo | En desacuerdo | De acuerdo | Totalmente de acuerdo

62. La mayoría de los conductores exceden el límite de velocidad mientras conducen por mi colonia

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo | En desacuerdo | De acuerdo | Totalmente de acuerdo

63. Las calles de mi colonia están bien iluminadas en la noche

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo | En desacuerdo | De acuerdo | Totalmente de acuerdo

64. Los peatones y ciclistas pueden ser fácilmente vistos por la gente desde sus casas

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo | En desacuerdo | De acuerdo | Totalmente de acuerdo

65. Hay señales de cruces y pasos peatonales en las calles de mi colonia que ayudan al paso de los peatones en calles concurridas o de alto tráfico

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo | En desacuerdo | De acuerdo | Totalmente de acuerdo

66. Hay un alto índice de delincuencia en mi colonia

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo | En desacuerdo | De acuerdo | Totalmente de acuerdo

67. El índice de delincuencia de mi colonia lo hace inseguro para caminar por él durante el día.

( )1 ( )2 ( )3 ( )4

Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

68. El índice de delincuencia de mi colonia lo hace inseguro para caminar por él <u>durante la noche.</u>

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

69. Los parques, plazas públicas, zonas verdes y sitios de recreación de mi colonia son inseguros para estar en ellos <u>durante el día.</u>

( )1	( )2	( )3	( )4
Totalmente en desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

70. Los parques, plazas públicas, zonas verdes y sitios de recreación de mi colonia son inseguros para estar en ellos <u>durante la noche.</u>

( )1	( )2	( )3	( )4
Totalmente en Desacuerdo	En desacuerdo	De acuerdo	Totalmente de acuerdo

G. PARQUES, PLAZAS Y CENTROS COMERCIALES

71. ¿Se puede ir caminando fácilmente a los siguientes tipos de parques?

a. Parques metropolitanos (grandes con muchas áreas verdes)	Si ( )	No ( )
b. Parque pequeño de juegos infantiles	Si ( )	No ( )
c. Plazas públicas	Si ( )	No ( )
d. Centros comerciales	Si ( )	No ( )

72. ¿Cuánto tiempo aproximado tarda en caminar desde su casa hacia los siguientes tipos de parques? (**Mostrar imágenes si es necesario)**

Tipo de Parque	1-5 min	6-10 min	11-20 min	21-30 min	+30 min	No sabe
a. Parques metropolitanos						
b. Parque pequeño						
c. Plazas públicas						
d. Centros comerciales						

73. ¿Se puede ir fácilmente en transporte público a los siguientes tipos de parques?

a. Parques metropolitanos	Si ( )	No ( )
b. Parques pequeños	Si ( )	No ( )
c. Plazas públicas	Si ( )	No ( )
d. Centros comerciales	Si ( )	No ( )

74. ¿Cuánto tiempo aproximado tarda en transporte público desde su casa hacia los siguientes tipos de parques/plazas?

Tipo de Parque	1-5 min	6-10 min	11-20 min	21-30 min	+30 min	No sabe
a.Parques metropolitanos						
b.Parques pequeños						
c. Plazas públicas						
d.Centros comerciales						

H. SOPORTE SOCIAL PARA LA PRÁCTICA DE ACTIVIDAD FÍSICA

75. **Lea:** Ahora vamos a conversar sobre qué lo motivó a caminar durante su tiempo libre

76. En los últimos 3 meses, con qué frecuencia alguien que vive con usted lo acompañó a caminar:

( )	( )	( )
Nunca	**A veces**	**Siempre**

77. En los últimos 3 meses, con qué frecuencia alguien que vive con usted, lo invitó a caminar

( )	( )	( )
Nunca	**A veces**	**Siempre**

78. En los últimos 3 meses, con qué frecuencia alguien que vive con usted, lo incentivó a caminar

( )	( )	( )
Nunca	**A veces**	**Siempre**

79. En los últimos tres meses, con qué frecuencia algún amigo, lo acompañó a caminar

( )	( )	( )
Nunca	**A veces**	**Siempre**

80. En los últimos tres meses, con qué frecuencia algún amigo, lo invitó a caminar

( ) ( ) ( )

Nunca **A veces** **Siempre**

81. En los últimos tres meses, con qué frecuencia algún amigo, lo incentivó a caminar

( ) ( ) ( )

Nunca **A veces** **Siempre**

82. **Lea:** ahora vamos a conversar sobre qué lo incentiva a usted a hacer actividad física de intensidad moderada o vigorosa en su tiempo libre

83. En los últimos 3 meses, con qué frecuencia alguien que vive con usted, hizo ejercicios de intensidad moderada o vigorosa con usted

( ) ( ) ( )

Nunca **A veces** **Siempre**

84. En los últimos 3 meses, con qué frecuencia alguien que vive con usted, lo invitó a hacer ejercicios de intensidad moderada o vigorosa

( ) ( ) ( )

Nunca **A veces** **Siempre**

85. En los últimos 3 meses, con qué frecuencia alguien que vive con usted, lo incentivó a hacer ejercicios de intensidad moderada o vigorosa

( ) ( ) ( )

Nunca **A veces** **Siempre**

86. En los últimos 3 meses, con qué frecuencia algún amigo, hizo ejercicios de intensidad moderada o vigorosa con usted

( ) ( ) ( )

Nunca **A veces** **Siempre**

87. En los últimos 3 meses, con qué frecuencia algún amigo, lo invitó a hacer ejercicios de intensidad moderada o vigorosa

( ) ( ) ( )

Nunca **A veces** **Siempre**

88. En los últimos 3 meses, con qué frecuencia algún amigo, lo incentivó a hacer ejercicios de intensidad moderada o vigorosa

( )	**( )**	**( )**
Nunca	**A veces**	**Siempre**

I. AUTO EFICACIA PARA LAS ACTIVIDADES FÍSICAS

89. **Lea:** ahora vamos a conversar sobre como usted percibe su práctica de actividad física. Piense solamente en las caminatas que realiza en su tiempo libre.

90. Usted logra caminar en su tiempo libre cuando usted está cansado

( )	( )
Si	No

91. Usted logra caminar en su tiempo libre cuando usted está de mal humor

( )	( )
Si	No

92. Usted logra caminar en su tiempo libre cuando usted está sin tiempo

( )	( )
Si	No

93. Usted logra caminar en su tiempo libre cuando usted está de vacaciones

( )	( )
Si	No

94. Usted logra caminar en su tiempo libre cuando está haciendo mucho frio

( )	( )
Si	No

95. Usted logra caminar en su tiempo libre cuando está haciendo mucho calor

( ) ( )

Si No

96. **Lea:** Ahora vamos a conversar sobre como usted percibe su práctica de actividades físicas de intensidad moderada o vigorosa en su tiempo libre. Piense en actividades físicas como nadar, correr, andar en bicicleta. No incluya caminar.

97. Usted logra hacer actividad física moderada a vigorosa en su tiempo libre cuando usted está cansado

( ) ( )

Si No

98. Usted logra hacer actividad física moderada a vigorosa en su tiempo libre cuando usted está de mal humor

( ) ( )

Si No

99. Usted logra hacer actividad física moderada a vigorosa en su tiempo libre cuando usted está sin tiempo

( ) ( )

Si No

100. Usted logra hacer actividad física moderada a vigorosa en su tiempo libre cuando usted está de vacaciones

( ) ( )

Si No

101. Usted logra caminar en su tiempo libre cuando está haciendo mucho frio

( ) ( )

Si No

102. Usted logra caminar en su tiempo libre cuando está haciendo mucho calor

( ) ( )

Si No

J. SATISFACCIÓN CON LA PRÁCTICA DE ACTIVIDAD FÍSICA

103. Lea: ahora vamos a hablar sobre qué tan satisfecho (a) se siente cuando practica actividad física en su tiempo libre

104. ¿Usted disfruta caminar en su tiempo libre?

( ) ( ) ( )

No Un poco Mucho

105. ¿Usted se siente bien cuando camina en su tiempo libre?

( ) ( ) ( )

No Un poco Mucho

106. ¿Usted se siente bien después de caminar en su tiempo libre?

( ) ( ) ( )

No Un poco Mucho

107. Lea: Ahora vamos a conversar sobre qué tan satisfecho (a) se siente cuando practica una actividad física de intensidad moderada o vigorosa en su tiempo libre. Piense en actividades como nadar, correr o andar en bicicleta. No incluya caminar.

108. ¿Usted disfruta hacer actividades físicas de intensidad moderada o vigorosa en su tiempo libre?

( ) ( ) ( )

No Un poco Mucho

109. ¿Usted se siente bien haciendo actividades físicas de intensidad moderada o vigorosa en su tiempo libre?

( ) ( ) ( )

No Un poco Mucho

110. ¿Usted se siente bien después de hacer actividades físicas de intensidad moderada o vigorosa en su tiempo libre?

( ) ( ) ( )

No Un poco Mucho

K. IDENTIFICACIÓN DEL ENCUESTADO

111. Sexo: (1) M ___ (2) F ___

112. ¿Cuál es su edad en años cumplidos? ___ ___

113. ¿Cuál es su fecha de nacimiento? (dd/mm/aa): ___/___/___

114. ¿Cuánto mide? ___ ___ ___ . __ __ cm

115. ¿Cuál es su peso ?______Kg

116. ¿Cuál es su estado civil? ***(No lea opciones)***

Soltero(a)... ( ) 1
Casado(a)... ( ) 2
Separado(a)/divorciado(a)........... ( ) 3
Viudo(a)... ( ) 4
Unión Libre………………………………….( )5

117. ¿Cuál es su teléfono? ___ ___ ___ ___ ___ ___ ___

118. ¿Cuál es el nombre de la colonia?
____

119. ¿Hace cuántos años vive de forma permanente en la colonia? ___ ___

120. ¿Cuál es el último nivel o grado de estudios que usted completó?

Tipo de enseñanza	**Año**					
Ninguna	0					
Primaria	1	2	3	4	5	6
Secundaria	7	8	9			
Preparatoria	10	11	12			
Universidad	13	14	15	16		
Postgrado	17					

121. ¿A qué se dedicó la mayor parte del tiempo en los últimos 30 días? ***(Leer Opciones)***

Trabajó (a)... ( ) 1
Trabajó y estudió.................................... ( ) 2
Estudió (a).. ( ) 3
Actividades del hogar............................. ( ) 4
Buscó trabajo... ( ) 5
Pensionado(a).. ( ) 6
Retirado sin pensión................................. ( ) 7
Otra…………………………………….... ( ) 8

¿Cuál?: ______________________

122. ¿En su casa tienen automóvil (funcional)?

Si ( ) 1 ¿Cuántos? ___ ___
No ( ) 2

123. ¿En su casa tienen moto?

Si ( ) 1 ¿Cuántas? ___ ___
No ( ) 2

124. ¿Tiene usted una licencia para manejar? Si ( ) No ( )

L. SECCIÓN ADICIONAL PARA ESTIMAR NIVEL SOCIOECONOMICO: SERVICIOS Y ACTIVOS EN EL HOGAR

CARACTERÍSTICAS DE LA VIVIENDA

1. ***¿De qué material es la mayor parte del piso de esta vivienda? (Circular una opción)***
   - ***i.*** Tierra
   - ***ii.*** Cemento firme
   - ***iii.*** Mosaico, madera u otros recubrimientos

2. ***¿De qué material es la mayor parte de las paredes o muros de esta vivienda?***
   - i. Lámina de cartón
   - ii. Madera
   - iii. Lámina de asbestos o metálica
   - iv. Adobe
   - v. Tabique, tabicón, block, piedra, mampostería o cemento

3. ***¿De qué material es la mayor parte del techo de esta vivienda?***
   - i. Lámina de cartón
   - ii. Losa de concreto, bóveda de ladrillo o terrado, en ladrillado con vigas
   - iii. Otros materiales
   - iv. No sabe

4. ***¿Hay en esta vivienda un cuarto para cocinar?***
   - i. Si
   - ii. No
5. ***¿Usa este cuarto (refiriéndose a la pregunta anterior) para dormir?***
   - i. Si
   - ii. No
6. ***En total, ¿cuántos cuartos tiene esta vivienda sin contar pasillos, baños y cocina?***
   - i. Número de cuartos _ _

7. ***¿Cuántos cuartos se usan para dormir?***
   - i. Número de cuartos _ _
8. **¿Cuántas personas viven en la vivienda?** __
9. **¿Cuántas personas menores de 18 años viven en el hogar?** __
10. ***Los ocupantes de esta vivienda disponen de: (lea las opciones hasta obtener una respuesta afirmativa)***
    - i. Agua entubada dentro de la cocina o baño
    - ii. Agua entubada fuera de la vivienda pero dentro del terreno

iii. Agua de pipa
iv. Otra fuente (especifique)

11. ***Los ocupantes de esta vivienda usan: (lea las opciones hasta obtener una respuesta afirmativa)***

i. Excusado o sanitario
ii. Letrina o retrete
iii. Fosa

12. ***Lea:*** *Ahora quisiera hacerle algunas preguntas sobre los bienes que son propiedad de usted:*

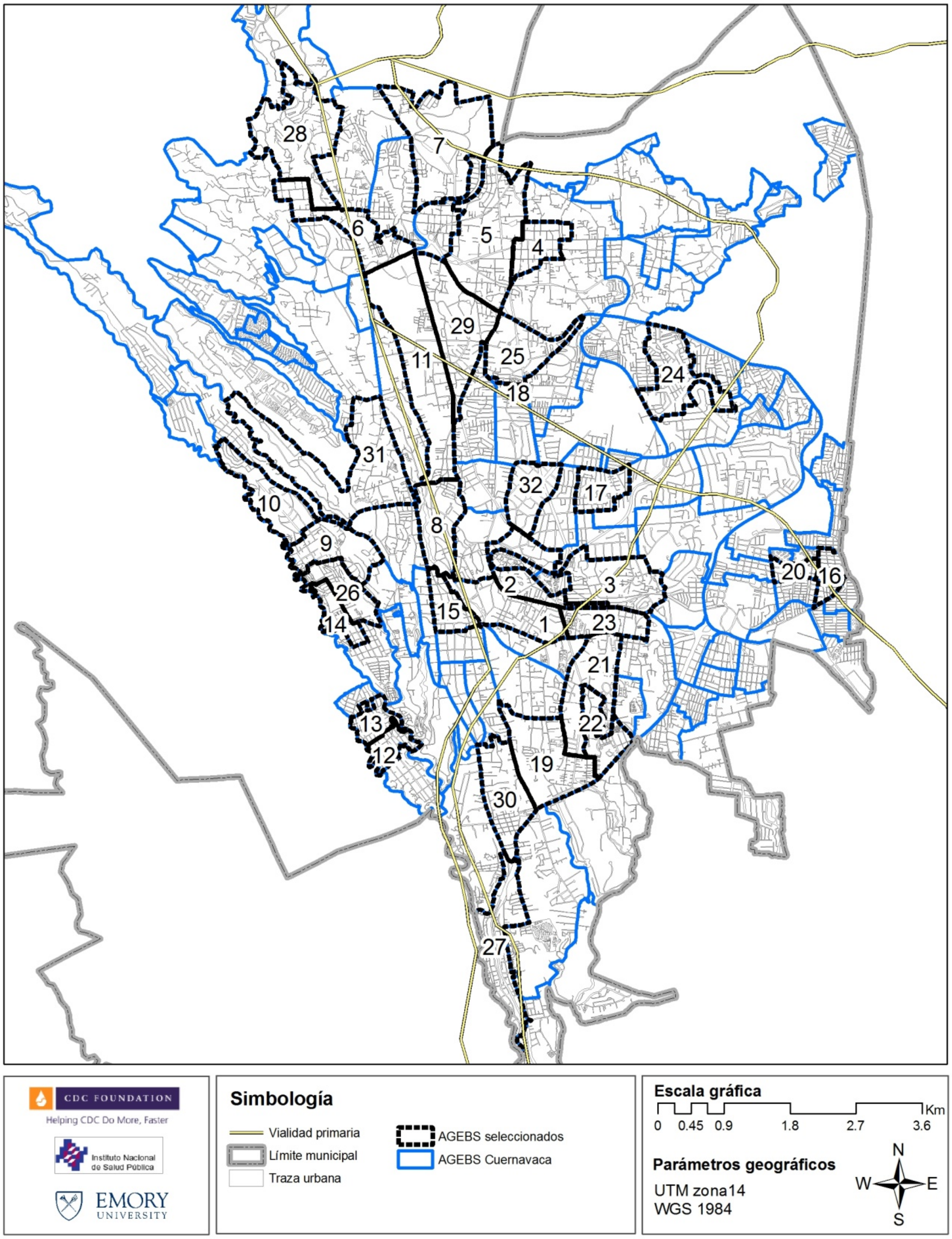
Posesión de activos

Podría decirme si en este hogar cuentan con:	**Si**	**No**	**No responde**	**No sabe**
13.1 Casa propia ocupada por este hogar	1	2	99	88
13.2 Otra casa, construcción , inmueble o terreno	1	2	99	88
13.3 Automóvil (Si contestó que sí, ¿cuántos? ___)	1	2	99	88
13.4 Motocicleta (Si contestó que sí, ¿cuántos?____)	1	2	99	88
13.5 Televisión	1	2	99	88
13.6 Refrigerador	1	2	99	88
13.7 Computadora	1	2	99	88
13.8 Servicio de internet	1	2	99	88
13.9 Horno de microondas	1	2	99	88
14.0 Teléfono fijo	1	2	99	88
14.1 Lavadora de ropa	1	2	99	88
14.2 Reproductor de DVD	1	2	99	88
14.3 Ventilador o abanico eléctrico	1	2	99	88
14.4 Reproductor Blue Ray	1	2	99	88

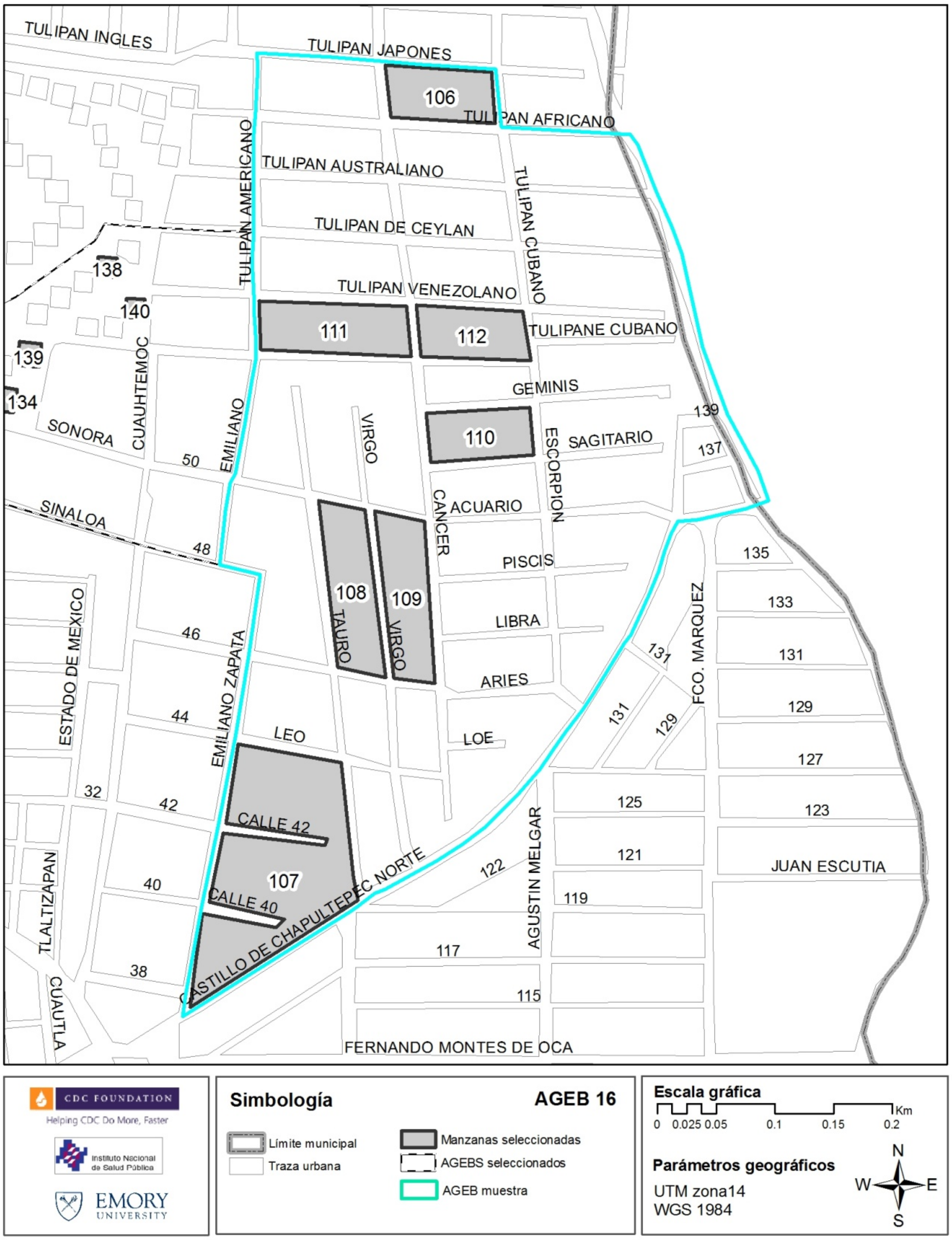
Fin de la Encuesta

OBSERVACIONES
………
………
………
………
……………………………………………………………………

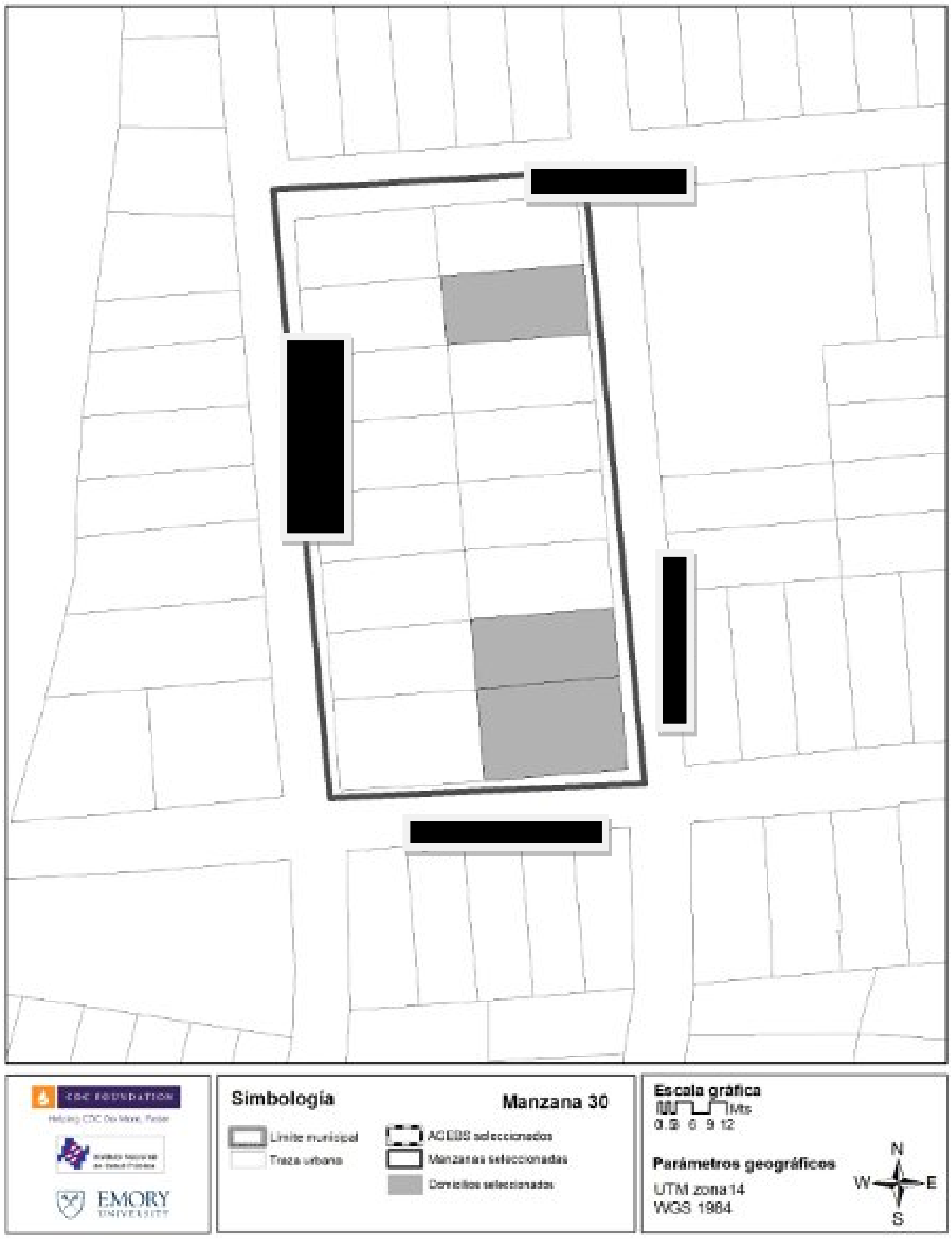
Appendix 4: Map of Cuernavaca showing selected census tracts for IPEN-Mexico study



Appendix 5: Example of map showing selected blocks within selected census tracts for IPEN-Mexico study



Appendix 6: Example of map showing selected households within selected blocks for IPEN-Mexico study (street names not shown)



Appendix 7: Block level environmental audit for IPEN-Mexico Study (Form and example map)

FORMATO DE CARACTERIZACIÓN DEL AMBIENTE

1. CODIGO DEL ENCUESTADOR |__|__|
2. Número de AGEB |__|__|__| 3.Número de manzana |__|__|

A continuación marca los espacios físicos que observas y el numero de los mismos, los cuales deberán coincidir con los códigos que marcaste en el mapa.

