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Impact of Childcare Licensing Regulations Related To Childhood Obesity on the Home Environment: A Study of the New York City