	LUGARES	CANTIDAD		LUGARES	CANTIDAD
1.	Tienda de abarrotes		36.	Internet	
2.	Supermercado		37.	Ofinas	
3.	Ferretería /Materiales construccion		38.	Hotel/Motel	
4.	Tienda de Frutas/verduras		39.	Papeleria	
5.	Lavandería		40.	Lotes baldios	
6.	Tienda de ropa/Novedades		41.	Construcciones/Antenas	
7.	Oficina de correo		42.	Herreria/Vidrerias	
8.	Biblioteca		43.	Pozo	
9.	Colegio/Ecuela (0-18 años)		44.	Centro religioso	
10.	Otros centros educativos		45.	Carniceria/Polleria/Pescaderia	
11.	Librería		46.	Bases de rutas	
12.	Restaurane de comida rápida		47.	Sitio de Taxis	
13.	Cafetería		48.	Zonas verdes (ranchos, granjas)	
14.	Banco		49.	Cementerios	
15.	Restaurante (No comida o cafetería)		50.	Paleteria/Heladeria/Aguas Frescas	
16.	Tienda de videos		51.	Cerrajeria	
17.	Farmacia		52.	Reparaciones (cualquiera)	
18.	Funeraria		53.	Veterinaria, tienda de animales	
19.	Parada de ruta		54.	Floreria/Puesto de revistas/Dulces	
20.	Rutas (no. de cada una)		55.	Tiendas de telefonía/computo	
21.	Parque		56.		

22.	Plaza Pública		57.		
23.	Gimnasio (privado)		58.		
24.	Mercado		59.		
25.	Puesto de comida en la calle		60.		
26.	Cruce peatonal		61.		
27.	Semáforo		62.		
28.	Teléfono público		63.		
29.	Deportivo		64.		
30.	Canchas (cualquier deporte)		65.		
31.	Tortilleria/Panaderia		66.		
32.	Taller		67.		
33.	Salon/Peluqueria/Spa		68.		
34.	Salud		69.		
35.	Centro Comercial		70.		

Observaciones:____
____
____

EMORY

W-2
NS-1

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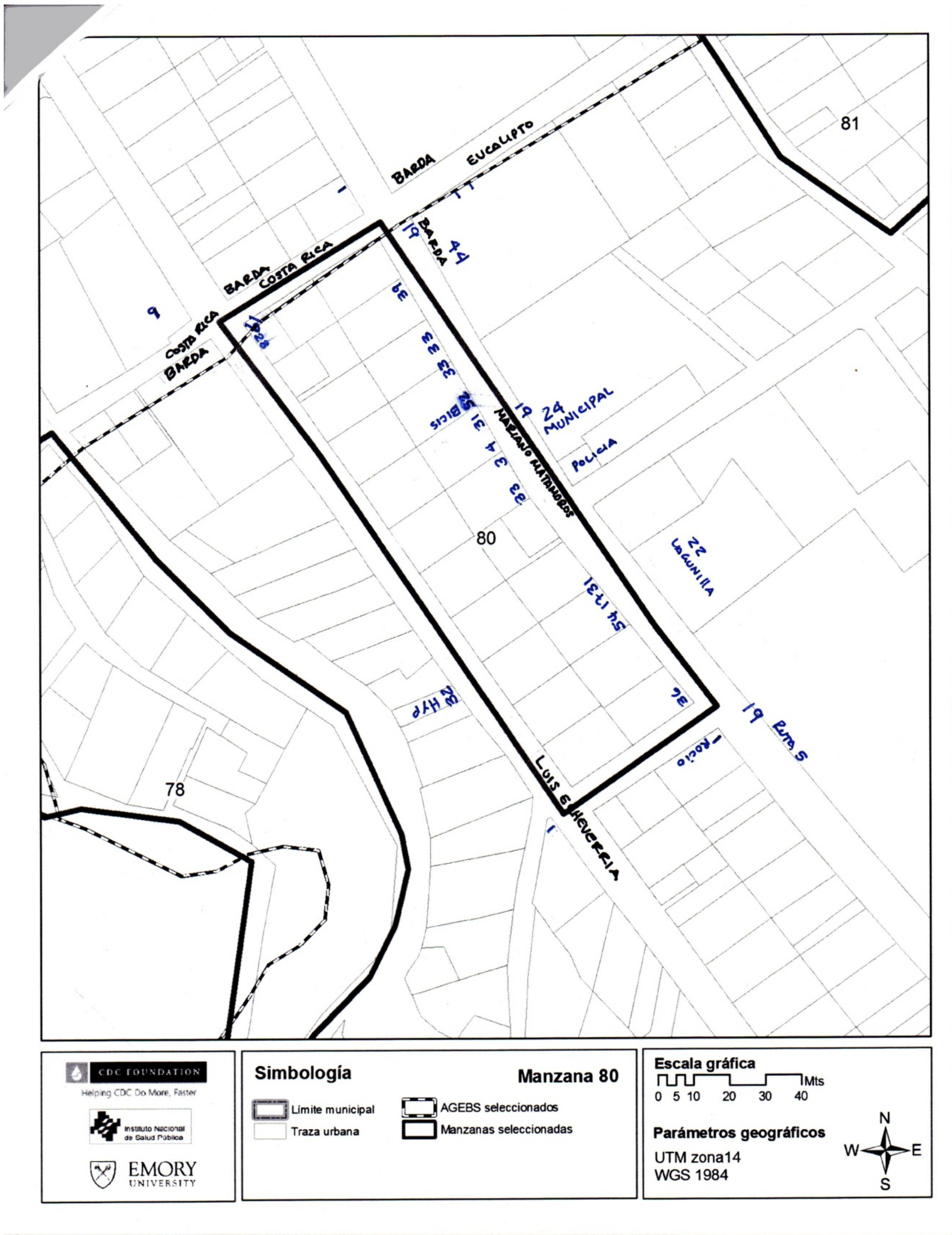
FORMATO DE CARACTERIZACIÓN DEL AMBIENTE

1. CODIGO DEL ENCUESTADOR |Ø|1|
2. Número de AGEB |0|1|2| 3.Número de manzana |0|8|0

A continuación marca los espacios físicos que observas y el numero de los mismos, los cuales deberán coincidir con los códigos que marcaste en el mapa.

	LUGARES	CANTIDAD		LUGARES	CANTIDAD
1.	Tienda de abarrotes	3	36.	Internet	1
2.	Supermercado		37.	Ofinas	
3.	Ferretería /Materiales construccion	1	38.	Hotel/Motel	
4.	Tienda de Frutas/verduras	1	39.	Papeleria	1
5.	Lavandería		40.	Lotes baldios	
6.	Tienda de ropa/Novedades		41.	Construcciones/Antenas	
7.	Oficina de correo		42.	Herreria/Vidrerias	
8.	Biblioteca		43.	Pozo	
9.	Colegio/Ecuela (0-18 años)	1	44.	Centro religioso	1
10.	Otros centros educativos		45.	Carniceria/Polleria/Pescaderia	
11.	Librería		46.	Bases de rutas	
12.	Restaurane de comida rápida		47.	Sitio de Taxis	
13.	Cafetería		48.	Zonas verdes (ranchos, granjas)	
14.	Banco		49.	Cementerios	
15.	Restaurante (No comida o cafetería)		50.	Paleteria/Heladeria/Aguas Frescas	
16.	Tienda de videos		51.	Cerrajeria	
17.	Farmacia	1	52.	Reparaciones (cualquiera) BICIS	1
18.	Funeraria/Crematorio/Urnas		53.	Veterinaria, tienda de animales	
19.	Parada de ruta	4	54.	Floreria/Puesto de revistas/Dulces	1
20.	Rutas (no. de cada una)		55.	Tiendas de telefonía/computo	
21.	Parque		56.	Bar/Disco/Antro	
22.	Plaza Pública	1	57.	Muebleria/Decoracion	
23.	Gimnasio (privado)		58.		
24.	Mercado	1	59.		
25.	Puesto de comida en la calle		60.		
26.	Cruce peatonal		61.		
27.	Semáforo		62.		
28.	Teléfono público	28	63.		
29.	Deportivo		64.		
30.	Canchas (cualquier deporte)		65.		
31.	Tortilleria/Panaderia	2	66.		
32.	Taller HYP	1	67.		
33.	Salon/Peluqueria/Spa	3	68.		
34.	Salud		69.		
35.	Centro Comercial		70.		

Observaciones: EN LA CALLE M. MATAMOROS ENTRE EL MERCADO MUNICIPAL Y LA PLAZA PUBLICA ESTA UNA JEFATURA DE POLICIA



BARDA
EUCALIPTO
COSTA RICA
BARDA
COSTA RICA
BARDA
BARDA
81
MUNICIPAL
POLICIA
MARIANO MATAMOROS
80
LAGUNILLA
RUTA 5
ROCIO
78
LUIS ECHEVERRIA
CDC FOUNDATION
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Instituto Nacional de Salud Pública
EMORY UNIVERSITY
Simbología
Manzana 80
Límite municipal
Traza urbana
AGEBS seleccionados
Manzanas seleccionadas
Escala gráfica
Mts
0 5 10 20 30 40
Parámetros geográficos
UTM zona14
WGS 1984
N
W
E
S

Appendix 8: Audit tool for spaces for physical activity in Latin American urban settings, and rotation report on the development of the tool

FORMATO DE OBSERVACION DE CENTROS COMERCIALES

1. Ficha de información
1.1 AGEB ______________ 1.2 Colonia ____________________________
1.3 Nombre del Centro Comercial__________________1.4 Código____________

1.5 Dirección del Centro Comercial
____

2. Información general del centro comercial

2.1 Tamaño del Centro Comercial Pequeño Grande

2.2 Parada de transporte publico cercana (<500 m) SI NO

1. Características del Centro Comercial

Características	**Presente en el centro comercial** **1=Si, 2=No**
3.1 Tiendas Boutique	
3.2 Tiendas departamentales	
3.3 Tiendas de música/videos	
3.4 Área de comida (rápida)	
3.5 Restaurantes	
3.6 Cines	

FORMATO DE OBSERVACION DE DEPORTIVO

3. Ficha de información

3.1 AGEB ______________ 1.2 Colonia ____________________________

1.3 Nombre del Deportivo__________________1.4 Código del Deportivo ____________

1.5 Dirección del Deportivo

____

4. Información general del Deportivo

4.1 Tamaño del Deportivo Pequeño Grande

4.2 Parada cercana de transporte public (cercana a la entrada del deportivo)

(<500 m) SI NO

5. Características del Deportivo

Características	Presentes en el Deportivo 1=Si, 2=No	Cantidad 99=No Aplica
3.1 Gimnasio		
3.2 Canchas de Volleyball		
3.3 Canchas de Basketball		
3.4 Alberca		
3.5 Salones de Baile		
3.6 Salones de Gimnasia		
3.7 Salones de Artes Marciales		
3.8 Canchas techadas de Futbol		
3.9 Canchas al aire libre de Futbol		
3.10 Pista (para correr)		
3.11 Canchas de Baseball		
3.12 Se ofrecen clases en el deportivo (zumba, yoga, deportes, natación, etc)		
3.12 Préstamo de equipo (balones, bats, etc)		

FORMATO DE OBSERVACION DE CANCHAS

6. Ficha de información

95. AGEB ______________ 2. Colonia ____________________________

a. Nombre de la cancha _________________ 4. Código ____________

5. Dirección de la cancha ____

7. Información general de las canchas

2.1 Tipo de cancha 1. Futbol soccer 2. Baseball 3. Basketball
4.Volleyball 5. Otra _______

2.2 Numero de canchas 1 2 >2

2.3 Cercanía de una parada de transporte público desde la entrada (<500 m)
1. Si 2.No

8. Características de las canchas

b. Soccer Características	**Presente 1.Si 2. No 99. No aplica**	**3.Basketball Características**	**Presente 1.Si 2. No 99. No aplica**
3.1 1Pasto		3.31 Redes en canastas	
3.12 Pasto artificial		3.32 Recuadro en tablero	
3.13 Tierra		3.33 Líneas de juego pintadas	
3.14 Portería			
3.15 Redes		**4.Volleyball Características**	**Presente 1.Si 2. No 99. No aplica**
3.16 Líneas de juego marcadas		3.41 Cancha de concreto	
2. Baseball Características	**Presente 1.Si 2. No 99. No aplica**	3.42 Líneas de juego pintadas	
3.21 Pasto		3.43 Cancha de arena	
3.23 Pasto Artificial		3.44 Red completa	
3.24 Bases			

FORMATO DE OBSERVACION DE PARQUES

9. Ficha de información

1.1 AGEB ______________ 1.2 Nombre de la colonia _____________________

1.3 Nombre del parque _______________________ 1.4 Código del parque _______

1.5 Dirección ____

10. Información General del parque

10.1Tipo de parque 1. Jardín (bosque) 2. Espacio abierto 3.Jardin (bosque)+Espacio abierto

10.2Topología del parque

1. Parque metropolitano 2. Parques pequeños

10.3Porcentaje del parque que se ubica dentro del AGEB

1. <25% 2. 25-50% 3. 51-75% 4. 76-99% 5. 100%

2.4 Cercanía de una parada de transporte público desde la entrada (<500 m)

1. Si 2.No

2.5 Funcionabilidad del parque 1. Si 2. No

M. Características del parque

Características	Presente 1.Si 2. No	Cantidad 99. No aplica	Observaciones (limpieza,obstaculos,funcionalidad,material, estado)
3.1 Áreas de juego al aire libre			
3.2 Canchas			
3.3 Veredas, caminos			
3.4 Lagos, fuentes			
3.5 Área de juegos infantiles			
3.6 Gimnasio al aire libre			
3.6 Áreas de convivencia social (cabañas, mesas, as adores)			

FORMATO DE OBSERVACION DE PLAZA PÚBLICA

11. Ficha de información

96. AGEB ____________ 2. Colonia ________________________

c. Nombre de la plaza ______________ 4. Código __________

6. Dirección de la plaza ____

12. Información General de la plaza

12.1Tamaño de la plaza 1. Pequeña 2. Grande
2.2 Cercanía de una parada de transporte público desde la entrada (<500 m)
1. Si 2.No

N. Características de la plaza

Características	Presente 1.Si 2. No	Cantidad 99. No aplica	Observaciones (limpieza,obstaculos,funcionalidad,material, estado)
3.1 Tiendas alrededor de la plaza			
3.2 Restaurantes, bares y cafés alrededor de la plaza			
3.3 Vendedores ambulantes en la plaza			
3.4 Sitios históricos alrededor de la plaza			
3.5 Eventos culturales / entretenimiento			
3.6 Actividad física comunitaria (baile, aerobics, zumba, etc.)			
3.7 Regulaciones de vialidad (señalamientos/policía)			

Rotation Report

Development of a Tool to Assess Physical Activity Environments and Policies in Latin America

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Rotation Advisor: Michael Pratt, M.D., MPH (CDC)

Background

Over the past two decades the prevalence of obesity and various chronic diseases have risen dramatically throughout the Latin American region[1,2]. These include Type II Diabetes, Cardiovascular Diseases, various types of cancers, osteoporosis, among many others[1]. Although there is heterogeneity across Latin America in terms of the prevalences of obesity and the mentioned chronic diseases, varying across countries and regions, the tendency of increase is clear[1,2].

Many determinants have been identified to explain the onset of obesity and the mentioned chronic diseases. One of these is inadequate levels of physical activity[1,3]. Low physical activity is a known risk factor for obesity, Type II Diabetes, osteoporosis, various types of cancer, cardiovascular disease, and other diseases[1].

While genetic factors have remained constant through time, this cannot be said for the environment. Latin America is currently undergoing demographic, epidemiological and nutritional transitions, as a consequence of globalization and urbanization[4]. These phenomena have lead to changes in both food and physical activity environments, which in turn have affected lifestyle patterns among the population[3,4]. Furthermore, policies and regulations are factors beyond the physical environment that may also have an impact upon people's physical activity patterns.

The relationship between the environment and people's habits or behaviors has long been studied. More recently, there has been increased focus on the role of the built environment and its influence upon physical activity practices within populations[4]. Many environmental variables and their association to physical activity have been identified in developed nations[5-7]. Such variables have been included in a variety of instruments available to measure the physical activity environment. Nonetheless, up to now, there has been no tool designed specifically to measure physical activity environments in Latin American contexts. The same statement is true for the measurement of policies affecting physical activity environments and practice in the region.

Given the structural, organizational and cultural differences that Latin America has in comparison to developed countries, such as the U.S.A, where most of the available tools have been developed, there is a need to have a tool that measures the environmental and policy correlates of physical activity, in an easy and practical way that's culturally appropriate for Latin America.

Objective:

To develop/adapt a tool for Latin America to assess Physical Activity environments and policies in community settings within urban contexts.

Methods:

This rotation was conducted in two phases.

Phase I

A systematic review of the available (published) tools to measure physical activity environments and or/policies was conducted. Such review centered in identifying three key factors:

1. The known environmental determinants of physical activity at a population/community level.
2. The available tools that assess such determinants.
3. The tools out of the total list that have been adapted for Latin America or translated into Spanish for their use in Latino/Hispanic communities within developed nations.

The review included subjective measures (i.e. tools that use self report or interviewing techniques) as well as objective measures (i.e. audits or inventories), as well as tools that included a combination of both measures.

As a compliment to the systematic assessment of the available tools in the literature, I attended the Built Environment Assessment Training Institute (BEAT) held in San Diego, in April 2009. The course focused on training the participants to use the available tools for the assessment of the built environment. Hence, I was able to acquire in depth knowledge of the use and practicality in the field of many of the tools identified previously through the systematic review. Most importantly, at the BEAT Institute I had one-on-one consultations with world renowned experts on Built Environment physical activity assessment who gave me their feedback and ideas regarding the potential tool for Latin America.

Phase II

During the second phase of the rotation project the actual tool development took place. A new tool was developed based on the results obtained from Phase I (systematic review + BEAT Institute expert consultation).

The development of the tool started off by identifying key community level environmental settings for physical activity practice within the context of Latin American cities. Then, assessment forms were developed for each of the identified key settings.

Finally, we identified research partners in Latin American cities were we could potentially pilot test our tool, and did the appropriate adaptations for their cities (since this tool aims to being adaptable for different cities in Latin America and researchers needs)

Results

Phase I

Over 70 potential environmental determinants of physical activity were found. Nevertheless, these are known determinants for American populations only. Some examples include availability, accessibility and quality to/of gyms, parks, sidewalks, crosswalks, stoplights, etc., as well as neighborhood safety from crime or neighborhood connectivity[5-7].

The systematic review of available tools to assess the known determinants of physical activity yielded a total of 90 tools. Of these, 73 were subjective measures while only 15 were objective measures. Moreover, of the 90 available tools only 6 had been translated to Spanish, and these all corresponded to subjective measures. Furthermore, those 6 tools translated into Spanish have only been used for Latino communities within the USA, and not in Latin American contexts. This information is presented in table 1.

Table 1: Available tools to assess the physical activity environment

	USA	UK	Other	Translated to Spanish	Total
Objective Measures	14	1	0	0	15
Subjective Measures	61	4	2	6	73
Both	5	1	1	0	7
Total	80	7	3	6	90

The information presented in table 1 was complimented with the feedback obtained from the expert consultation at the BEAT Institute. As a summary, they agreed upon the need to develop a culturally appropriate tool to assess physical activity environments and policies in Latin America. Furthermore, they confirmed the lack of available tools adapted or designed for their use in Latin American cities to date. Two major suggestions came out from the consultations. The first one was to adapt NEWS, a self assessment tool for community environments. The second suggestion was to develop an entirely new community assessment audit tool that should include information on parks and public spaces, community centers and transportation services. Other important information obtained from these consultations was the fact that many of the items currently measured by many of the USA/UK tools have not been proven to be determinants of physical activity, even in developed nations. This is due to a lack of testing up to date. Nonetheless, such items have been included in many of the available tools for developed nations due to empirical evidence or previous knowledge on similar determinants. Hence, in spite of the list of over 70 known environmental and policy determinants of physical activity for the USA, many others are still under current research.

Phase II

Based on empirical data from Mexico (not-published), personal experience from my prior research work at the National Institute of Public Health in Mexico, consultations with a research team in Colombia as well as feedback from the BEAT Institute team, 6 key community settings for the practice of physical activity in Latin American contexts were identified. These include: Plazas/Public Squares, Parks, Soccer Fields (or other), Recreation Centers/Deportivos and Shopping Malls. Table 2 presents such identified settings and the corresponding number of US/UK tools that assess them.

Table 2. Identified key settings for physical activity in Latin America vs. number of USA/UK tools that assess them.

Key Settings for Physical Activity Practice in Latin American cities	Number of US/UK tools that assess each setting
Plazas / Public Squares	0
Parks	48
Soccer Fields	0
Schools	30
Recreation Centers / Deportivos	17

Shopping Malls	0

As shown in table 2, there is a mismatch between what the USA/UK tools assess and the reality of the Latin American environments and policies. For instance, street life seems to constitute a major difference between Latin American and USA cities, and the importance of public plazas is thought to be of great importance for Latin American environments. Other variations include the common use and availability of soccer fields in Latin America. Furthermore, many of the items assessed by the USA/UK tools are irrelevant or have a different meaning in the Latin American context. Examples include “cul de sacs” (not common in Latin America), the presence of unpaved streets (common in Latin America but not so in USA/UK) or the perception of safety (in some places the presence of a policeman may provoke a feeling of insecurity rather than the opposite). Nevertheless, these are just a handful of examples among a long list of identified mismatches between the USA/UK and the Latin American environments. For such reason, the adaptation of a USA/UK tool was discarded, and it was decided to make a new tool that is adequate for Latin American contexts.

Although an essentially new tool was designed, it must be noted that some elements from previously existent tools from the USA/UK were incorporated when possible, given that these individual elements have already been tested for validity and reliability. In particular, the elements came from EAPRS (Environmental Assessment of Public Recreation Spaces Tool, by Saelens et al.). In addition, the tool recommends the complimentary use of SOFIT for PE class assessments in schools, and of SOPARC for parks, soccer fields, shopping malls, recreation centers and plazas. Both SOFIT and SOPARC were developed by McKenzie et al. Furthermore, we adapted SOFIT for its use during recess time and developed a simplified version. This work was developed during my previous work in the School Based Environmental Intervention project in Mexico City for the prevention of childhood obesity in public elementary schools. These new versions of SOFIT have been validated in the mentioned project in Mexico City. The present tool suggests the use of the full tool for PE classes and the adapted tool for recess, but allows an option to use the simplified version for PE classes if considered more practical by the researcher in charge.

Another important source of information for the selection of items to assess with regards to shopping malls assessment was a report of the “Shopping Areas Development Industry of Mexico City and Cancun”, where they identified the characteristics of a shopping area that draw more people to it.

Therefore, the new tool consists of 8 sections and 15 forms. The tool sections are:

1. General Information (Form 1)
2. School Assessment (Form 2, 3 and 4 –includes SOFIT-)
3. Park Assessment (Form 5 and 6 – includes SOPARC -)
4. Public Square/Plazas Assessment (Form 7 and 8 – includes SOPARC)
5. Sports Fields Assessment (Form 9 and 10 –includes SOPARC)
6. Recreation Center Assessment (Form 11 and 12 – includes SOPARC)
7. Shopping Areas Assessment (Form 13 and 14 – includes SOPARC)
8. Policy Assessment (Form 15)

The tool is intended to be an audit. Nevertheless some items must be filled in using reported data (e.g. from school authorities regarding number of PE lessons per week, or from Recreation Centers records of usage, etc.). The source of information, whether it be directly from the audit done by a member of the research team or elsewhere (self report, official records, GIS data) must be recorded in every form to further assess the quality and comparability of the data.

We identified a research partner in Colombia willing to pilot test the tool in the city of Pasto. Some adaptations of the tool were necessary for this. This worked well since the tool is designed in such way that if each individual form (out of the total 15) is used completely, without eliminating any of its items, then the data obtained will be comparable to data collected elsewhere.

Therefore, researchers can choose which forms they want to use according to their needs, budget, time and characteristics of their city.

Strengths and Weaknesses

This study has various weaknesses. Primarily, a clear limitation was the fact that there is no published data on environmental and policy correlates of physical activity for Latin America and therefore the items we included in the tool relate to the known correlates for USA/UK. Nonetheless It must be noted that this is also a problem for a substantial proportion of the measured items in many of the USA/UK tools (i.e. they assess environmental components that have not yet been proven to be correlated to increased or decreased physical activity). Nevertheless, the US already counts with over 70 well defined environmental correlates of physical activity. Hence, the gap in knowledge in this area is outstanding for the Latin American region. Another issue is the fact that given the cultural and structural differences between Latin American and US/UK settings, we weren't able to adapt a previously validated tool, and thus we had to come up with a new tool that has not yet been piloted for validity and practicality in the field. Finally, another important criticism is that our tool attempts to be adaptable for any urban setting in the entire Latin American region. Although we have many reasons to believe this is plausible in spite of the heterogeneity of the region, this is yet to be assessed in each country.

On the other hand, our study has many strengths worth mentioning. This tool is the first of its type focusing on Latin American environment and policies assessment for physical activity. Additionally, we used an evidence based approach and included consultations with top-field experts for its development. Finally and most importantly, it provides a practical option to assess physical activity environments and policies in Latin America.

Conclusion

The tool developed for this rotation project needs further pilot testing to guarantee its utility and validity in assessing physical activity environments in Latin America.

An important contribution of this study was that we discovered the gap in knowledge that exists regarding the environmental and policy determinants for physical activity in Latin America, given these have not yet been defined. Hence, the next step towards this will be to identify such determinants using objective measures for both the potential determinants and physical activity practice, to further assess the correlations between these two.

After pilot testing and identification of the true determinants of physical activity in Latin America, this tool will result in a practical instrument to: 1) assess the characteristics of Latin American environments that promote or prevent adequate physical activity levels, 2) identify opportunities to promote physical activity through environmental and policy interventions, and 3) evaluate environmental and policy interventions that promote physical activity in Latin America.

Dissemination

An abstract for a poster presentation was submitted for the 3rd International Congress on Physical Activity and Public Health to be held in Toronto, Canada, in May 2010. After this we will elaborate a manuscript for publication.

The tool will be pilot tested in Pasto, Colombia.

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Databases for Tool Search:

1. http://www.drjamessallis.sdsu.edu/measures.html James Sallis measures and surveys
2. http://www.activelivingresearch.org/resourcesearch/toolsandmeasures Active Living Research Database
3. http://www.healthyeatingresearch.org/ Healthy Eating Research Database
4. http://www.ncpad.org/ The National Center on Physical Activity and Disability Database
5. http://www.health.gov/PAGuidelines/ U.S. Department of Health and Human Services, Physical Activity Guidelines and Tools
6. http://www.thecommunityguide.org/pa/index.html The Community Guide
7. http://www.euro.who.int/eprise/main/WHO/Progs/TRT/policy/ World Health Organization: Regional Office for Europe. Quantifying the positive health effects of walking and cycling.
8. http://www.cdc.gov/healthyplaces/ Center for Disease Control Resources Database: Designing and Building Healthy Places
9. http://www.cdc.gov/nccdphp/dnpa/physical/health_professionals/active_environments/index.htm Center for Disease Control Resources Database: Physical Activity Resources for Health Professionals

Appendix 9: General Information Survey for IPEN-Mexico study

INFORMACIÓN GENERAL DEL PARTICIPANTE Y CONTROL DE ACELERÓMETROS

1. CODIGO DEL ENCUESTADOR |__|__|

2. Folio |__|__|__|__|__|__|__|__|__|__|__|__|__|

3. Nombre completo ____________________________

4. Teléfono ______________________

5. Dirección ____

6. Numero de acelerómetro ___________________________

7. Fecha de inicialización |__|__|__|__|__|__|

8. Fecha de entrega |__|__|__|__|__|__|

9. Fecha de recolección programada |__|__|__|__|__|__|

10. Hora de recolección programada___________________

11. Fecha de llamada1 programada |__|__|__|__|__|__|

12. Horario llamada 1 programada _____________________

13. Fecha de Llamada1 |__|__|__|__|__|__|

14. Hora de Llamada1 |__|__|__|__|

15. Código del encuestador que realizó llamada 1 |__|__|

16. Observaciones de Llamada1____________________________________

17. Fecha de Llamada 2 programada |__|__|__|__|__|__|

18. Horario de Llamada 2 programada __________________

19. Fecha de Llamada 2 |__|__|__|__|__|__|

20. Hora de Llamada2 |__|__|__|__|

21. Código del encuestador que realizó llamada 2 |__|__|

22. Observaciones de Llamada 2 _____________________________________

23. Fecha de recolección del acelerómetro |__|__|__|__|__|__|

24. Número de días validos |__|__|

25. Reutilización 1. Si 2. No

26. Número de días válidos de reutilización |__|__|

27. Total de días validos |__|__|

28. Entrega final 1. Si 2. No

29. Peso (Kg)________________

30. Talla (cm) _______________

31. Correo electrónico _________________________

Observaciones:

____

____

Appendix 10: Instructions for use of accelerometer given to participants of the IPEN-Mexico study

EMORY

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INSTRUCCIONES PARA EL USO DEL ACELERÓMETRO

Este pequeño medidor registra el movimiento en general, y con ello obtenemos una mejor idea de su nivel de actividad física. El medidor no registra donde está ni el tipo de actividad que está haciendo.
Es muy importante para nuestro estudio que usted utilice el acelerómetro correctamente. Por favor siga las siguientes instrucciones cuidadosamente:

1. Ponga el medidor con el cinturón alrededor de la cintura (Figura 1.).
2. Use el medidor de la manera más cómoda para usted. Si es necesario, puede ajustar el cinturón jalando del extremo para apretarla o empujar parte de la correa a través del lazo para aflojarla.
3. Cuando utilice el acelerómetro, la cara que contiene las letras grabadas con el logo de Actigraph debe apuntar hacia afuera y la cara que contiene la etiqueta (información de contacto) impresa debe apuntar hacia usted.
4. De igual manera es muy importante que la pequeña etiqueta plateada localizada en uno de los extremos del aparato apunte hacia arriba.
5. Utilice el acelerómetro contra su cuerpo, justo arriba de su cadera derecha (Figura 1.).
6. Procure colocarlo lejos de su teléfono celular.
7. Colóquelo en las mañanas, en cuanto se levante o inmediatamente después de bañarse. Retírelo justo antes de ir a dormir, cuando vaya a tomar un baño o a nadar, o cuando corra peligro de mojarse.
8. Para no olvidar ponerse el aparato, colóquelo en la mesa de noche, cerca de sus llaves, cartera, u objetos personales de manera que recuerde usarlo. Para la validez de la información es muy importante que usted use el aparato la mayoría del tiempo posible por los próximos 7 días.
9. Durante los siguientes 7 días, por favor no cambie en nada su comportamiento o actividades habituales.
10. No deje que nadie más use el medidor.
11. No hay interruptor para prender o apagar el medidor. Este funciona continuamente. El medidor ya tiene una pila que dura 10 días y está programado para funcionar sin necesidad de que lo prenda. Por favor, no intente destapar el medidor.

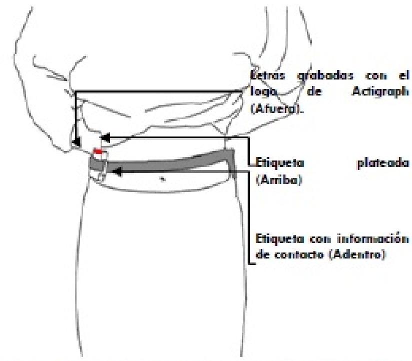


Figura 1. Posición correcta del acelerómetro sobre cadera derecha.

Appendix 11: Accelerometer log used by participants of the IPEN-Mexico study

Diario de acelerómetro

Use el acelerómetro por siete (7) días seguidos, incluyendo el fin de semana. En los espacios de abajo, escriba las fechas, días y horas en los que usó el acelerómetro. Si se quitó el aparato por más de media hora (30 minutos), para bañarse, nadar o tomar una siesta, anote cuándo se lo quitó y por qué. Si en alguno de los 7 días no pudo usar el acelerómetro por lo menos 12 horas, úselo un octavo día. Gracias!

Por favor comience a usar el aparato el: ________________________.
El ultimo día para el cuál su aparato tiene batería es: __________________!

Día 1
(circule el día) **Lun Mar Miér Jue Vie Sáb Dom** **Fecha**__________

Hora en que se lo puso: am / pm
Hora en que se lo quitó: am / pm
Horario en que se lo quitó durante el día (ej. 10:30-11am): ____ _________ _________
Razón (ej. alberca): _________ _________ _________

Día 2
(circule el día) **Lun Mar Miér Jue Vie Sáb Dom** **Fecha**__________

Hora en que se lo puso: am / pm
Hora en que se lo quitó: am / pm
Horario en que se lo quitó durante el día (ej. 10:30-11am): ____ _________ _________
Razón (ej. alberca): _________ _________ _________

Día 3
(circule el día) **Lun Mar Miér Jue Vie Sáb Dom** **Fecha**__________

Hora en que se lo puso: am / pm
Hora en que se lo quitó: am / pm
Horario en que se lo quitó durante el día (ej. 10:30-11am): ____ _________ _________
Razón (ej. alberca): _________ _________ _________

Día 4
(circule el día) **Lun Mar Miér Jue Vie Sáb Dom** **Fecha**__________

Hora en que se lo puso: am / pm
Hora en que se lo quitó: am / pm
Horario en que se lo quitó durante el día (ej. 10:30-11am): ____ _________ _________
Razón (ej. alberca): _________ _________ _________

Día 5

(circule el dia) **Lun Mar Miér Jue Vie Sáb Dom Fecha____________**

Hora en que se lo puso: am / pm **Hora en que se lo quitó:** am / pm	
Horario en que se lo quitó durante el día (ej. 10:30-11am): _____ __________ __________ **Razón (ej. alberca):** __________ __________ __________	

Día 6

(circule el dia) **Lun Mar Miér Jue Vie Sáb Dom Fecha____________**

Hora en que se lo puso: am / pm **Hora en que se lo quitó:** am / pm	
Horario en que se lo quitó durante el día (ej. 10:30-11am): _____ __________ __________ **Razón (ej. alberca):** __________ __________ __________	

Día 7

(circule el dia) **Lun Mar Miér Jue Vie Sáb Dom Fecha____________**

Hora en que se lo puso: am / pm **Hora en que se lo quitó:** am / pm	
Horario en que se lo quitó durante el día (ej. 10:30-11am): _____ __________ __________ **Razón (ej. alberca):** __________ __________ __________	

Día 8 (de ser necesario)

(circule el dia) **Lun Mar Miér Jue Vie Sáb Dom Fecha____________**

Hora en que se lo puso: am / pm **Hora en que se lo quitó:** am / pm	
Horario en que se lo quitó durante el día (ej. 10:30-11am): _____ __________ __________ **Razón (ej. alberca):** __________ __________ __________	

¡Es todo! ¡Muchas gracias por su participación!

PARA USO OFICIAL UNICAMENTE

ID del participante ______________	Fecha de inicialización: ______________
Encuestador ______________	Dias válidos: ______________
Número de aparato ______________	Fecha de captura : ______________

Appendix 12: Example of Individual study results for participants (incentive for participation)

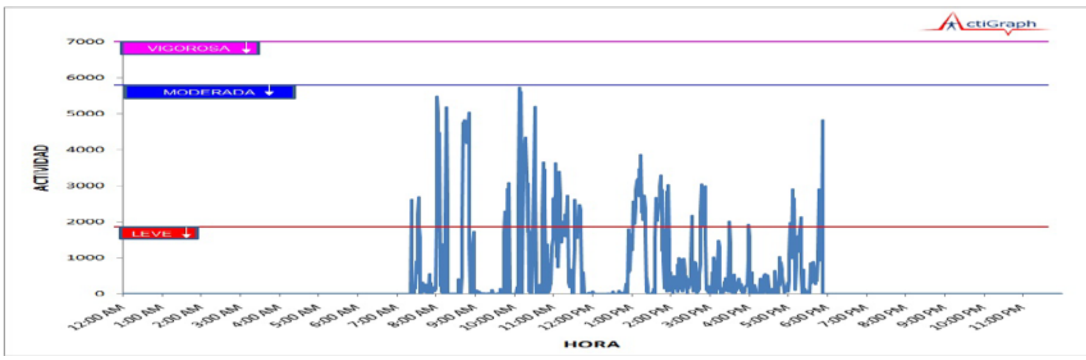
EMORY

CDC FOUNDATION
Helping CDC Do More, Faster

Nombre: --------------------- **No. de participante: 340**

Días válidos de actividad : 6

<u>Actividad física en un día promedio de los estudiados</u>



Diagnóstico de Actividad Física: MODERADA

Nivel de Actividad Física	Interpretación
Leve	Menos de 75 minutos de actividad física moderada o vigorosa por semana
Moderada	Entre 75 y 150 minutos de actividad física moderada a vigorosa por semana
Intensa	Más de 150 minutos de actividad física por semana. Se cumplen las recomendaciones oficiales

Peso: 86.0 kilogramos   Estatura: 1.72 metros   **Diagnóstico: Sobrepeso**

Estatus Nutricional	Interpretación
Normal	El peso es saludable y no representa un riesgo para la salud
Sobrepeso	En riesgo de obesidad
Obesidad	En riesgo de padecer diabetes, enfermedades cardiovasculares y otros padecimientos

Recomendaciones sobre estilos de vida saludables para mejorar la salud

ACTIVIDAD FÍSICA

• La Organización Mundial de la Salud (OMS) recomienda realizar 150 minutos de actividad física moderada a vigorosa a la semana.

• Existe evidencia científica que demuestra que si uno cumple con la recomendación de la OMS puede:

- Incrementar su esperanza de vida
- Disminuir el riesgo de enfermadedes del corazón
- Disminuir el riesgo de desarrollar Diabetes
- Tener mejor coordinación psico-motora
- Gozar de una buena salud ósea y prevenir fracturas y torceduras
- Prevenir varios tipos de cáncer
- Reducir el riesgo de depresión
- Reducir las probabilidades de presentar sobrepeso u obesidad

Consejos para cumplir con la actividad física suficiente para una vida saludable

- Todo cuenta!
- Con caminar a un paso no muy lento es suficiente, se puede hacer por placer o incorporarlo a la rutina diari
- No se tiene que hacer por períodos prolongados, sino que se puede fragmentar a lo largo del día (ejemplo: 10 minutos en la mañana, 10 al medio día y 10 en la noche)
- Mientras más intensa sea la actividad es mejor, pero lo que sea es mejor que nada. (Ejemplo: Correr es mejor que trotar, trotar es mejor que caminar, caminar es mejor que estar parado sin moverse, estar parado sin moverse es mejor que estar sentado) Por lo tanto, es mejor empezar a incorporar la actividad física en nuestra rutina diaria poco a poco.
- No hace falta hacer algún deporte o ir al gimnasio, actividades como sacar a pasear al perro, caminar hacia la parada de la ruta, hacer mandados, etc., cuentan
- Consejos claves: Si usa el transporte público, no siempre tomarlo en el punto más cercano al hogar, caminar un poquito más hasta otro punto donde pare.
- Si uno se transporta en coche, no estacionarlo en el lugar más cercano a la entrada de su destino, así uno debe caminar un poco más
- Si uno tiene un trabajo donde se está sentado todo el día, con tomarse cinco minutos cada hora y media para caminar un poco o hacer estiramientos basta.
- Planear actividades en familia o con amigos el fin de semana que impliquen ser activo (puede ser sólo caminar), en lugar de favorecer actividades sedentarias (como ver la televisión).

NUTRICIÓN

• Una buena nutrición nos puede ayudar a tener una mejor calidad de vida y prevenir varias enfermedades, entre estas se encuentran:

- Sobrepeso y Obesidad
- Presión arterial alta
- Problemas del corazón
- Diabetes
- Varios tipos de cáncer
- Gastritis
- Colitis
- Diverticulosis
- Problemas en los riñones
- Problemas en el hígado
- Depresión

Consejos para tener una alimentación saludable

- No saltarse comidas. Hacer 3 comidas fuertes al día y tener dos colaciones entre cada una de ellas
- Comer colaciones saludables (una fruta, pepinos o zanahorias con chile y limón, etc.)
- Tomar mucha agua simple y limitar el consumo de bebidas dulces, incluyendo jugos naturales
- Consumir leche semi-descremada o "light", evitar la leche entera, incluso en los niños (mayores de dos años)
- Si se tiene la costumbre de beber refresco, cambiar a la versión "light"
- Controlar las porciones. Uno debe sentirse satisfecho (sin hambre) después de cada comida, más no lleno.
- Dar preferencia a alimentos integrales (pan integral en vez de blanco, tortilla de maiz en vez de de harina, etc.)
- La porción de carne, pollo o pescado en la comida fuerte del día no debe exceder el tamaño de la palma de la mano. El resto del plato debe ser completado con verduras, cereales (pan, tortilla, etc.) y leguminosas (frijoles, habas, etc.).
- Reducir el consumo de alimentos fritos o empanizados.
- Reducir el consumo de alimentos con mucho dulce
- No comer sólo: tendemos a tener malos hábitos si no comemos acompañados
- No comer comida comprada en la calle más de dos veces a la semana. Si no se tiene tiempo de volver a casa a la hora de la comida, llevar algo de casa para la hora de la comida.
- Darse gusto: Si llevamos una dieta excesivamente estricta y prohibitiva de ciertos alimentos, nos será más difícil apegarnos a ella. Si nos damos ciertos gustos ocasionales (una vez por semana), llevar una dieta saludable nos será más llevadero.

Appendix 13: GIS variable codebook

LIST OF GIS VARIABLES TO BE TRANSFERED TO IPEN		
Count	**Variable Name**	**Description**
1	fullid	IPEN Mexico full participant number (sample: 52_XXXXXXXXXXXX)
2	Cnt_KM_Sc_ALL	Count of parks of all sizes that intersect the 1 KM buffer
3	SumArea__KM_ALL_Ac	Acres of park area of all parks that intersect the 1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
4	SumArea__KM_CAT1_Ac	Acres of park area of Category 1 size parks (as defined by the IPEN protocol), that intersect the 1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
5	SumArea__KM_CAT2_Ac	Acres of park area of Category 2 size parks (as defined by the IPEN protocol), that intersect the 1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
6	SumArea__KM_CAT3_Ac	Acres of park area of Category 3 size parks (as defined by the IPEN protocol), that intersect the 1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
7	SumArea__KM_CAT4_Ac	Acres of park area of Category 4 size parks (as defined by the IPEN protocol), that intersect the 1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
8	SumArea__KM_CAT5_Ac	Acres of park area of Category 5 size parks (as defined by the IPEN protocol), that intersect the 1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
9	SumArea__KM_CAT6_Ac	Acres of park area of Category 6 size parks (as defined by the IPEN protocol), that intersect the 1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
10	Cnt_KM_Sc_CAT1	Count of parks of Category 1 size (as defined by IPEN protocol) that intersect the 1 KM buffer
11	Cnt_KM_Sc_CAT2	Count of parks of Category 2 size (as defined by IPEN protocol) that intersect the 1 KM buffer
12	Cnt_KM_Sc_CAT3	Count of parks of Category 3 size (as defined by IPEN protocol) that intersect the 1 KM buffer
13	Cnt_KM_Sc_CAT4	Count of parks of Category 4 size (as defined by IPEN protocol) that intersect the 1 KM buffer
14	Cnt_KM_Sc_CAT5	Count of parks of Category 5 size (as defined by IPEN protocol) that intersect the 1 KM buffer
15	Cnt_KM_Sc_CAT6	Count of parks of Category 6 size (as defined by IPEN protocol) that intersect the 1 KM buffer
16	Cnt_KM_Wthn_ALL	Count of parks of all sizes fully within the 1 KM buffer
17	Area_Ac_KM_Wthn_ALL	Acres of park area of all parks fully within the 1 KM buffer
18	Cnt_KM_Wthn_CAT1	Count of parks of Category 1 size (as defined by IPEN protocol) that are fully within the 1 KM buffer
19	Area_Ac_KM_Wthn_CAT1	Acres of park area of only Category 1 size parks, that are fully within the 1 KM buffer
20	Cnt_KM_Wthn_CAT2	Count of parks of Category 2 size (as defined by IPEN protocol) that are fully within the 1 KM buffer
21	Area_Ac_KM_Wthn_CAT2	Acres of park area of only Category 2 size parks, that are fully within the 1 KM buffer
22	Cnt_KM_Wthn_CAT3	Count of parks of Category 3 size (as defined by IPEN protocol) that are fully within the 1 KM buffer
23	Area_Ac_KM_Wthn_CAT3	Acres of park area of only Category 3 size parks, that are fully within the 1 KM buffer
24	Cnt_KM_Wthn_CAT4	Count of parks of Category 4 size (as defined by IPEN protocol) that are fully within the 1 KM buffer
25	Area_Ac_KM_Wthn_CAT4	Acres of park area of only Category 4 size parks, that are fully within the 1 KM buffer
26	Cnt_KM_Wthn_CAT5	Count of parks of Category 5 size (as defined by IPEN protocol) that are fully within the 1 KM buffer
27	Area_Ac_KM_Wthn_CAT5	Acres of park area of only Category 5 size parks, that are fully within the 1 KM buffer
28	Cnt_KM_Wthn_CAT6	Count of parks of Category 6 size (as defined by IPEN protocol) that are fully within the 1 KM buffer
29	Area_Ac_KM_Wthn_CAT6	Acres of park area of only Category 6 size parks, that are fully within

		the 1 KM buffer
30	Area_Ac_500_FullAr_ALL	Acres of park area of all parks that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
31	Area_Ac_500_FullAr_CAT1	Acres of park area of Category 1 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
32	Area_Ac_500_FullAr_CAT2	Acres of park area of Category 2 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
33	Area_Ac_500_FullAr_CAT3	Acres of park area of Category 3 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
34	Area_Ac_500_FullAr_CAT4	Acres of park area of Category 4 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
35	Area_Ac_500_FullAr_CAT5	Acres of park area of Category 5 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
36	Area_Ac_500_FullAr_CAT6	Acres of park area of Category 6 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside of the buffer)
37	Cnt_500M_Sc_ALL	Count of parks of all sizes that intersect the 500M buffer
38	Cnt_500M_Sc_CAT1	Count of parks of Category 1 size (as defined by IPEN protocol) that intersect the 500M buffer
39	Cnt_500M_Sc_CAT2	Count of parks of Category 2 size (as defined by IPEN protocol) that intersect the 500M buffer
40	Cnt_500M_Sc_CAT3	Count of parks of Category 3 size (as defined by IPEN protocol) that intersect the500M buffer
41	Cnt_500M_Sc_CAT4	Count of parks of Category 4 size (as defined by IPEN protocol) that intersect the 500M buffer
42	Cnt_500M_Sc_CAT5	Count of parks of Category 5 size (as defined by IPEN protocol) that intersect the 500M buffer
43	Cnt_500M_Sc_CAT6	Count of parks of Category 6 size (as defined by IPEN protocol) that intersect the 500M buffer
44	Cnt_500M_Wthn_ALL	Count of parks of all sizes fully within the 500M buffer
45	Area_Ac_500M_Wthn_ALL	Acres of park area of all parks fully within the 500M buffer
46	Cnt_500M_Wthn_CAT1	Count of parks of Category 1 size (as defined by IPEN protocol) that are fully within the 500M buffer
47	Area_Ac_500M_Wthn_CAT1	Acres of park area of only Category 1 size parks, that are fully within the 500M buffer
48	Cnt_500M_Wthn_CAT2	Count of parks of Category 2 size (as defined by IPEN protocol) that are fully within the 500M buffer
49	Area_Ac_500M_Wthn_CAT2	Acres of park area of only Category 2 size parks, that are fully within the 500M buffer
50	Cnt_500M_Wthn_CAT3	Count of parks of Category 3 size (as defined by IPEN protocol) that are fully within the 500M buffer
51	Area_Ac_500M_Wthn_CAT3	Acres of park area of only Category 3 size parks, that are fully within the 500M buffer
52	Cnt_500M_Wthn_CAT4	Count of parks of Category 4 size (as defined by IPEN protocol) that are fully within the 500M buffer
53	Area_Ac_500M_Wthn_CAT4	Acres of park area of only Category 4 size parks, that are fully within the 500M buffer
54	Cnt_500M_Wthn_CAT5	Count of parks of Category 5 size (as defined by IPEN protocol) that are fully within the 500M buffer
55	Area_Ac_500M_Wthn_CAT5	Acres of park area of only Category 5 size parks, that are fully within the 500M buffer
56	Cnt_500M_Wthn_CAT6	Count of parks of Category 6 size (as defined by IPEN protocol) that are fully within the 500M buffer
57	Area_Ac_500M_Wthn_CAT6	Acres of park area of only Category 6 size parks, that are fully within the 500M buffer
58	LU_500M_M2_Comm	Meters squared of Commercial Land use within the 500M buffer
59	LU_500M_M2_Edu	Meters squared of Educational Land Use within the 500M buffer
60	LU_500M_M2_Oth	Meters squared of Other Land Use within the 500M buffer
61	LU_500M_M2_Rec	Meters squared of Recreational Land Use within the 500M buffer
62	LU_1KM_M2_Comm	Meters squared of Commercial Land Use within the 1 KM buffer
63	LU_1KM_M2_Edu	Meters squared of Educational Land Use within the 1 KM buffer
64	LU_1KM_M2_Oth	Meters squared of Other Land Use within the 1 KM buffer

65	LU_1KM_M2_Rec	Meters squared of Recreational Land Use within the 1 KM buffer
66	KM_BufferM2	Meters squared of 1 KM buffer
67	Sum_ResSc_KM	Total Residential Units within the 1 KM buffer (calculated by using the number of residential units per census tract, and obtaining the area per census tract within each 1 KM buffer, and adding values of all slices that made up the 1 KM buffer).
68	Sum_PopSc_KM	Total Population within 1 KM buffer (calculated by using the number of people per census tract, and obtaining the area per census tract within each 1 KM buffer, and adding values of all slices that made up the 1 KM buffer).
69	Gross_ResD_KM	Number of residences per 1 KM buffer over total Meters Squared of 1 KM buffer
70	Net_ResD_KM	Number of residences per 1 KM buffer over Meters Squared of Residential land use area per 1 KM buffer
71	LU_1KM_M2_Res	Meters squared of Residential Land Use within the 1 KM buffer
72	LU_500M_M2_Res	Meters squared of Residential Land Use within the 500M buffer
73	M500_BufferM2	Meters squared of 500M buffer
74	Sum_ResSc_500	Total Residential Units within the 500M buffer (calculated by using the number of residential units per census tract, and obtaining the area per census tract within each 1 KM buffer, and adding values of all slices that made up the 1 KM buffer).
75	Sum_PopSc_500	Total Population within 500M buffer (calculated by using the number of people per census tract, and obtaining the area per census tract within each 1 KM buffer, and adding values of all slices that made up the 1 KM buffer).
76	Gross_ResD_500	Number of residences per 1 KM buffer over total Meters Squared of 1 KM buffer
77	Net_ResD_500	Number of residences per 1 KM buffer over Meters Squared of Residential land use area per 500M buffer
78	INT_1KM_Ct	Number of 3-way intersections within the 1 KM buffer
79	Int_Dens_1KM	Number of 3-way intersections within the 1 KM buffer over KM squared of 1 KM buffer
80	INT_500M_Ct	Number of 3-way intersections within the 500M buffer
81	Int_Dens_500M	Number of 3-way intersections within the 500M buffer over KM squared of 500M buffer
82	PubTrans_1KM_Ct	Number of public transportation (bus) routes that intersect 1 KM buffer
83	PubTrans_500M_Ct	Number of public transportation (bus) routes that intersect 500M buffer
84	PubTrans_1KM_Dens	Number of public transportation (bus) routes that intersect 1 KM buffer over KM squared of 1 KM buffer
85	PubTrans_500M_Dens	Number of public transportation (bus) routes that intersect 500M buffer over KM squared of 500M buffer

OTHER GIS AVAILABLE VARIABLES IN IPEN-MEX DATASET, NOT INCLUDED IN DATA TRANSFER.

Count	Variable Name	Description
1	SumArea_KM_ALL_M2	Meters squared of park area of all parks that intersect the1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
2	SumArea_KM_CAT1_M2	Meters squared of park area of Category 1 size parks (as defined by the IPEN protocol), that intersect the1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
3	SumArea_KM_CAT2_M2	Meters squared of park area of Category 2 size parks (as defined by the IPEN protocol), that intersect the1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
4	SumArea_KM_CAT3_M2	Meters squared of park area of Category 3 size parks (as defined by the IPEN protocol), that intersect the1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
5	SumArea_KM_CAT4_M2	Meters squared of park area of Category 4 size parks (as defined by the IPEN protocol), that intersect the1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
6	SumArea_KM_CAT5_M2	Meters squared of park area of Category 5 size parks (as defined by the

		IPEN protocol), that intersect the1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
7	SumArea_KM_CAT6_M2	Meters squared of park area of Category 6 size parks (as defined by the IPEN protocol), that intersect the1 KM buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
8	Area_M2_KM_Sc_ALL	Meters squared of all park area within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
9	Area_Ac_KM_Sc_ALL	Acres of all park area within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
10	Area_M2_KM_Sc_CAT1	Meters squared of park area of Category 1 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
11	Area_Ac_KM_Sc_CAT1	Acres of park area of Category 1 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
12	Area_M2_KM_Sc_CAT2	Meters squared of park area of Category 2 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
13	Area_Ac_KM_Sc_CAT2	Acres of park area of Category 2 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
14	Area_M2_KM_Sc_CAT3	Meters squared of park area of Category 3 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
15	Area_Ac_KM_Sc_CAT3	Acres of park area of Category 3 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
16	Area_M2_KM_Sc_CAT4	Meters squared of park area of Category 4 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
17	Area_Ac_KM_Sc_CAT4	Acres of park area of Category 4 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
18	Area_M2_KM_Sc_CAT5	Meters squared of park area of Category 5 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
19	Area_Ac_KM_Sc_CAT5	Acres of park area of Category 5 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
20	Area_M2_KM_Sc_CAT6	Meters squared of park area of Category 6 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
21	Area_Ac_KM_Sc_CAT6	Acres of park area of Category 6 parks only, within each 1 KM buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
22	ACCEDATA_Avlbl	Availability of accelerometry data for each participant (1=yes, 0 or 2=no) CHECK!
23	Area_M2_KM_Wthn_ALL	Meters squared of park area of all parks fully within the 1 KM buffer
24	Area_M2_KM_Wthn_CAT1	Meters squared of park area of only Category 1 size parks, that are fully within the 1 KM buffer
25	Area_M2_KM_Wthn_CAT2	Meters squared of park area of only Category 2 size parks, that are fully within the 1 KM buffer
26	Area_M2_KM_Wthn_CAT3	Meters squared of park area of only Category 3 size parks, that are fully within the 1 KM buffer
27	Area_M2_KM_Wthn_CAT4	Meters squared of park area of only Category 4 size parks, that are fully within the 1 KM buffer
28	Area_M2_KM_Wthn_CAT5	Meters squared of park area of only Category 5 size parks, that are fully within the 1 KM buffer
29	Area_M2_KM_Wthn_CAT6	Meters squared of park area of only Category 6 size parks, that are fully within the 1 KM buffer
30	Area_M2_500_FullAr_ALL	Meters squared of park area of all parks that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
31	Area_M2_500_FullAr_CAT1	Meters squared of park area of Category 1 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given

		buffer)
32	Area_M2_500_FullAr_CAT2	Meters squared of park area of Category 2 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
33	Area_M2_500_FullAr_CAT3	Meters squared of park area of Category 3 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
34	Area_M2_500_FullAr_CAT4	Meters squared of park area of Category 4 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
35	Area_M2_500_FullAr_CAT5	Meters squared of park area of Category 5 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
36	Area_M2_500_FullAr_CAT6	Meters squared of park area of Category 6 size parks (as defined by the IPEN protocol), that intersect the 500M buffer (the area includes the whole park, i.e. both the portions that fall inside and outside the given buffer)
37	Area_M2_500M_Sc_ALL	Meters squared of all park area within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
38	Area_Ac_500M_Sc_ALL	Acres of all park area within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
39	Area_M2_500M_Sc_CAT1	Meters squared of park area of Category 1 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
40	Area_Ac_500M_Sc_CAT1	Acres of park area of Category 1 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
41	Area_M2_500M_Sc_CAT2	Meters squared of park area of Category 2 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
42	Area_Ac_500M_Sc_CAT2	Acres of park area of Category 2 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
43	Area_M2_500M_Sc_CAT3	Meters squared of park area of Category 3 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
44	Area_Ac_500M_Sc_CAT3	Acres of park area of Category 3 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
45	Area_M2_500M_Sc_CAT4	Meters squared of park area of Category 4 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
46	Area_Ac_500M_Sc_CAT4	Acres of park area of Category 4 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
47	Area_M2_500M_Sc_CAT5	Meters squared of park area of Category 5 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
48	Area_Ac_500M_Sc_CAT5	Acres of park area of Category 5 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
49	Area_M2_500M_Sc_CAT6	Meters squared of park area of Category 6 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
50	Area_Ac_500M_Sc_CAT6	Acres of park area of Category 6 parks only, within each 500M buffer (only slices considered, not full park area if part of the park falls outside of the buffer)
51	Area_M2_500M_Wthn_ALL	Meters squared of park area of all parks fully within the 500M buffer
52	Area_M2_500M_Wthn_CAT1	Meters squared of park area of only Category 1 size parks, that are fully within the 500M buffer
53	Area_M2_500M_Wthn_CAT2	Meters squared of park area of only Category 2 size parks, that are fully within the 500M buffer

54	Area_M2_500M_Wthn_CAT3	Meters squared of park area of only Category 3 size parks, that are fully within the 500M buffer
55	Area_M2_500M_Wthn_CAT4	Meters squared of park area of only Category 4 size parks, that are fully within the 500M buffer
56	Area_M2_500M_Wthn_CAT5	Meters squared of park area of only Category 5 size parks, that are fully within the 500M buffer
57	Area_M2_500M_Wthn_CAT6	Meters squared of park area of only Category 6 size parks, that are fully within the 500M buffer
58	Gross_PopD_KM	Number of people per 1 KM buffer over total Meters Squared of 1 KM buffer
59	Net_PopD_KM	Number of people per 1 KM buffer over Meters Squared of Residential land use area per 1 KM buffer
60	Gross_PopD_500	Number of people per 1 KM buffer over total Meters Squared of 1 KM buffer
61	Net_PopD_500	Number of people per 1 KM buffer over Meters Squared of Residential land use area per 1 KM buffer
62	Buffer_1KM_ArKM	KM squared of 1 KM buffer
63	Buffer_500M_ArKM	KM squared of 500M buffer

Appendix 14: IPEN-Mexico survey variable codebook

Variable name	Type (numerical-ordinal, numerical-non ordinal or categorical)	Description	Range/Categories/examples
fullid	numerical-non ordinal	Full IPEN Mexico participant ID code. 52 (Mexico's country code) followed by 12 digits. Digit 1: 1=male, 2=female; Digit 2: 1=low walkability neighborhood, 2=high walkability neighborhood; Digit 3: 1=very low ses neighborhood, 2=low ses neighborhood, 3=high ses neighborhood, 4=very high ses neighborhood; Digits 4-6: neighborhood (ageb) code; Digits 7-9: Block code; Digits 10-12: participant unique identifier code.	Sample: 52_124001001001 (male participante from high walkability and very high ses neighborhood, from block 001, with participant ID code 001.
Country	numerical-non ordinal	code for Mexico	52
city	numerical-non ordinal	code for Cuernavaca	1
sex	numerical-non ordinal	code for participant's sex	1=male, 2=female
wa	numerical-ordinal	code for neighborhood walkability	1=low walkability, 2=high walkability
ses	numerical-ordinal	code for neighborhood ses (as defined by government sources)	1=very low, 2=low, 3=high, 4=very high
ageb	numerical-non ordinal	code for neighborhood (ageb=census tract)	1-32
block	numerical-non ordinal	code for block	1-231
ppt	numerical-non ordinal	unique identifier code for ipen-mex participants	1-685
ACC_NUM	numerical-non ordinal	code of the accelerometer worn by the given participant. IPEN-MEX accelerometer codes	1-65
date	date	Date the survey took place	May 2011 to September 2011
ENC	numerical-non ordinal	identifier code for field worker that did the face to face survey application	1-12
SUP	numerical-non ordinal	identifier code for the supervisor that verified that the survey was filled in correctly before data entry took place	1-10
colonia	categorical	name of the neighborhood the participant lives in (NOTE: The geographical boundaries of the neighborhood are not the same of the census tract. For IPEN-Mex purposes, census tracts were used instead of neighborhoods for sample selection, since neighborhoods don't hold an administrative value in Mexico, and there is no official information about them, yet people identify the fact that they live in a neighborhood. The name of the neighborhood (colonia) was reported by the participants.	Names (text)
Time_S	time	Time of start of survey	_ _ : _ _
Time_F	time	Time of end of survey	_ _ : _ _
Q2A_DIAS	Numerical-ordinal	Days per week the participant used a bus for transportation	0-7
Q2A2_HRA	Numerical-ordinal	Hours per day the participant spent in a bus for transportation (multiply X 60 to convert to minutes)	0-24
Q2A_MIN	Numerical-ordinal	Minutes per day the participant spent in a bus for transportation (to obtain total time of time spent in a bus per week, add this variable to the previous one refering to hours, and multiply times number of days when the participant used a bus)	0-59
Q2B_DIAS	numerical-ordinal	Days per week the participant used a taxi for transportation	0-7
Q2B_HRA	numerical-ordinal	Hours per day the participant spent in a taxi for transportation	0-24
Q2B_MIN	numerical-	Minutes per day the participant spent in a taxi for	0-59

	ordinal	transportation (to obtain total time of time spent in a taxi per week, add this variable to the previous one refering to hours, and multiply times number of days when the participant used a taxi)	
Q2C_DIAS	numerical-ordinal	Days per week the participant used a car for transportation	0-7
Q2C_HRA	numerical-ordinal	Hours per day the participant spent in a car for transportation	0-24
Q2C_MIN	numerical-ordinal	Minutes per day the participant spent in a car for transportation (to obtain total time of time spent in a car per week, add this variable to the previous one refering to hours, and multiply times number of days when the participant used a car)	0-59
Q2D_DIAS	numerical-ordinal	Days per week the participant used a motorbike for transportation	0-7
Q2D_HRA	numerical-ordinal	Hours per day the participant spent in a motorbike for transportation	0-24
Q2D_MIN	numerical-ordinal	Minutes per day the participant spent in a motorbike for transportation (to obtain total time of time spent in a motorbike per week, add this variable to the previous one refering to hours, and multiply times number of days when the participant used a motorbike)	0-59
Q2E_DIAS	numerical-ordinal	Days per week the participant used another motorized method for transportation	0-7
Q2E_HRA	numerical-ordinal	Hours per day the participant spent in another motorized method for transportation	0-24
Q2E_MIN	numerical-ordinal	Minutes per day the participant spent in another motorized method for transportation (to obtain total time of time spent in a another motorized method per week, add this variable to the previous one refering to hours, and multiply times number of days when the participant used another motorized method)	0-59
Q2E_CUAL	categorical	What is the other motorized method the participant uses	text
Q3TP	numerical-ordinal	How many days do you use public transportation?	0=0 days, 1=1 day, 2=2 days, 3=3 days, 4=4 days, 5=5 days, 6=6 days, 7=7 days, 0.5=a few times a month, less than once a week.
Q4TP	numerical-ordinal	How many days do you use private (motorized) transportation? (ie car or motorbike)	0=0 days, 1=1 day, 2=2 days, 3=3 days, 4=4 days, 5=5 days, 6=6 days, 7=7 days, 0.5=a few times a month, less than once a week.
Q51MT	categorical	When you leave home, what is the first (motorized) form of transportation you use?	text; 99=NA, ie. Does not use motorized transportation.
Q6_MIN	numerical-ordinal	How many minutes must you walk to reach your first menas of (motorized) transportation?	0-59; 99=NA (does not use motorized transportation)
Q6_HRA	numerical-ordinal	How many hours must you walk to reach your first means of transportation? (NOTE: to obtain total time the participant walks to its first means of motorized transportation, add this variable to the previous one, ie. Add hours to minutes to obtain a total. Finally multiply X days per week to obtain mins per week)	0-24; 99=NA (does not use motorized transportation)
Q7MTF	categorical	What is the last (motorized) form of transportation you use.	text (Note: Any word with a "2" in the end, eg. RUTA2, means its not the same vehicle they started their journey in, i.e. they use more than one motorized transportation to reach their final destination); 99=NA, ie. Does not use motorized transportation.
Q8_MIN	numerical-ordinal	How many minutes must you walk from your last means of (motorized) transportation to your final destination?	0-59; 99=NA (does not use motorized transportation)
Q8_HRA	numerical-ordinal	How many hours must you walk to reach your first means of transportation? (NOTE: to obtain total time	0-24; 99=NA (does not use motorized transportation)

		the participant walks to its first means of motorized transportation, add this variable to the previous one that needs to be converted to minutes, ie. Add hours to minutes to obtain a total)	
Q10VM	numerical-non ordinal	During the last 7 days, did you use a motorized vehicle for transportation?	1=yes, 2=no, 88=does not answer
Q12_DIASsem	numerical-ordinal	How many days of last week did you use a motorized vehicle for transportation?	0-7; 99=NA (does not use motorized transportation); 88=does not answer/doesn't know
Q12_HRAdia	numerical-ordinal	Hours per day the participant spent in a motorized vehicle	0-24; 99=NA (does not use motorized transportation); 88=does not answer/doesn't know
Q12_MINdia	numerical-ordinal	Minutes per day the participant spent in a motorized vehicle (NOTE: to obtain total time the participant spent in a motorized vehicle per day, add this variable to the previous one, ie add minutes plus hours. To obtain time spent in a motorized vehicle per week, add minutes plus hours per day and multiply times the reported days per week)	0-59; 99=NA (does not use motorized transportation); 88=does not answer/doesn't know
Q12_HRAsem	numerical-ordinal	Hours per week in motorized vehicles. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours per week.	0-168; 99=NA (does not use motorized transportation OR already responded using average hourse per day); 88=does not answer/doesn't know
Q12_MINsem	numerical-ordinal	Minutes per week in motorized vehicles. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours per week. NOTE: to obtain total time spent in motorized vehicles per week, add this variable to the previous one, ie add minutes per week to hours per week.	0-59; 99=NA (does not use motorized transportation OR already responded using average hourse per day); 88=does not answer/doesn't know
Q14_CAM	numerical-non ordinal	During the past 7 days, did the participant walk for at least 10 continuous minutes for transportation	1=yes, 2=no, 88=does not answer
Q15_DIASsem	numerical-ordinal	How many days of last week did you walk for transportation?	0-7; 99=NA (does not walk for transportation); 88=does not answer/doesn't know
Q16_HRAdia	numerical-ordinal	Hours per day the participant walked for transportation	0-24; 99=NA (does not walk for transportation); 88=does not answer/doesn't know
Q16_MINdia	numerical-ordinal	Minutes per day the participant walked for transportation (NOTE: to obtain total time the participant walked for transportation per day, add this variable to the previous one, ie add minutes plus hours. To obtain time per week, add minutes plus hours per day and multiply times the reported days per week)	0-59; 99=NA (does not walk for transportation); 88=does not answer/doesn't know
Q16_HRAsem	numerical-ordinal	Hours per week the participant walks for transportation. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week.	0-168; 99=NA (does not walk for transportation OR already responded using average hourse per day); 88=does not answer/doesn't know
Q16_MINsem	numerical-ordinal	Minutes per week the participant walks for transportation. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week. NOTE: to obtain total time spent walking for transportation per week, add this variable to the previous one, ie add minutes per week to hours per week.	0-59; 99=NA (does not walk for transportation transportation OR already responded using average hourse per day); 88=does not answer/doesn't know
Q16B1_DSEM	numerical-ordinal	During the past 7 days, how many days did you use a bicycle for transportation for at least 10 minutes in a row?	0-7, 88=no reply
Q16B2_HDIA	numerical-	Hours per day the participant biked for transportation	0-24, 99=does not apply

	ordinal		(participant does not bike for transportation), 88=no reply
Q16B2MIND	numerical-ordinal	Minutes per day the participant biked for transportation (NOTE: to obtain total time the participant biked for transportation per day, add this variable to the previous one, ie add minutes plus hours. To obtain time per week, add minutes plus hours per day and multiply times the reported days per week)	0-59, 99=does not apply (participant does not bike for transportation), 88=no reply
Q16B3_HSEM	numerical-ordinal	Hours per week the participant bikes for transportation. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week.	0-168, 99=does not apply (participant does not bike for transportation), 88=no reply
Q16B3MINSEM	numerical-ordinal	Minutes per week the participant bikes for transportation. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week. NOTE: to obtain total time spent biking for transportation per week, add this variable to the previous one, ie add minutes per week to hours per week.	0-59, 99=does not apply (participant does not bike for transportation), 88=no reply
Q18CAM10m	numerical-non ordinal	During the past 7 days, did the participant walk for at least 10 continuous minutes for leisure	1=yes, 2=no, 88=does not answer
Q19_DIAsem	numerical-ordinal	How many days of last week did you walk for leisure?	0-7; 99=NA (does not walk for leisure); 88=does not answer/doesn't know
Q20_HRAdia	numerical-ordinal	Hours per day the participant walked for leisure	0-24; 99=NA (does not walk for leisure); 88=does not answer/doesn't know
Q20_MINdia	numerical-ordinal	Minutes per day the participant walked for leisure(NOTE: to obtain total time the participant walked for leisure per day, add this variable to the previous one, ie add minutes plus hours. To obtain time per week, add minutes plus hours per day and multiply times the reported days per week)	0-59; 99=NA (does not walk for leisure); 88=does not answer/doesn't know
Q20_HRAsem	numerical-ordinal	Hours per week the participant walks for leisure. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week.	0-168; 99=NA (does not walk for leisure OR already responded using average hourse per day); 88=does not answer/doesn't know
Q20_MINsem	numerical-ordinal	Minutes per week the participant walks for leisure. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week. NOTE: to obtain total time walking for leisure per week, add this variable to the previous one, ie add minutes per week to hours per week.	0-59; 99=NA (does not walk for leisure OR already responded using average hourse per day); 88=does not answer/doesn't know
Q22AFV	numerical-non ordinal	During the past 7 days, did the participant perform vigorous PA for at least 10 continuous minutes for leisure	1=yes, 2=no, 88=does not answer
Q23_DIAsem	numerical-ordinal	How many days of last week did the participant perform vigorous PA for leisure?	0-7; 99=NA (does not do vigorous PA); 88=does not answer/doesn't know
Q24_HRAdia	numerical-ordinal	Hours per day the participant performed vigorous PA	0-24; 99=NA (does not do vigorous PA); 88=does not answer/doesn't know
Q24_MINdia	numerical-ordinal	Minutes per day the participant performed vigorous PA (NOTE: to obtain total time of vigorous PA per day, add this variable to the previous one, ie add minutes plus hours. To obtain time per week, add minutes plus hours per day and multiply times the reported days per week)	0-59; 99=NA (does not do vigorous PA); 88=does not answer/doesn't know
Q24_HRAsem	numerical-ordinal	Hours per week the participant performs vigorous PA. Ideally participants should respond by giving average	0-168; 99=NA (does not do vigorous PA OR already

		hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week.	responded using average hourse per day); 88=does not answer/doesn't know
Q24_MINsem	numerical-ordinal	Minutes per week the participant performs vigorous PA. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week. NOTE: to obtain total time of vigorous PA, add this variable to the previous one, ie add minutes per week to hours per week.	0-59; 99=NA (does not do vigorous PA OR already responded using average hourse per day); 88=does not answer/doesn't know
Q26AFM	numerical-non ordinal	During the past 7 days, did the participant perform moderate PA for at least 10 continuous minutes for leisure	1=yes, 2=no, 88=does not answer
Q27_DIAsem	numerical-ordinal	How many days of last week did the participant perform moderate PA for leisure?	0-7; 99=NA (does not do moderate PA); 88=does not answer/doesn't know
Q28_HRAdia	numerical-ordinal	Hours per day the participant performed moderate PA	0-24; 99=NA (does not do moderate PA); 88=does not answer/doesn't know
Q28_MINdia	numerical-ordinal	Minutes per day the participant performed moderate PA (NOTE: to obtain total time of moderate PA per day, add this variable to the previous one, ie add minutes plus hours. To obtain time per week, add minutes plus hours per day and multiply times the reported days per week)	0-59; 99=NA (does not do moderate PA); 88=does not answer/doesn't know
Q28_HRAsem	numerical-ordinal	Hours per week the participant performs moderate PA. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week.	0-168; 99=NA (does not do moderate PA OR already responded using average hourse per day); 88=does not answer/doesn't know
Q28_MINsem	numerical-ordinal	Minutes per week the participant performs moderate PA. Ideally participants should respond by giving average hours per day, yet if it is too complicated for them do to extreme variability throughout the week, they are asked to provide the total hours and minutes per week. NOTE: to obtain total time of moderate PA, add this variable to the previous one, ie add minutes per week to hours per week.	0-59; 99=NA (does not do moderate PA OR already responded using average hourse per day); 88=does not answer/doesn't know
Q30SEN	numerical-non ordinal	During the past 7 days, did the participant sit	1=yes, 2=no, 88=does not answer
Q31_DIAsem	numerical-ordinal	How many days of last week did the participant sit?	0-7; 99=NA (does not do sit); 88=does not answer/doesn't know
Q32_HRAdia	numerical-ordinal	Hours per day, for a WEEK day, that the participant spent time sitting	0-24; 99=NA (does not sit in week days or in total); 88=does not answer/doesn't know
Q32_MINdia	numerical-ordinal	Minutes per day, during a WEEK day, that the participant spent time sitting (NOTE: to obtain total sitting time per week day add this variable to the previous one, ie add minutes plus hours)	0-59; 99=NA (does not sit in week days or in total); 88=does not answer/doesn't know
Q32_HRAs	numerical-ordinal	Hours per day, for a WEEK-END day, that the participant spent time sitting	0-24; 99=NA (does not sit on weekends or in total); 88=does not answer/doesn't know
Q32_MINs	numerical-ordinal	Minutes per day, during a WEEK-END day, that the participant spent time sitting (NOTE: to obtain total sitting time per week day add this variable to the previous one, ie add minutes plus hours)	0-59; 99=NA (does not sit on weekends or in total); 88=does not answer/doesn't know
Q34_aA	categorical	Type of activity the participant does in shopping malls	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_aF	numerical-ordinal	Days per week the participant does PA in shopping malls	0-7; 99=does not do PA in this location
Q34_bA	categorical	Type of activity the participant does in parks	text categories (caminar, correr, trotar, nadar, futbol,

			etc.); 0=does not do activity in this location
Q34_bF	numerical-ordinal	Days per week the participant does PA in parks	0-7; 99=does not do PA in this location
Q34_cA	categorical	Type of activity the participant does in public squares/plazas	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_cF	numerical-ordinal	Days per week the participant does PA in public squares/plazas	0-7; 99=does not do PA in this location
Q34_dA	categorical	Type of activity the participant does in streets	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_dF	numerical-ordinal	Days per week the participant does PA in streets	0-7; 99=does not do PA in this location
Q34_eA	categorical	Type of activity the participant does in cycling paths/closed streets for biking	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_eF	numerical-ordinal	Days per week the participant does PA in cycling paths/closed streets for cycling	0-7; 99=does not do PA in this location
Q34_fA	categorical	Type of activity the participant does in open air courts	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_fF	numerical-ordinal	Days per week the participant does PA in open air courts	0-7; 99=does not do PA in this location
Q34_gA	categorical	Type of activity the participant does in indoor courts	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_gF	numerical-ordinal	Days per week the participant does PA in indoor courts	0-7; 99=does not do PA in this location
Q34_hA	categorical	Type of activity the participant does in a gym	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_hF	numerical-ordinal	Days per week the participant does PA in a gym	0-7; 99=does not do PA in this location
Q34_iA	categorical	Type of activity the participant does in a school/university	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_iF	numerical-ordinal	Days per week the participant does PA in school/university	0-7; 99=does not do PA in this location
Q34_jA	categorical	Type of activity the participant does at work	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_jF	numerical-ordinal	Days per week the participant does PA at work	0-7; 99=does not do PA in this location
Q34_kA	categorical	Type of activity the participant does in museums	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_kF	numerical-ordinal	Days per week the participant does PA in museums	0-7; 99=does not do PA in this location
Q34_lA	categorical	Type of activity the participant does at home	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_lF	numerical-ordinal	Days per week the participant does PA at home	0-7; 99=does not do PA in this location
Q34_mA	categorical	Type of activity the participant does outside/open air/open spaces	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_mF	numerical-	Days per week the participant does PA outside/open	0-7; 99=does not do PA in this

	ordinal	air/open spaces	location
Q34_nA	categorical	Type of activity the participant does at bars	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_nF	numerical-ordinal	Days per week the participant does PA at bars	0-7; 99=does not do PA in this location
Q34_oA	categorical	Type of activity the participant does at nightclubs	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_oF	numerical-ordinal	Days per week the participant does PA at nightclubs	0-7; 99=does not do PA in this location
Q34_pA	categorical	Type of activity the participant does at recreation centers	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_pF	numerical-ordinal	Days per week the participant does PA at recreation centers	0-7; 99=does not do PA in this location
Q24_q_otros	categorical	Other location where the participant regularly does PA	text categories of locations
Q34_qA	categorical	Type of activity the participant does at other location	text categories (caminar, correr, trotar, nadar, futbol, etc.); 0=does not do activity in this location
Q34_qF	numerical-ordinal	Days per week the participant does PA at other location	0-7; 99=does not do PA in this location
Q35_1d	Numerical-ordinal	Days per week (for past 7 days) the participant used a computer/internet for leisure	0-7
Q35_1m	Numerical-ordinal	Minutes per day the participant used a computer/internet for leisure	0-720; 99= does not apply (participant does not use computer/internet for leisure)
Q35_2d	Numerical-ordinal	Days per week (for past 7 days) the participant used videogames	0-7
Q35_2m	Numerical-ordinal	Minutes per day the participant used videogames	0-720; 99= does not apply (participant does not use videogames)
Q35_3d	Numerical-ordinal	Days per week (for past 7 days) the participant spent time reading	0-7
Q35_3m	Numerical-ordinal	Minutes per day the participant spent time reading	0-720; 99= does not apply (participant does not spend time reading)
Q35_4d	Numerical-ordinal	Days per week (for past 7 days) the participant sat down to talk with friends (not on the phone) or to listen to music	0-7
Q35_4m	Numerical-ordinal	Minutes per day the participant spent time sitting down to talk with friends (not on the phone) or to listening to music	0-720; 99= does not apply (participant does not sit down to talk with friends (not on the phone) or to listen to music
Q35_5d	Numerical-ordinal	Days per week (for past 7 days) the participant spent time on the phone	0-7
Q35_5m	Numerical-ordinal	Minutes per day the participant spent time on the phone	0-720; 99= does not apply (participant does not spend time on the phone)
Q35_6d	Numerical-ordinal	Days per week (for past 7 days) the participant spent time watching TV or movies	0-7
Q35_6m	Numerical-ordinal	Minutes per day the participant spent time watching TV or movies	0-720; 99= does not apply (participant does not spend time watching TV or movies)
Q35_7d	Numerical-ordinal	Days per week (for past 7 days) the participant spent time driving or being in a car/bus	0-7
Q35_7m	Numerical-ordinal	Minutes per day the participant spent time driving or being in a car/bus	0-720; 99= does not apply (participant does not spend time driving or being in a car/bus)
Q37VU	Numerical-ordinal	Frequency of single family households in the neighborhood	1=None, 2=Little, 3=Some, 4=Many, 5=All, 88=No response
Q38CH	Numerical-ordinal	Frequency of townhomes/horizontal condominiums (1-3 floors) in the neighborhood	1=None, 2=Little, 3=Some, 4=Many, 5=All, 88=No

			response
Q39ED13	Numerical-ordinal	Frequency of apartment/condominiums buildings of 1 to 3 floors in the neighborhood	1=None, 2=Little, 3=Some, 4=Many, 5=All, 88=No response
Q40ED46	Numerical-ordinal	Frequency of apartment/condominiums buildings of 4 to 6 floors in the neighborhood	1=None, 2=Little, 3=Some, 4=Many, 5=All, 88=No response
Q41ED712	Numerical-ordinal	Frequency of apartment/condominiums buildings of 7 to 12 floors in the neighborhood	1=None, 2=Little, 3=Some, 4=Many, 5=All, 88=No response
Q42AC12	Numerical-ordinal	Frequency of apartment/condominiums buildings of 13 floors or more in the neighborhood	1=None, 2=Little, 3=Some, 4=Many, 5=All, 88=No response
Q43_1	numerical-ordinal	Time walking to nearest convenience store	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_2	numerical-ordinal	Time walking to nearest supermarket	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_3	numerical-ordinal	Time walking to nearest hardware store	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_4	numerical-ordinal	Time walking to nearest fruits/vegetables store	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_5	numerical-ordinal	Time walking to nearest laundry cleaners	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_6	numerical-ordinal	Time walking to nearest clothes (retail) store	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_7	numerical-ordinal	Time walking to nearest post office	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_8	numerical-ordinal	Time walking to nearest library	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_9	numerical-ordinal	Time walking to nearest school (elementary/middle/high school; private or public)	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_10	numerical-ordinal	Time walking to nearest different education centers (language schools, art schools, special schools, etc)	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_11	numerical-ordinal	Time walking to nearest bookstore	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_12	numerical-ordinal	Time walking to nearest fast-food restaurant	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_13	numerical-ordinal	Time walking to nearest coffee shop	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_14	numerical-ordinal	Time walking to nearest bank	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response

Q43_15	numerical-ordinal	Time walking to nearest restaurant (does not include fast food restaurants or coffee shops, only sit down restaurants)	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_16	numerical-ordinal	Time walking to nearest video store	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_17	numerical-ordinal	Time walking to nearest pharmacy/drug store	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_18	numerical-ordinal	Time walking to nearest salon/barber shop	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_19	numerical-ordinal	Time walking to your work or school	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response, 99=does not work or go to school
Q43_20	numerical-ordinal	Time walking to nearest public transportation (bus) stop	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_21	numerical-ordinal	Time walking to nearest park	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_22	numerical-ordinal	Time walking to nearest plaza (public square)	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q43_23	numerical-ordinal	Time walking to nearest gym/recreation center/sports facilities	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q45CFTIEN	numerical-ordinal	Agreement for: Its easy to walk to the stores from my home	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q46CFPTP	numerical-ordinal	Agreement for: Its easy to walk to the public transportation stop from my home	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q47EST	numerical-ordinal	Agreement for: Its hard to park close to the stores of the neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q48ML	numerical-ordinal	Agreement for: There are many places that I can easily walk to from my home	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q49CPS	numerical-ordinal	Agreement for: There are many slopes and inclines in my neighborhood streets that make it dificult to walk through them	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q50OC	numerical-ordinal	Agreement for: There are many obstacles in my neighborhood that make it dificult to walk to one place to another (large avenues, cul-de-sacs, rivers, etc)	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q51NC	numerical-ordinal	Agreement for: The streets in my neighborhood DO NOT have a lot of cul-de-sacs or dead-ends	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q52DI	numerical-ordinal	Agreement for: The distance between intersections in my neighborhood is usually short (100 meters or less, less than the size of a soccer field)	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q53RA	numerical-ordinal	Agreement for: There are many alternative routes in my neighborhood to walk to one place to another (ie I don't always have to take the same route)	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q54BC	numerical-ordinal	Agreement for: There are sidewalks in most of the streets of my neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q55BSC	numerical-ordinal	Agreement for: The sidewalks in my neighborhood are separated from street traffic by parked cars	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q56BSP	numerical-ordinal	Agreement for: The sidewalks in my neighborhood are separated from street traffic by grass/dirt	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q57AC	numerical-ordinal	Agreement for: There are many trees along the streets of my neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q58CI	numerical-	Agreement for: There are interesting things to see	1=totally disagree, 2=disagree,

	ordinal	while walking in my neighborhood	3=agree, 4=totally agree
Q59PB	numerical-ordinal	Agreement for: There are beautiful landscapes in my neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q60CEB	numerical-ordinal	Agreement for: There are beautiful houses and/or buildings in my neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q61TCC	numerical-ordinal	Agreement for: There is a lot of traffic in the nearby streets of my neighborhood, which makes it difficult or unpleasant to walk through them	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q62VTL	numerical-ordinal	Agreement for: The speed of traffic in the nearby streets of my neighborhood is usually slow (50 KM/hr or less)	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q63ELV	numerical-ordinal	Agreement for: Most drivers exceed the speed limit in the neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q64CI	numerical-ordinal	Agreement for: The streets in my neighborhood are well lit at night	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q65PV	numerical-ordinal	Agreement for: Pedestrians can be easily seen by people from inside their houses in my neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q66SC	numerical-ordinal	Agreement for: There are crossing signs and crosswalks that facilitate pedestrian crossing of high-transit streets in my neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q67DEL	numerical-ordinal	Agreement for: There's a high crime rate in my neighborhood	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q68INSD	numerical-ordinal	Agreement for: The crime rate in my neighborhood makes it unsafe to walk during the day	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q69INSN	numerical-ordinal	Agreement for: The crime rate in my neighborhood makes it unsafe to walk during the night	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q70PINSD	numerical-ordinal	Agreement for: The parks, plazas (public squares), recreation centers, and other recreation areas are unsafe to visit during the day	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q71PINSN	numerical-ordinal	Agreement for: The parks, plazas (public squares), recreation centers, and other recreation areas are unsafe to visit during the night	1=totally disagree, 2=disagree, 3=agree, 4=totally agree
Q72_A	numerical-ordinal	Agreement for: Its easy to walk to a metropolitan park (large parks) from my home	1=yes, 2=no, 88=does not know/does not answer
Q72_B	numerical-ordinal	Agreement for: Its easy to walk to a neighborhood park (small pocket parks) from my home	1=yes, 2=no, 88=does not know/does not answer
Q72_C	numerical-ordinal	Agreement for: Its easy to walk to a plaza (public square) from my home	1=yes, 2=no, 88=does not know/does not answer
Q72_D	numerical-ordinal	Agreement for: Its easy to walk to a shopping mall from my home	1=yes, 2=no, 88=does not know/does not answer
Q73_A	numerical-ordinal	Time walking to nearest metropolitan park (large park) from home	1=0-5 mins, 2=6-10 mins, 3=11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q73_B	numerical-ordinal	Time walking to nearest neighborhood park (small pocket park) from home	1=0-5 mins, 2=6-10 mins, 3=11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q73_C	numerical-ordinal	Time walking to nearest plaza (public square) from home	1=0-5 mins, 2=6-10 mins, 3=11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q73_D	numerical-ordinal	Time walking to nearest shopping mall from home	1=0-5 mins, 2=6-10 mins, 3=11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q74_A	numerical-ordinal	Agreement for: Its easy to go to a metropolitan park (large park) from my home using public transportation	1=yes, 2=no, 88=does not know/does not answer
Q74_B	numerical-ordinal	Agreement for: Its easy to go to a neighborhood park (small pocket parks) from my home using public transportation	1=yes, 2=no, 88=does not know/does not answer
Q74_C	numerical-ordinal	Agreement for: Its easy to go to a plaza (public square) from my home using public transportation	1=yes, 2=no, 88=does not know/does not answer
Q74_D	numerical-ordinal	Agreement for: Its easy to go to a shopping mall from my home using public transportation	1=yes, 2=no, 88=does not know/does not answer
Q75_A	numerical-ordinal	Time going to nearest metropolitan park (large park) from home using public transportation	1=0-5 mins, 2=6-10 mins, 3=11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not

			know, 88=No response
Q75_B	numerical-ordinal	Time going to nearest neighborhood park (small pocket park) from home using public transportation	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q75_C	numerical-ordinal	Time going to nearest plaza (public square) from home using public transportation	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q75_D	numerical-ordinal	Time going to nearest shopping mall from home using public transportation	1=0-5 mins, 2=6-10 mins, 3= 11-20, 4=21-30 mins, 5=more than 30 mins, 6=Does not know, 88=No response
Q77AVAC	numerical-ordinal	During the past 3 months, with what frequency did someone that lives with you walk with you	1=never, 2=sometimes, 3=always, 88=no response
Q78AVIN	numerical-ordinal	During the past 3 months, with what frequency did someone that lives with you invite you to walk	1=never, 2=sometimes, 3=always, 88=no response
Q79AVINC	numerical-ordinal	During the past 3 months, with what frequency did someone that lives with you incentivate you to walk	1=never, 2=sometimes, 3=always, 88=no response
Q80AMAC	numerical-ordinal	During the past 3 months, with what frequency did a friend (not living with you) walk with you	1=never, 2=sometimes, 3=always, 88=no response
Q81AMIN	numerical-ordinal	During the past 3 months, with what frequency did a friend (not living with you) invite you to walk	1=never, 2=sometimes, 3=always, 88=no response
Q82AMINC	numerical-ordinal	During the past 3 months, with what frequency did a friend (not living with you) incentivate you to walk	1=never, 2=sometimes, 3=always, 88=no response
Q84HIZ	numerical-ordinal	During the past 3 months, with what frequency did someone that lives with do MVPA (not walking) with you	1=never, 2=sometimes, 3=always, 88=no response
Q85INV	numerical-ordinal	During the past 3 months, with what frequency did someone that lives with you invite you to do MVPA	1=never, 2=sometimes, 3=always, 88=no response
Q86INC	numerical-ordinal	During the past 3 months, with what frequency did someone that lives with you incentivate you to do MVPA	1=never, 2=sometimes, 3=always, 88=no response
Q87FAM	numerical-ordinal	During the past 3 months, with what frequency did a friend (not living with you) do MVPA with you	1=never, 2=sometimes, 3=always, 88=no response
Q88AMIN	numerical-ordinal	During the past 3 months, with what frequency did a friend (not living with you) invite you to do MVPA	1=never, 2=sometimes, 3=always, 88=no response
Q89AMINC	numerical-ordinal	During the past 3 months, with what frequency did a friend (not living with you) incentivate you to do MVPA	1=never, 2=sometimes, 3=always, 88=no response
Q91CCAN	numerical-ordinal	Agreement: I am able to walk in my free time when I am tired	1=yes, 2=no, 88=no reply
Q92CMH	numerical-ordinal	Agreement: I am able to walk in my free time when I am in a bad mood	1=yes, 2=no, 88=no reply
Q93CST	numerical-ordinal	Agreement: I am able to walk in my free time when I don't have time	1=yes, 2=no, 88=no reply
Q94CVAC	numerical-ordinal	Agreement: I am able to walk in my free time when I am on vacation	1=yes, 2=no, 88=no reply
Q95CFRIO	numerical-ordinal	Agreement: I am able to walk in my free time when the weather is too cold	1=yes, 2=no, 88=no reply
Q96CCALOR	numerical-ordinal	Agreement: I am able to walk in my free time when the weather is too hot	1=yes, 2=no, 88=no reply
Q98MCAN	numerical-ordinal	Agreement: I am able to do MVPA in my free time when I am tired	1=yes, 2=no, 88=no reply
Q99MNH	numerical-ordinal	Agreement: I am able to do MVPA in my free time when I am in a bad mood	1=yes, 2=no, 88=no reply
Q100MST	numerical-ordinal	Agreement: I am able to do MVPA in my free time when I don't have time	1=yes, 2=no, 88=no reply
Q101MVAC	numerical-ordinal	Agreement: I am able to do MVPA in my free time when I am on vacation	1=yes, 2=no, 88=no reply
Q102MFRIO	numerical-ordinal	Agreement: I am able to do MVPA in my free time when the weather is too cold	1=yes, 2=no, 88=no reply
Q103MCALOR	numerical-ordinal	Agreement: I am able to do MVPA in my free time when the weather is too hot	1=yes, 2=no, 88=no reply
Q105DCTL	Numerical-ordinal	Do you enjoy walking in your free time?	1=no, 2=a little, 3=a lot
Q106SBCTL	Numerical-ordinal	Do you feel good while you walk in your free time?	1=no, 2=a little, 3=a lot

Q107SBDCTL	Numerical-ordinal	Do you feel good after you've walked in your free time?	1=no, 2=a little, 3=a lot
Q109DMTL	Numerical-ordinal	Do you enjoy doing MVPA in your free time?	1=no, 2=a little, 3=a lot
Q110SBMTL	Numerical-ordinal	Do you feel good while doing MVPA in your free time?	1=no, 2=a little, 3=a lot
Q111SBDMTL	Numerical-ordinal	Do you feel good after you've done MVPA in your free time?	1=no, 2=a little, 3=a lot
age	Numerical-ordinal	Self reported age in years	continuous, range 20-65
datebirth	Numerical-ordinal	date of birth (American format, MM/DD/YYYY)	MM/DD/YYYY
Height	numerical-ordinal	Height in centimeters; objectively measured by standardized fieldworkers.	continuous, 2 decimal places
Weight	numerical-ordinal	Weight in Kilograms; objectively measured by standardized fieldworkers.	continuous, 1 decimal place
Q117_EC	numerical-non ordinal	Marital status	1=Single, 2=Married, 3=Separated/Divorced, 4=Widower
Q120_AÑOSCOL	Numerical-ordinal	Years the participant has lived in the neighborhood	continuous, 0.5 or above
Q121_ESC	Numerical-ordinal	Education level achieved	0=No education, 1=1 year of elementary schoo, 2=2 years of elementary school, 3=three years of elementary school, 4=4 years of elementary school, 5=5 years of elementary school, 6=6 years of elementary school, 7=1 year of middle schoo, 8=2 years of middle school, 9=3 years of middle school, 10=1 year of high school, 11=2 years of high school, 12=3 years of high school, 13= 1 year of college, 14=2 years of college, 15=3 years of college, 16=4 years of college, 17=graduate school (any level)
Q122_ACT30D	numerical-non ordinal	Occupation during the past 30 days	1=worked, 2=work and study, 3=full time student, 4=sayed at home, 5=searched for a job, 6=retired with a pension, 7=retired with no pension, 8=other, 88=missing, doesn't reply
Q122_CUAL	categorical	If replied "other occupation" in previous quesiton	text (most common answer was "on vacation" for students and teachers/professors), 99=does not apply
OBS_1	categorical	Any observations/notes of relevance reported by the participant	text; 99=does not apply (ie no observations)
J_1	numerical-ordinal	Material of the floor in the household (SES indicator for index)	1=uncovered soil, 2=firm cement, 3=mosaic, wood, other floor covers
J_2	numerical-ordinal	Material of the walls in the household (SES indicator for index)	1=carton, 2=wood, 3=aluminium or asbestus, 4=adobe, 5=cement, bricks, etc
J_3	numerical-ordinal	Material of the ceiling in the household (SES indicator for index)	1=carton cover, 2=concrete cover, bricks, etc, 3=other material, 4=doesn't know
J_4	numerical-ordinal	Is there a room for cooking? (SES indicator for index)	1=yes, 2=no, 88=no reply
J_5	numerical-ordinal	Is this room (the one refered to in the previous question, for cooking) used for someone to sleep in? (SES indicator for index)	1=yes, 2=no, 88=no reply
J_6	numerical-	How many rooms does the household have without	Continuous

	ordinal	including the kitchen, bathroom and hallways (this includes living rooms, dinning rooms)? (SES indicator for index)	
J_7	numerical-ordinal	How many rooms are used to sleep in?(SES indicator for index)	Continuous
J_8	numerical-ordinal	How many persons live in the household? (SES indicator for index)	Continuous
J_9	numerical-ordinal	How many persons under 18 years of age live in the household? (SES indicator for index)	Continuous
J_10	numerical-ordinal	Source of water for the household (SES indicator for index)	1=piped water inside the household, 2=piped water outside of household, 3= water from "water bus", 4=other source
J_11	numerical-ordinal	Bathroom facilities (SES indicator for index)	1=WC (toilet), 2=letrine, 3=pit
PA_131	numerical-ordinal	Own (anyone in the houshold) this home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_132	numerical-ordinal	Another property (land, house, apartment, construction) owned by someone in the household (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_133	numerical-non ordinal	Do you have a car(s) in this household? (SES indicator for index)	1=yes, 2=no,99= no reply, 88=does not know
PA_133NUM	numerical-ordinal	How many cars do you have in this household? (SES indicator for index)	continuous; 99=does not apply, 88=no reply
PA_134	numerical-non ordinal	Do you have a motorbike(s) in this household? (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_134NUM	numerical-ordinal	How many motorbikes do you have in this household? (SES indicator for index)	continuous; 99=does not apply, 88=no reply
PA_135	numerical-ordinal	Television at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_136	numerical-ordinal	Refrigerator at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_137	numerical-ordinal	Computer at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_138	numerical-ordinal	Internet service at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_139	numerical-ordinal	Microwave at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_140	numerical-ordinal	Landline at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_141	numerical-ordinal	Washing mashine at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_142	numerical-ordinal	DVD player at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_143	numerical-ordinal	Electric fan at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
PA_144	numerical-ordinal	Blue Ray Player at home (SES indicator for index)	1=yes, 2=no, 99=no reply, 88=does not know
DIARIO_1	numerical-ordinal	The participant returned back the accelerometer log	1=yes, 2=no
DIARIO_2	numerical-ordinal	The participant used the accelerometer log	1=yes, 2=no, 99=does not apply (no log returned)
DIARIO_3	numerical-ordinal	The participant used the log correctly	1=yes, 2=no, 99=does not apply (no log returned or log not used)

Appendix 15: Guide book for field work for the IPEN-Mexico study (Manual del Encuestador y Trabajo de Oficina)

MANUAL DEL ENCUESTADOR PARA TRABAJO DE CAMPO Y DE OFICINA EN EL PROYECTO IPEN MEXICO (INSP)

2011

DESARROLLADO POR:

DEBORAH SALVO
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VERONICA ANGEL
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SASHA SALINAS

OBJETIVO DEL ESTUDIO:

Conocer cómo influye la estructura de las colonias en la actividad física de las personas que viven en la vivienda seleccionada.

INTRODUCCION

Por medio del presente se da un panorama general de las actividades realizadas por parte del asistente de oficina y encuestadores, así como los conocimientos que deben emplear para desempeñar de mejor manera sus actividades.

TRABAJO DE OFICINA (ASISTENTE EN OFICINA)

Pasos a seguir:

1. **Familiarizarse con los procedimientos en campo y el procedimiento en oficina.**

Para esto debemos conocer cada uno de los pasos a seguir en campo, y por consecuente conocer el procedimiento a seguir en oficina.

Procedimientos en campo:

El encuestador teniendo su cartografía, se dirige a su área de trabajo, ya ubicado, realiza un recorrido por cada una de las manzanas de la misma anotando todas las características visuales en su formato de caracterización del ambiente.

Primera visita:

Después de lo anterior, se ubica en una de las manzanas seleccionadas de su ageb e inicia a tocar puertas e invitar a los habitantes de cada vivienda a participar en el estudio.
En el momento en que uno de los integrantes de un hogar acepte participar en el estudio se amplía la información del estudio, se le entrega la carta de consentimiento, la cual se le pide a la persona que la lea con detenimiento, así como se le indica que firme en la parte donde se le pide su nombre, firma y fecha, en la cual también firma el encuestador y anota su nombre.
Prosiguiendo así a el llenado del formato general, para el cual se le pide su nombre completo a el participante, teléfono, dirección, e-mail; se le informa la fecha en se le recogerá el acelerómetro, y las fechas en que se realizaran llamadas; y se le pide un horario en que se le pueda localizar vía telefónica.

Posteriormente, se le entrega el acelerómetro, se le indica como se lo debe de colocar, y el llenado del formato de uso del acelerómetro.
Al formato general se le engrapa la parte de la carta de consentimiento donde se incluyen las firmas.
En el periodo entre ambas visitas se realiza la primera y segunda llamada. La primera llamada con el fin de informarse sobre el uso adecuado del acelerómetro y la segunda llamada para confirmar la cita de recolección.

Segunda visita:

En la segunda visita se recoge el acelerómetro, se descarga la información contenida en el mismo, para corroborar el uso diario y sus horarios; se realiza el cuestionario del estudio, y se mide y pesa el participante.
Y finalmente se le hace entrega de su vale de despensa y se le recuerda que sus resultados se le harán llegar unos días después.
Así como también conocer las actividades a realizar por parte de cada uno de los entrevistadores.

Procedimiento en oficina

Los encuestadores ponen los formatos generales en el cajón de captura uno (definida más adelante), cuando los formatos que traen son para segunda captura (definida más adelante) los dejan con la encargada de corroborar la información de los acelerómetros, la cual posteriormente los pasa a el cajón de captura de los mismos.
Los encuestadores llenan los blocs de control de la oficina y se retiran a campo.

2. **Familiarizarse con los formatos de captación en campo, así como con los instrumentos utilizados en oficina.**

Formatos de captación en campo

- Mapas
- Caracterización del ambiente
- Cartas de consentimiento
- Formatos generales
- Diario de uso del acelerómetro
- Cuestionarios

También conocer la forma de llenado y los tiempos de cada uno de ellos.
Los cuales se acomodaron en cajas, en un librero junto con el material utilizado en campo; excepto mapas de ageb, para los cuales se destino un cajón.

Instrumentos utilizados en oficina:

- Control de equipo y de acelerómetros
  (Control de básculas, control de mini laptop, control de recolección de acelerómetros, control de acelerómetros)
- Control de llamadas
  (Folio,# de encuestador, acelerómetro, teléfono, llamada1;fecha, hora, llamada realizada, llamada2;fecha, hora, llamada confirmada, observaciones)
- Control de entrega y recepción de vales de despensa
  (Código del encuestador, número de vales, fecha, código de vales, firma enc., firma coordinadora)
- Control de entrega y recepción de acelerómetros
  (De forma textual, fecha y firma de encuestador)
- Agenda general
  (Lugar en donde se anota todas y cada una de las citas programadas de cada encuestador)

También conocer la forma de llenado de cada uno de ellos, así como el momento en que tienen que ser llenados.
Los cuales se acomodan en el escritorio utilizado por los encuestadores, ya que ellos se encargan de su llenado.

3. Conocer la forma de captura, procedimiento y organización.

- Conocer la base de datos utilizada para la captura de formatos generales.
  La base de datos utilizada en el estudio fue generada en Microsoft Excel, se utiliza la misma base para ambas capturas. (Imagen A)
- Organizar los lugares destinados para cada uno de los formatos, así como su forma de archivar.
  Lo cual se organizo de la siguiente manera:
  - Sobre el escritorio los cuestionarios para revisión.
  - Los formatos destinados a segunda captura sobre el escritorio de la persona encargada de checar la información de los acelerómetros que regresan de campo, que posteriormente pasan al cajón de formatos para captura.
  - Un cajón para formatos para primera y segunda captura, los cuales se diferencian, ya que a los formatos de segunda captura se acomoda de forma que se quede a la vista la segunda hoja.
  - Un cajón para carpetas de equipos; las cuales están identificadas por medio de una etiqueta con el nombre de los integrantes de cada quipo, según corresponda; en las cuales se guardan los formatos generales después de la primera captura.
  - Un cajón para formatos generales, después de la segunda captura (captura final)
  - Cajas de cartón para organizar los cuestionarios por ageb y consecutivo, listos para captura.
  - Cajas de cartón para colocar los cuestionarios ya capturados de forma consecutiva y por ageb.
  -

Seguimiento que se le da a cada formato:

Formatos generales: Los encuestadores los colocan directamente en el cajón de formatos para captura, la primera captura es inmediatamente después de reclutar al participante, el formato debe tener llenos los apartados: Folio, nombre del participante, teléfono, dirección, número de acelerómetro, fecha de entrega, fecha probable de recolección, fecha y hora de primera y segunda llamada. En la base de datos después de capturar la información, se deja de color azul el relleno de la fila correspondiente a dicho formato. Además de los datos contenidos en el formato se ingresan a la base un 1 en la columna de reclutado, la fecha de captura y el numero asignado a él o la capturista, así como el desglose del folio según la columna correspondiente. (Imagen B)
Después de la primera captura, el formato general se ingresa a una carpeta destinada al equipo que corresponda donde permanecerá hasta que sea requerido para realizar alguna de las llamadas y será devuelto a su carpeta, el formato deberá ser recogido por el encuestador que va a realizar la recolección del acelerómetro para anotar en él los datos que se capten en la segunda visita.
En caso de segunda captura, se revisa que contenga todos los datos requeridos en el formato, los cuales son los restantes del formato es decir: hora y fecha en que se realizaron la primera y segunda llamada, así como sus respectivas observaciones, fecha de recolección, numero de días validos, reutilización, días validos de reutilización, entrega final; algo muy importante es el peso y la talla del participante, firma de que recibió el vale de gratificación y email. La captura de fecha de inicialización se coloca al momento de leer los resultados y es el día inmediato anterior al que aparece como primer día que se tiene información en pantalla, se ordena en forma ascendente en el lugar destinado para dicho fin (archivo de formatos generales).

En la base de datos la fila donde esta contenido se rellena de color verde y se agrega un 1 en la columna total, y el número de capturista. (Imagen C)
En ambas capturas se anota en la parte superior del formato C1 para la primera captura, C2 para la segunda captura y el nombre del capturista, según corresponda.
Acelerómetros: En este caso solo verificar que se anote correctamente su número en formato, captura y cuestionario, así como en los blocks destinados a control de entrega y recepción de acelerómetro; y control de llamadas. Y también re realiza la conexión de los mismos para carga de batería.
En los últimos días de entrega de acelerómetros se realizo una base de datos para organizar la entrega de los mismos y tener un mejor control del total de acelerómetros, broches y cinturones.
Carta de consentimiento: Verificar que esté contenida junto con el formato general y contenga las firmas y fechas correspondientes.
Cuestionario: Solo comparar datos contra formato y contra captura. Antes de esto se realiza la revisión de éste, lo cual se lleva a cabo primeramente checando que el folio contenga 12 caracteres, que contenga todos los datos requeridos y cumpla con la forma de llenado establecida; la forma correcta de llenado del cuestionario es:

- Numero de acelerómetro, de encuestador, días y horas con dos dígitos Ej. 02,15,07,etc)
- Folio con 12 dígitos (Ej.52_125782252152)
- Minutos con tres dígitos (Ej. 003,010, 015, etc.)
- Actividades en forma de verbo (Ej. Correr, brincar, etc.)
- En caso de que no aplique alguna respuesta se indica con 99
- En caso de omisión o falta de respuesta, se indica con 88

También checar el contenido o ausencia del formato de uso del acelerómetro.
Lo cual se indica con un 1= para indicar que existe el formato o 2= para indicar la ausencia del mismo; seguido de un 1= para indicar que si existen datos en el formato o 99= para indicar que no aplica o no existe información en el formato; y finalmente con un 1= para indicar que está completo el llenado del formato o 99= para indicar que no aplica ya que no existe información en el formato.
En caso de que no cumpla con alguno de los requisitos de llenado se apoya en el encuestador para verificar datos; y después se ingrese a el lugar destinado para la incorporación de los cuestionarios por numero de ageb y por numero de participante en forma consecutiva, y así quede listo para su captura.
Las correcciones que se realizan en el cuestionario, en el momento de la revisión, se marcan con color rojo y se anota en la parte superior del cuestionario revisado/captura también con color rojo.
Así mismo se realiza el dictado a las encargadas de captura de cuestionarios para agilizar la misma.
Y posteriormente se le anota el número correspondiente de captura, el nombre y número de capturista.
Y se procede a guardar los cuestionarios capturados en cajas organizadas por número de participante y de ageb.

4. Apoyo a elaboración de reportes de participantes

Para la realización de resultados de los participantes se apoyo realizando los formatos, diseñados en Microsoft Power Point, a el cual solo se le insertan los datos del participante ingresados con anterioridad en la base de datos de los formatos generales.
Se busca la ubicación de los datos obtenidos del acelerómetro que utilizo el participante.
Se realizan las graficas utilizando el programa Actilife ; esto se realiza abriendo el programa, dando clic en el menú *analize data* y posteriormente *create graphs (Imagen D)*, después aparece una pantalla en Excel (Imagen E), en donde se le da clic y pide la ubicación del archivo .dat necesario para generar la grafica, se le indica la ubicación, aparece una nueva pantalla donde nos indica los valores que puede analizar el programa para lo cual solo se selecciona activity (Imagen F), se da aceptar y comienza a generar las graficas solicitadas. (Imagen G)
Finalmente se busca la grafica más representativa de la actividad realizada por el participante, se realizan cambios en las palabras contenidas en la grafica ya que se arrojan los resultados en

ingles (Imagen H), después se imprime página y se pega en el archivo de power point correspondiente al folio del cual se arrojo la grafica, se pega, se acomoda y se realiza el diagnostico de actividad física con apoyo de la nutrióloga encargada. (Imagen I)
Por último se guarda el archivo en formato .ppt y .pdf (Imagen J); las graficas no se guardan.
El envío de los resultados se puede hacer por e-mail o en persona por medio de los encuestadores, en este caso se imprime el archivo .pdf.
Para el envío de resultados se imprimen etiquetas con el nombre del participante, dirección y se adjunta el nombre del INSP; la cual se pega en un sobre oficio del n°. 10, se introducen los resultados y se sella.
Los encuestadores son los encargados de su entrega.

5. **Empaque de documentos y material.**

Finalmente para el empaque de estos documentos se utilizaron bolsas de plástico transparentes para una mejor organización.
Lo cual se realizo de la siguiente manera:
Los cuestionarios se guardaron en bolsas de plástico por ageb y de acuerdo al número de participante y se les incluyo una hoja como portada en la cual se le anoto el número de ageb, los folios incluidos en el paquete y el total de cuestionarios del ageb.
Los formatos generales se guardaron de la misma manera que los cuestionarios y también se les incluyo una portada similar solo que con el número de ageb, los folios incluidos y el número de formatos del ageb.
Para lo cual se realizo una base de datos donde se anoto el orden de los paquetes y en qué forma se acomodaron para su transporte.

MANUAL DEL ENCUESTADOR

Por medio del presente se da un panorama general de los conocimientos y pasos a seguir por parte de los encuestadores, así mismo tiene como finalidad facilitar el aprendizaje y capacitación a personal que se integre a este estudio de investigación.

Caracterización de manzana.

Después de haber recibido una capacitación preliminar por parte de las coordinadoras del estudio, el encuestador deberá realizar la caracterización de manzanas para lo cual debe tomar en cuenta los siguientes puntos:

- Llevar material: formatos de caracterización, plano de AGEBS y manzanas, plumas, colores.
- Ubicarse en el punto más noroeste de la manzana.
- Iniciar el recorrido de la manzana como en las manecillas del reloj
- Enlistar todos los establecimientos, espacio públicos y servicios que se encuentren dentro de la manzana y frente a la misma
- Marcar con cualquier color en el plano el recorrido que realiza el transporte público cerca de la manzana en que se hace la caracterización.
- Deben de coincidir la cantidad de servicios que se registro en formato con los que hay en la manzana
- La caracterización debe de ir de manera muy clara para mejor ubicación de la zona que se trabajara posteriormente.

En el momento de la caracterización y reclutamiento de participantes se pueden presentar las siguientes situaciones:

- Que la manzana no cubra con las viviendas suficientes para reclutamiento.
- Que haya insuficiente número de participantes o negatividad

En ambos casos se realizara una sustitución de manzana para lo cual se informará al coordinador el motivo de la sustitución y se procederá a tomar la manzana más próxima a la derecha, deberá realizarse la caracterización de la nueva manzana y el plano de esta, en cuyo caso la manzana que está sustituyendo conservara el número de la manzana original y remarcar con rojo la nueva manzana escribiendo el número de manzana a la que está sustituyendo.

- Cada manzana deberá tener mínimo 2 participantes máximo 4 y cada ageb deberá contener un total de 21 participantes.
- En caso de manzanas con 2 participantes, en el folio del tercer participante deberá colocarse el numero de la manzana en que está quedando conservando su número de participante original.

Manzanas extras.

Se agregan manzanas extras al ageb cuando las manzanas seleccionadas dentro de este no alcancen a cubrir el número de participantes requeridos (21 participantes), en cuyo caso se tendrá que notificar al coordinador para la asignación de una nueva manzana y su numeración.

Logística de campo.

Cada equipo se conforma por dos encuestadores, los cuales se reparten el trabajo y material de campo de la siguiente manera:

Encuestador 1:

1. Reclutamiento de participantes y firma de carta de consentimiento
2. Realizar llamada 1
3. Descarga de información de acelerómetro a mini lap top
4. Peso y talla
5. Entrega de vale
6. Cargar estadímetro y lap (cerciorarse que este con batería cargada y cable USB)
7. Registro de control de llamadas en agenda de oficina
8. Registro de entrada y salida de equipo en agenda de oficina.

Encuestador 2:

1. Preparación de papelería necesaria
2. Registro de acelerómetros y salida de material
3. Reclutamiento de participantes, llenado de diario de uso, entrega de instructivo de medidor de movimiento.
4. Llenado de formatos generales
5. Realizar la llamada 2
6. Aplicación de cuestionario
7. Control de agenda
8. Cargar bascula

Primera visita.

Material a utilizar en primera visita.

Para realizar la primera visita es necesario contar con la siguiente lista de materiales:

1. Plano de Ageb y Manzana con domicilios seleccionados
2. Acelerómetros cargados, cinturones
3. Cartas de consentimiento informado
4. Diario de uso de Acelerómetro
5. Instructivo de uso de Acelerómetro
6. Formato general
7. Marcadores de colores, tabla, plumas, engrapadora
8. Uniforme y credencial.
9. Agenda.

Acudir a manzanas y viviendas previamente seleccionadas.
Que nos entrega la coordinadora uno.

Presentación.

Tocar la puerta, si se encuentra deshabitada se tomará la siguiente vivienda de la derecha, y si al momento   no se localiza a alguien realizar una segunda visita en las próximas 8 horas, si sigue sin localizarse a los miembros del hogar seleccionado se tomará la siguiente vivienda de la derecha.

Si al momento de la visita se encuentra algún integrante del hogar, presentarse con un cordial saludo indicando nuestro nombre, lugar de trabajo y motivo de la visita, explicar que es un estudio para saber cómo influye la infraestructura de las colonias en la actividad física de las personas que viven ahí, comentarle que su domicilio fue seleccionado al azar para participar en este estudio y que su participación es muy importante ya que nos permitirá hacer recomendaciones para mejorar la infraestructura de las colonias.
Hacer las siguientes preguntas para determinar si cumple con los criterios de inclusión.

Criterios de inclusión.

1. Hombres y Mujeres de 20 a 65 años
2. Residencia permanente en el domicilio (mínimo 6 meses o más)
3. Sin problemas para caminar
4. No intoxicados
5. No discapacitados
6. Mujeres no embarazadas
7. Que hablen español.

A la persona que nos atienda explicar los beneficios que obtendrá al participar en el estudio:

Beneficios de participación.

a) Conocer sus niveles de actividad física.
b) Índice de masa corporal, peso y talla.
c) Recomendaciones generales para mejorar su salud (actividad física y nutrición).
d) Vale de despensa por 100 pesos. (Aclarar que solo se entregará una vez que haya cumplido con todo el estudio.

Aceptación de reclutamiento.

Asignación de folio.

En el momento en que se recluta el participante, se le asigna un folio, para lo cual se deben de seguir los siguientes criterios:
El folio se conforma por 12 dígitos que describe un número de control de cada participante ejemplo:
Sexo (1.hombre 2. mujer) wocability (1, 2) estrato socio-económico (1,2,3,4) número de Ageb (3 dígitos) número de manzana (3 dígitos) número de participante (3 dígitos).

sexo	walkability	nivel socioeconómico*	agebs	manzana	No. participante
1. (hombre)	1 (alto)	(1,2,3 y 4)	3 (dígitos)	3 (dígitos)	3 (dígitos)
2. (mujer)	2 (bajo)				

Walkability: es un índice para estratificar (asignado por el coordinador)
*nivel socio-económico: 1(bajo) 2 (medio) 3 (medio alto) 4 (alto)

Agebs, manzana, participante, (previamente asignado por la coordinadora)

Indicaciones generales.

Una vez que la persona acepte participar en el estudio se deberá hacer lo siguiente:

1. Dar a firmar carta de consentimiento informado (Previa lectura del participante), cortar la parte de la firma y anexarla al formato general y entregar el resto de la carta de consentimiento informado al participante y hacer hincapié en los teléfonos para contactarnos.
2. Llenar formato general: al momento de hacer la cita para recolección mencionarle que en la segunda visita requeriremos aproximadamente una hora de su tiempo ya que se le medirá, pesara y se le aplicará un cuestionario.
3. Utilizar un medidor de movimiento que se deberá colocar del lado derecho, a la altura de la cadera por 7 días desde el momento en que se levanta hasta que se va a dormir, cubriendo un mínimo de 12 horas diarias de uso.

NOTA: Aclarar que el medidor trae una pequeña etiqueta que en todo momento deberá apuntar hacia arriba. Solo podrá retirarlo para bañarse, nadar y dormir.

4. Ocasionalmente llega a encender una luz que parpadea, hacer caso omiso de ella pues sigue funcionando aun si deja de hacerlo.
5. Deberá llenar un diario de uso de acelerómetro en el que registrara la hora en que lo está colocando por la mañana y la hora en que lo está quitando, anotar si en el transcurso del día lo retira, porque motivo, y tomar en cuenta el tiempo que lo retiro para reponerlo
6. Aclarar con el instructivo dudas que tenga sobre su uso.
7. Aclarar que no es un GPS, no lo vigila ni nos dice que hace.
8. Se realizarán 2 llamadas 1 para saber si lo está utilizando o si tiene dudas la 2 para confirmar fecha y hora de recolección.
9. Al termino de la semana se le hará una segunda visita a la hora que nos indique para recoger el medidor de movimiento y realizarle una encuesta sobre actividad física y características de su colonia, se le medirá y pesara.
10. Entregar medidor de movimiento con cinturón y pedirle que se lo coloque para cerciorarse que lo haga correctamente.
11. Entregar instructivo de medidor de movimiento y diario de uso previamente fechados por el encuestador.
12. Se marca en el plano de la manzana correspondiente el número de participante en el lote seleccionado.
13. En caso de sustitución se borrará el número colocado en el lote participante y se coloca correctamente ya que estemos seguros que el participante concluyó el estudio.

NOTA: Toda la información que nos proporcione es confidencial y será utilizada solo para fines estadísticos y de investigación.

Negativa a participar.

a) Preguntar si algún otro miembro del hogar desea participar en el estudio (deberá cubrir con los criterios ya mencionados). En caso de cubrir con estos repetir los pasos anteriores.
b) Si hay más de una persona elegible dispuesta a participar y cubran con las características, hacer un sorteo a través de papeles.
c) En caso de negativa de los miembros del domicilio a participar, tomar el próximo domicilio de la derecha.
d) Si llegamos a un lote y dentro del mismo hay más de 1 vivienda se realizara un sorteo para definir cual participara en el estudio. Mismo procedimiento para edificios participantes.

Trabajo en oficina después de primera visita.

1.- Vaciar la información de los formatos generales en los registros de control de llamadas y de acelerómetros cada registro deberá contener los siguientes datos:

1. Registro de control de llamadas:
    - Código de encuestador
    - No. de acelerómetro
    - Folio de participante
    - Nombre de participante
    - Teléfono
    - Fecha de llamada 1
    - Hora de llamada 1
    - Llamada realizada sí o no
    - Fecha de llamada 2
    - Hora de llamada 2
    - Llamada realizada si no
    - Observaciones
2. Control de acelerómetros
    - Folio
    - No. de acelerómetro
    - No. de encuestador
    - Nombre de participante
    - Fecha de entrega

- Fecha de recolección
- Hora de recolección
- Fecha y hora definitiva
- Observaciones

Una vez realizado el registro se coloca en el cajón asignado para su captura en la base general de formatos.

Captura de formato general.

1.-Fecha en que se captura
2.-No.de encuestador que captura
3.-Folio
4.-Nombre
5.-Telefono
6.-Direccion
7.-No de acelerómetro
8.-Fecha de inicialización
9.-Fecha de entrega
10.-Fecha de recolección
11.-Fecha de llamada 1
12.-Hora de llamada 1
13.-Fecha de llamada 2
14.-Hora de llamada 2
15.-Correo electrónico
16.-Observaciones.

Confirmación de citas.

La primera llamada se realiza al cuarto día de haber dejado el acelerómetro, la cual debe realizarse de la siguiente manera:

- Presentarse
- Nombre del encuestador, indicar que llama del INSP,
- Preguntar si tiene alguna duda sobre el uso del acelerómetro y
- Si lo ha estado utilizando como se le indico.

En caso de que conteste que lo ha utilizado como se le indico hacer hincapié en que se le hará una segunda llamada para confirmar fecha y hora de recolección.
En caso de que conteste que no lo ha utilizado correctamente pedir al participante que lo utilice los días faltantes para concluir el estudio y reagendar fecha y hora de recolección.
La segunda llamada se realizara un día antes de la fecha de recolección, confirmando si lo uso los días y horas indicados.
En caso de que conteste que lo ha utilizado como se le indico confirmar fecha y hora de recolección.
En caso de que conteste que no lo ha utilizado correctamente reagendar fecha y hora de recolección.

Segunda visita.

Recolección de acelerómetro.

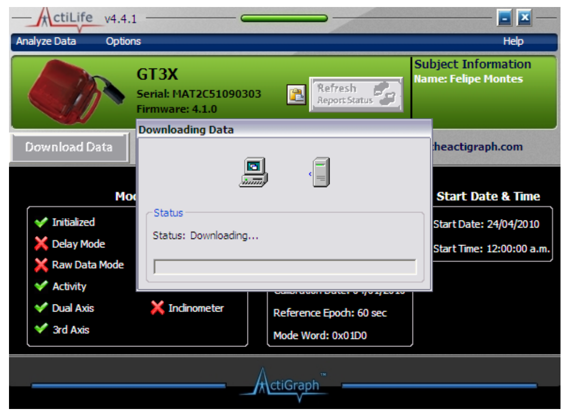
Material:

1.-Formato general con datos de visita 1 (previa confirmación d cita)
2.-Netbook con batería, cable USB
3.-Cuestionarios
4.-Tabla
5.-Pluma
6.-Báscula
7.-Estadímetro
8.-Uniforme y credencial
9.-Vale de despensa.
10.-Tarjetas que facilitan, agilizan y ayudan a la comprensión de preguntas y respuestas.

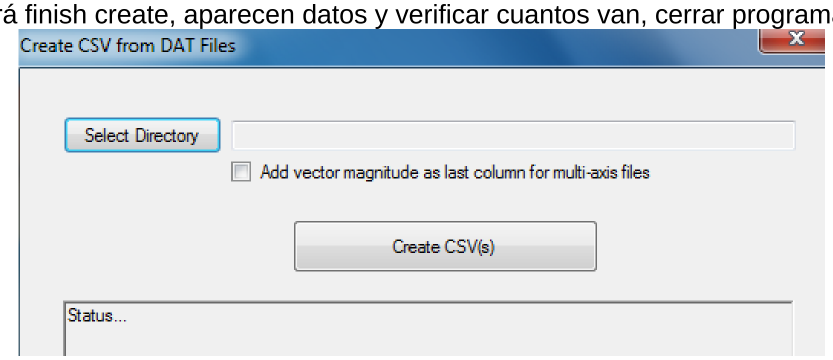
Procedimiento:

a. Se pedirá el medidor de movimiento al participante comentándole que se bajara la información al sistema.

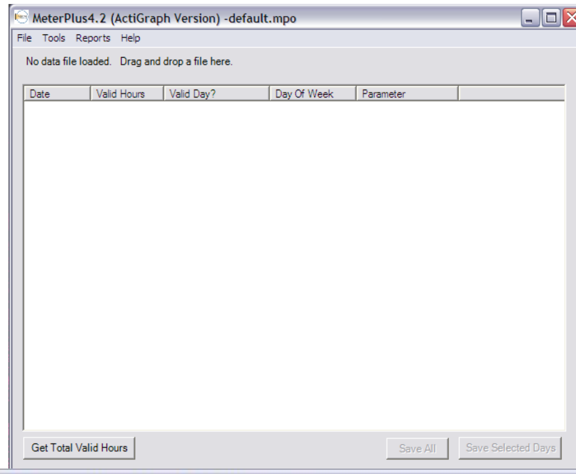
b. Crear una carpeta con la fecha del día.
c. Crear una carpeta con el nombre del participante, incluida en la carpeta creada para las recolecciones de ese día. Ya que en caso de no crearla no se realiza la conversión de *.dat a *.csv (Imagen K).
d. Conectar el acelerómetro y que este se encuentre parpadeando, si aparece una x cerciorarse de conectar bien y se reconozca el dispositivo, de no ser así posiblemente se debe a un error en el puerto en cuyo caso se hará lo siguiente:
    - Ir a panel de control dar clic en opción hardware and sound dar clic en device manager, dar clic en ports com y lpt, dar clic en gt3xusb to uart bridge aparecerá la lista de los puertos seleccionar cualquier puerto del 4 al 8 dar ok y yes al finalizar. (Imagen M – Imagen Q.)
    - Abrir nuevamente Actilife y aparecerá una ventana seleccionar la opción NO, cerrar el programa y cambiar el cable USB de puerto en la netbook, y realizar el procedimiento normal que se describe a continuación.
e. Actilife: Abrir, si en la maquina te aparece actualización dar clic en NO y en siguiente ventana dar clic en DOWLOAD, encontrar la carpeta con la fecha, renombrar el archivo del folio del participante, si ya está listo guardarlo y minimizar Actilife.

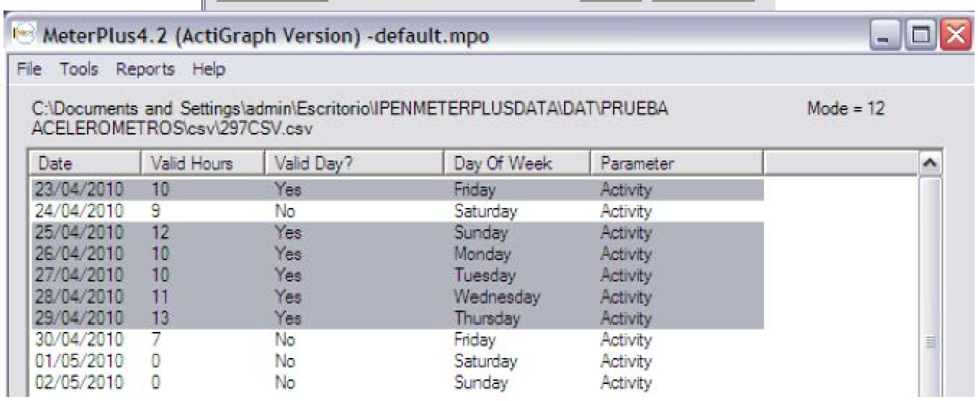


f. Abrir Convert Dat, dar click en el cuadro vector select directory, buscar carpeta por fecha clic y abrir créate csv, clic y aparecerá finish create, aparecen datos y verificar cuantos van, cerrar programa.



g. Abrir Meter Plus 4.2 aparecerá un recuadro clic en yes, elegir la opción file dar clic en open. Clic en destok y buscar la carpeta con fecha del día dentro de la carpeta csv dar clic y abrir, aparece un archivo con numero de folio seleccionar la opción open dar clic en checar parámetro de activity. Confirmar en columna de activity y yes que el participante haya cubierto un mínimo de 5 de días de uso con 10 horas cada uno sin considerar la fecha de entrega y fecha de recolección.





h. Vaciar la información de días y horas cubiertos en el formato general.

En caso de no cubrir con el tiempo requerido se pedirá amablemente al participante que lo use los días faltantes para concluir el estudio, en caso de negarse se sustituirá con otra persona del mismo hogar, de no existir o negarse se pasara al domicilio próximo a la derecha, y realizar los siguientes pasos:

- Llenar un nuevo formato general en el cual se deberá conservar el número original del participante, engrapar el nuevo formato al del participante sustituido y colocar una nota aclarando a quien sustituye para realizar la sustitución en la base remarcando en esta ambos participantes del mismo color y se continuara con los pasos de un reclutamiento normal.

Si cumplió con los días requeridos, se le aplicara cuestionario, se pesa y mide, recoger el diario de uso y se le entregará su vale de despensa pidiéndole su firma de recibido agradeciendo su participación recordándole que recibirá sus resultados vía email o correo postal.

Una vez que el participantes haya concluido el estudio se circulara en el plano de la manzana el numero de participante definitivo en el lote, así mismo es importante mencionar que el vale solo se otorgara a participantes que hayan concluido el estudio.

Puntos a considerar para un correcto peso y talla del participante:

PESO: Pedir al participante quitar todo lo que traiga de peso (reloj, cinturón, etc.) zapatos, subir de un solo paso a la bascula tratando de quedar lo más centrado posible mantenerse firme y derecho esperar a que la bascula de el resultado.

TALLA: Subir al estadimetro de espaldas sin zapatos y en posición recta, alinearlo de manera que el rostro forme un ángulo de 90 grados, pedir que quite accesorios de la cabeza e incluso el peinado si fuera necesario.

NOTA: Antes de realizar los pasos anteriores verificar que la carga de batería del acelerómetro sea arriba del 50%, en caso de no ser así probablemente no aparezcan los datos, en este caso cargar el acelerómetro por unos minutos.

En caso de que no aparezcan todos los días repetir el procedimiento.

Regreso de campo visita 2

1.-Colocar los acelerómetros en la caja de entrada con su formato general y cuestionario correspondiente.
2.-Registrar en bitácora de control de acelerómetros la fecha de entrada de acelerómetros
3.-Coordinadora 1 baja la información para corroborarla e inicializar en acelerómetro, hecho lo anterior se pone a cargar y se coloca en la caja de salida y el formato general se coloca en el cajón para su segunda captura.

Datos a capturar en segunda visita

Previo a la captura es necesario revisar que la información capturada en la primera visita sea la correcta de ser así registrar lo siguiente:
1.- Fecha de llamada 2 y hora
2.- No.de encuestador que realizo la llamada
3.- Observaciones
4.- Fecha de recolección de acelerómetro
5.- No. de días validos
6.- No de días de reutilización si los hubo
7.- Total de días validos
8.- Una vez concluida la captura se colocara el formato general en el cajón asignado para archivarlo.
9.- al concluir cada Ageb (21 participantes) entregar plano de ageb a coordinadora para asignación de uno nuevo.

ANEXO

IMAGEN A.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1							FWID	ID							AGEB		
2	CUESTIONA	TOT	RECLUTAD	FECHA CAP	PTUR	CAPTU	ENCU	Folio		PAIS	CIUD	SEXO	WAL	NIVE	AG	NZA	TICIPAN
3	1	1	1		02	02	3	52_214031169001		52	1	2	1	4	031	169	001
4	1	1	1		08	08	3	52_114031169002		52	1	1	1	4	031	169	002

	X	Y	Z	AA	AB	AC	AD	AE	AF
1	ACC_NUM	IN_DATE	DEL_DATE	01/00/00	PROG_R_HOUR	CALL1P_DATE	CALL1P_TIME	CALL1_DATE	CALL1_TIM
2	Num acel	Fecha_ini	Fecha_entre	Recoleccionp	Hora_Recoleccion_p	Fecha_llamadaprog1	Horario_Llamadaprog	echa_Llamad	Hora_Llamad
3	10	04/26/11	04/27/11	05/05/11	09:43	05/01/11	10:00	05/04/11	10:0
4	11	04/26/11	04/27/11	05/04/11	10:00	05/01/11	10:00	05/01/11	11:5

	AN	AO	AP	AQ	AR	AS	AT	AU	AV
1	NOTES_CALL2	REC_DATE	VALID_DAYS	REUSE	RVALID_DAYS	TVALID_DAYS	Peso (Kg)		E-MAIL
2	Observ_Llam	echa_Recolecci	Dias_Vali	Reu	Dias_Vali	Totaldiasv	Peso (Kg)	Talla (CM)	CORREO ELECTRONI
3	CONFIRMO CITA	05/05/11	6	2	99	6	53.60	168.30	larissaps@prodigy.net.mx
4	CHECAR LOS DIAS VALIDOS COF	05/10/11	5	1	1	[illegible]	[illegible]	193.00	aduardy90@hotmail.com

IMAGEN B.

BASE DE DATOS

INFORMACIÓN GENERAL DEL PARTICIPANTE Y CONTROL DE ACELERÓMETROS

1. CODIGO DEL ENCUESTADOR |__|__|
2. Folio |__|__|__|__|__|__|__|__|__|__|__|__|__|__|
3. Nombre completo ______________________________
4. Teléfono ______________________
5. Dirección ____
6. Numero de acelerómetro ___________________________
7. Fecha de inicialización |__|__|__|__|__|__|
8. Fecha de entrega |__|__|__|__|__|__|
9. Fecha de recolección programada |__|__|__|__|__|__|
10. Hora de recolección programada___________________
11. Fecha de llamada1 programada |__|__|__|__|__|__|
12. Horario llamada 1 programada _____________________
13. Fecha de Llamada1 |__|__|__|__|__|__|
14. Hora de Llamada1 |__|__|__|__|
15. Código del encuestador que realizó llamada 1 |__|__|
16. Observaciones de Llamada1_______________________________________
17. Fecha de Llamada 2 programada |__|__|__|__|__|__|
18. Horario de Llamada 2 programada __________________
19. Fecha de Llamada 2 |__|__|__|__|__|__|
20. Hora de Llamada2 |__|__|__|__|
21. Código del encuestador que realizó llamada 2 |__|__|
22. Observaciones de Llamada 2 ___________________________________
23. Fecha de recolección del acelerómetro |__|__|__|__|__|__|
24. Número de días validos |__|__|
25. Reutilización 1. Si 2. No
26. Número de días válidos de reutilización |__|__|
27. Total de días validos |__|__|
28. Entrega final 1. Si 2. No
29. Peso (Kg)_______________
30. Talla (cm) ______________
31. Correo electrónico ______________________

Observaciones:

____

Recibí un vale de despensa por $100.00 MN

Nombre ________________________________

Fecha _________________________________

Firma _________________________________

INFORMACIÓN GENERAL DEL PARTICIPANTE Y CONTROL DE ACELERÓMETROS

1. CODIGO DEL ENCUESTADOR |__|__|
2. Folio |__|__|__|__|__|__|__|__|__|__|__|__|__|__|
3. Nombre completo ______________________________
4. Teléfono ______________________
5. Dirección ____
6. Numero de acelerómetro ___________________________
7. Fecha de inicialización |__|__|__|__|__|__|
8. Fecha de entrega |__|__|__|__|__|__|
9. Fecha de recolección programada |__|__|__|__|__|__|
10. Hora de recolección programada___________________
11. Fecha de llamada1 programada |__|__|__|__|__|__|
12. Horario llamada 1 programada _____________________
13. Fecha de Llamada1 |__|__|__|__|__|__|
14. Hora de Llamada1 |__|__|__|__|
15. Código del encuestador que realizó llamada 1 |__|__|
16. Observaciones de Llamada1_______________________________________
17. Fecha de Llamada 2 programada |__|__|__|__|__|__|
18. Horario de Llamada 2 programada __________________
19. Fecha de Llamada 2 |__|__|__|__|__|__|

IMAGEN D.

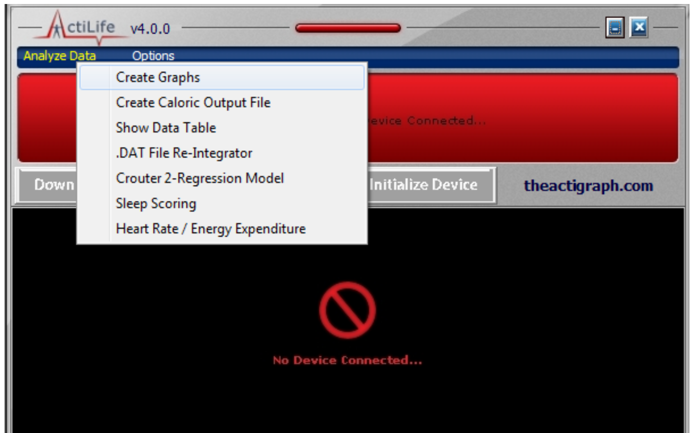


IMAGEN E.

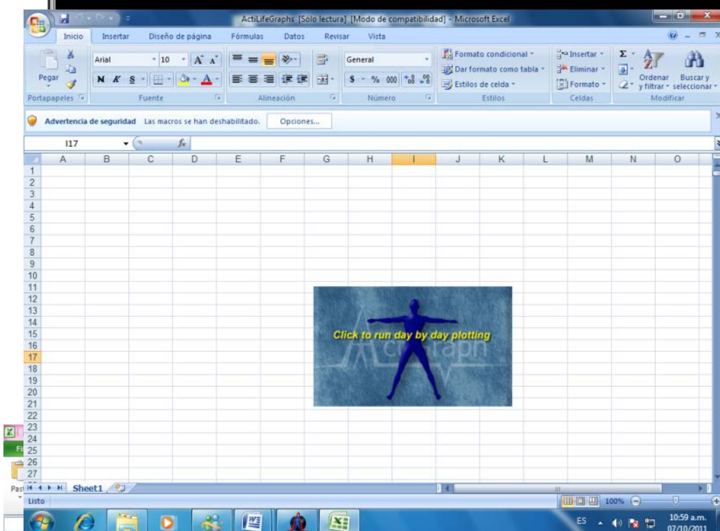


IMAGEN F.

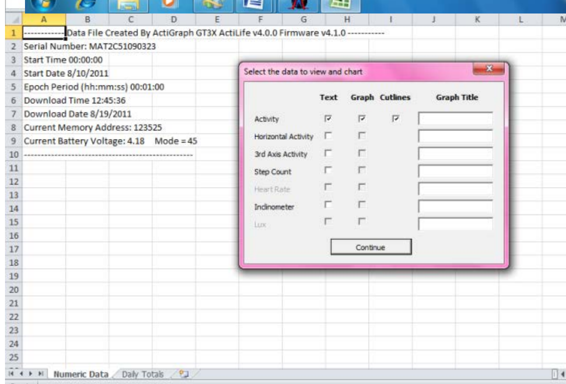


IMAGEN G.

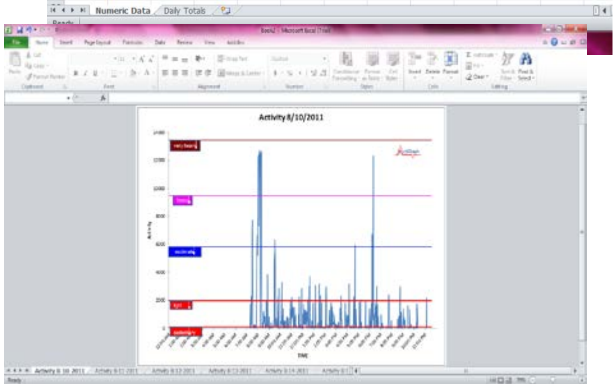


IMAGEN H.

IMAGEN I.

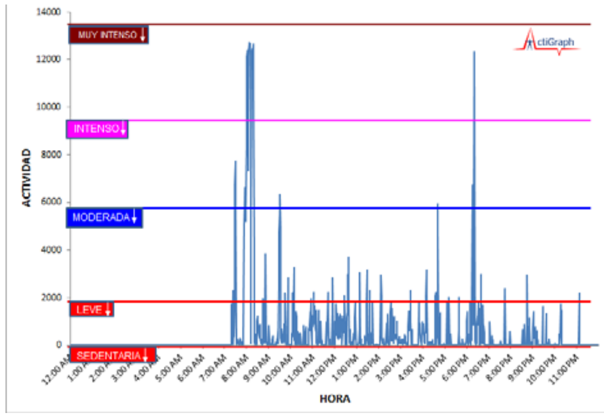


IMAGEN J.

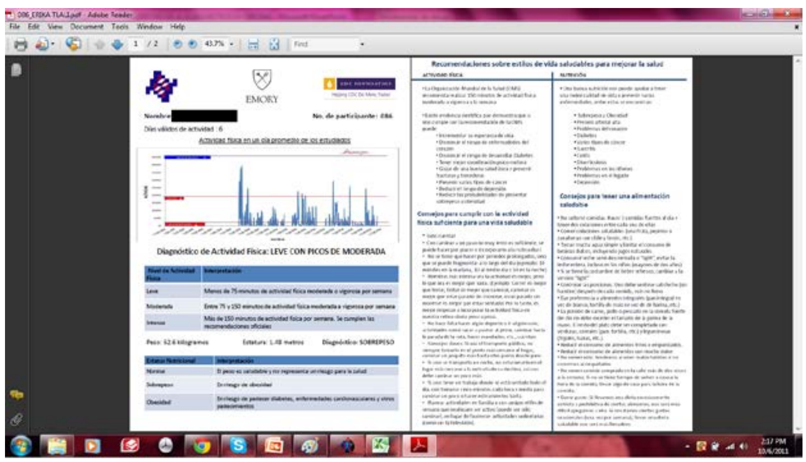


IMAGEN K.

EMORY

CDC FOUNDATION
Helping CDC Do More, Faster

Nombre: **No. de participante:**

Días válidos de actividad:

Actividad física en un día promedio de los estudiados

Diagnóstico de Actividad Física: MUY INTENSA

Nivel de Actividad Física	Interpretación
Leve	Menos de 75 minutos de actividad física moderada o vigorosa por semana
Moderada	Entre 75 y 150 minutos de actividad física moderada a vigorosa por semana
Intensa	Más de 150 minutos de actividad física por semana. Se cumplen las recomendaciones oficiales

Peso: kilogramos Estatura: 1. metros **Diagnóstico:**

Estatus Nutricional	Interpretación
Normal	El peso es saludable y no representa un riesgo para la salud
Sobrepeso	En riesgo de obesidad
Obesidad	En riesgo de padecer diabetes, enfermedades cardiovasculares y otros padecimientos

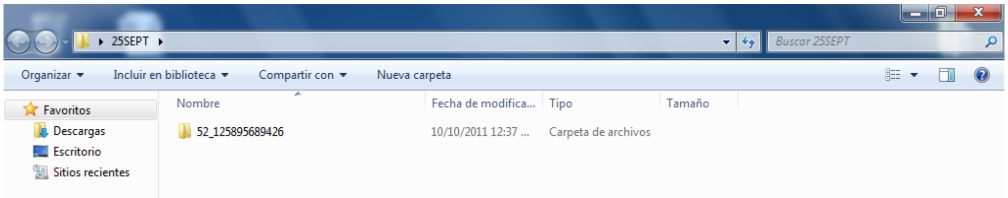


IMAGEN L.

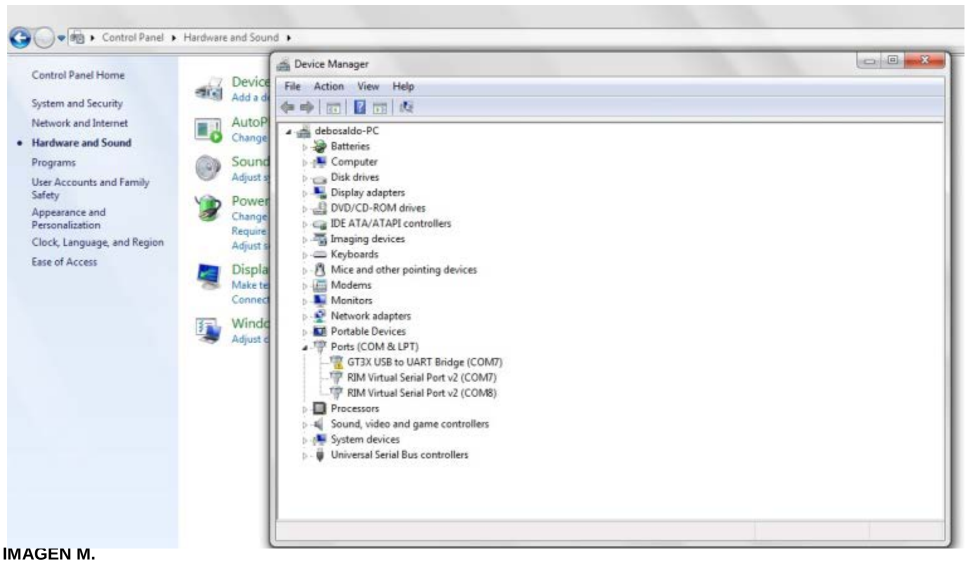


IMAGEN M.

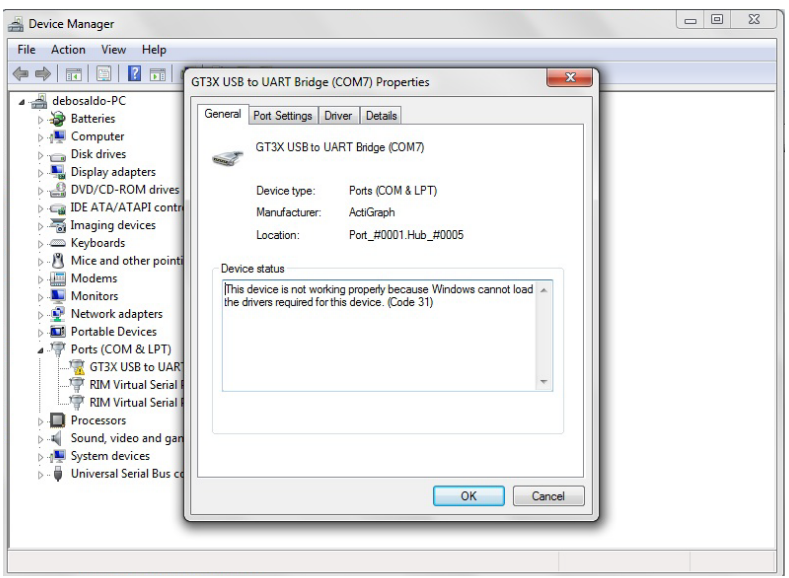


IMAGEN N.

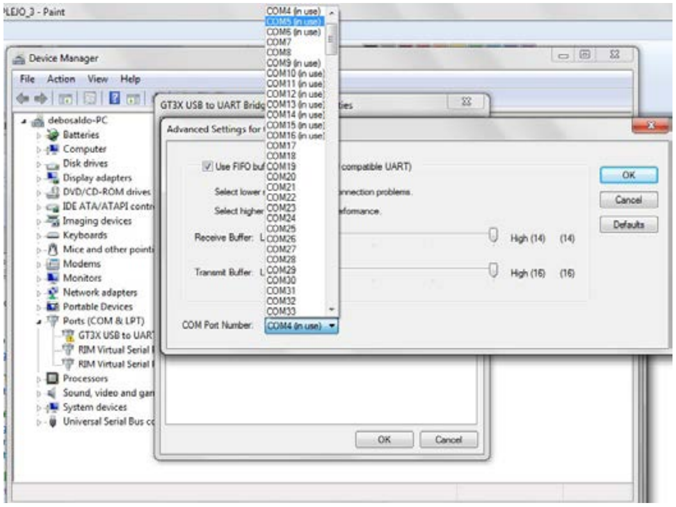


IMAGEN Ñ.

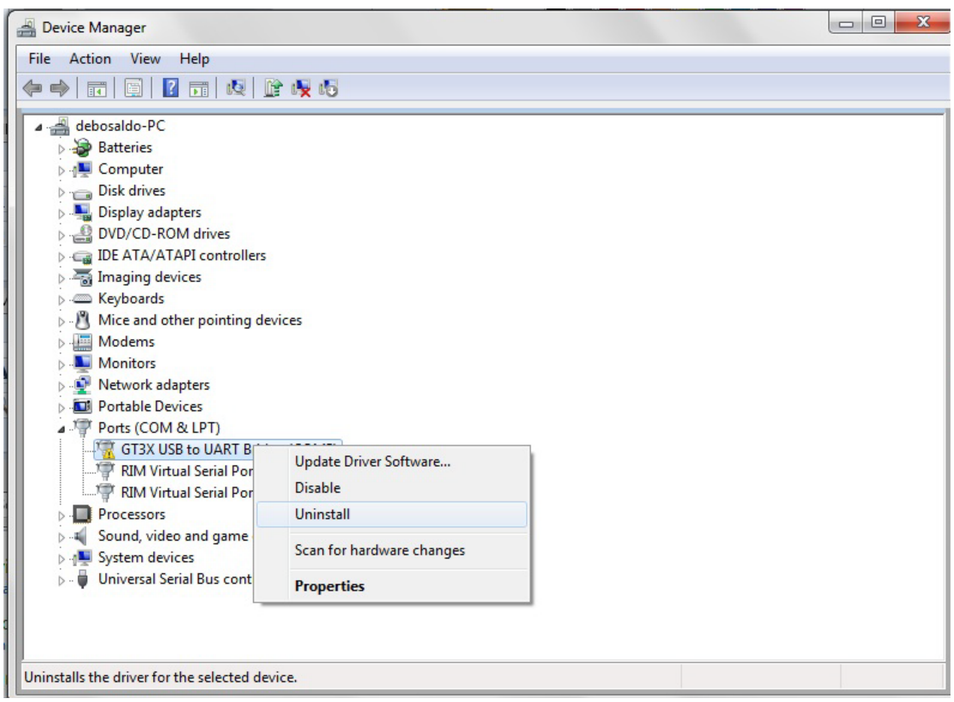


IMAGEN O.

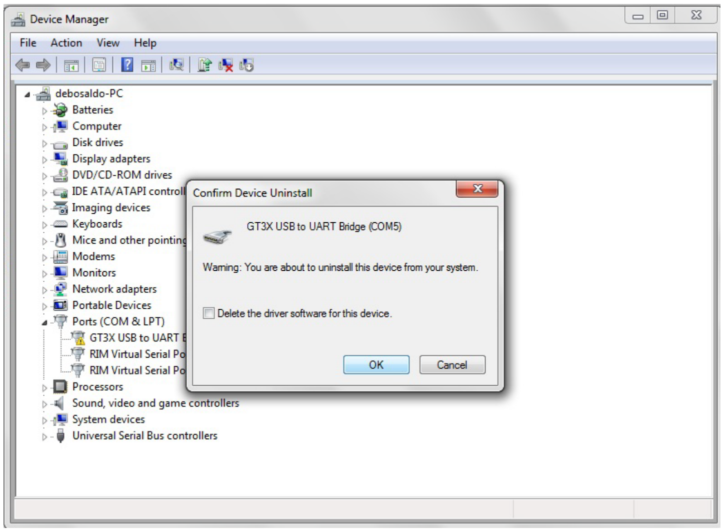


IMAGEN P.

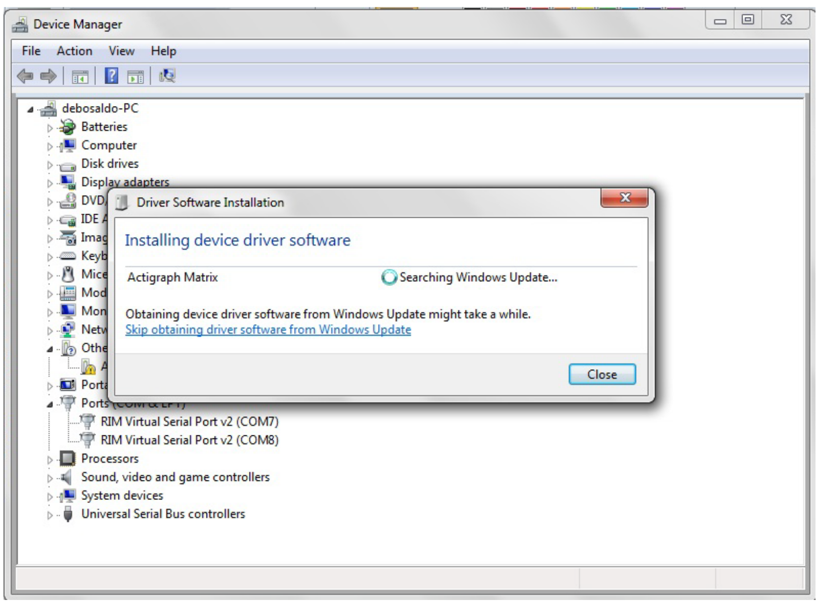
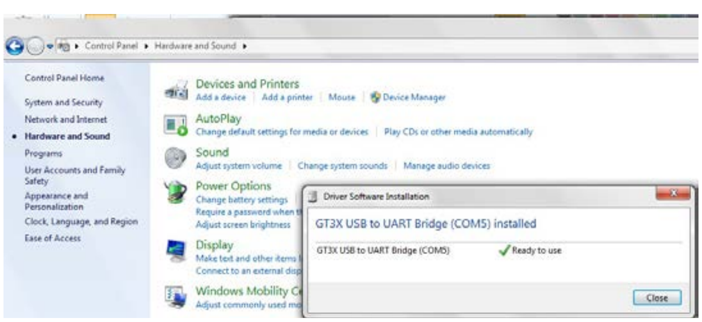
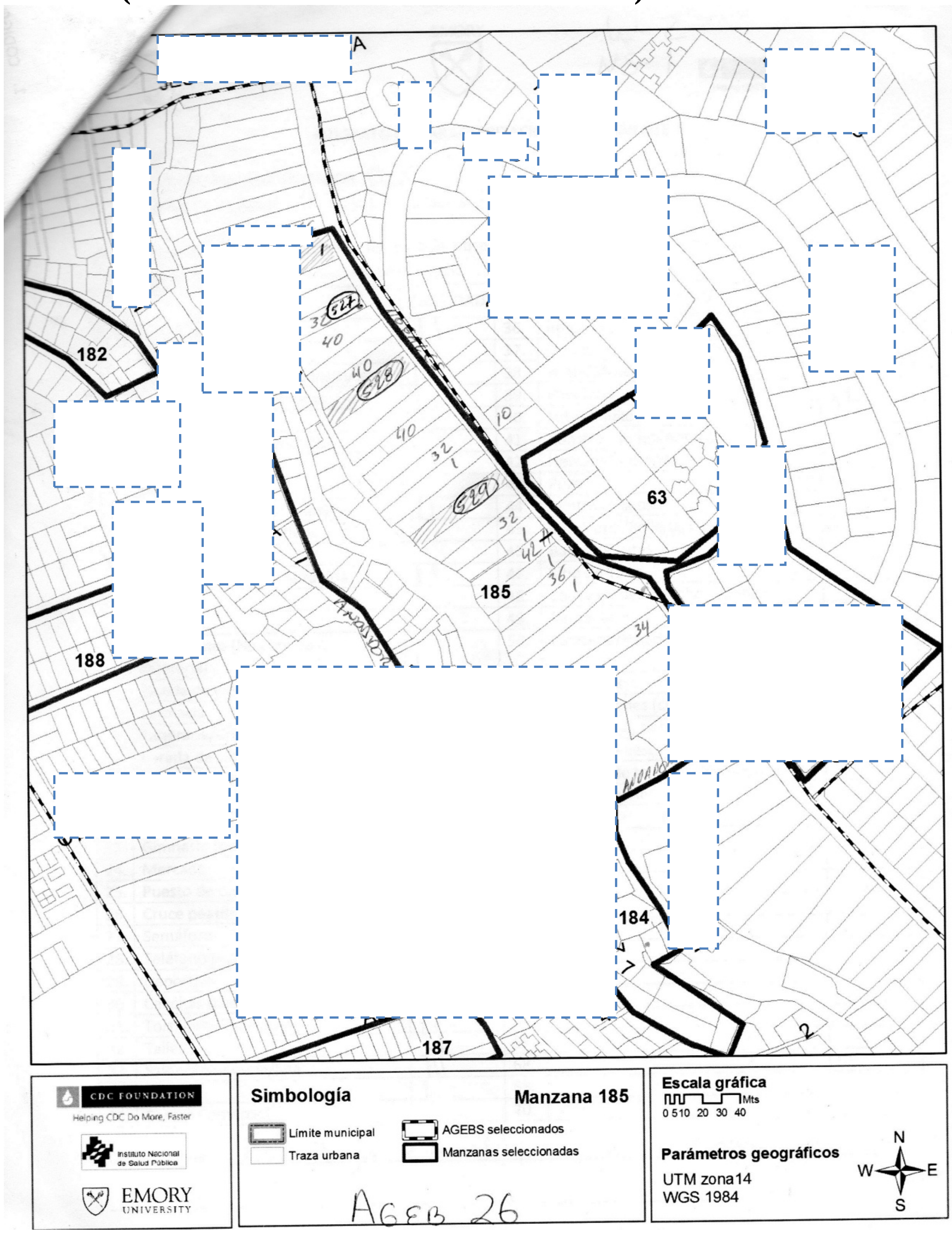


IMAGEN Q.



Appendix 16: Example of map showing participants codes and their location. (street names covered with white boxes)



Appendix 17: Land use map as provided by the Zoning Department of the City of Cuernavaca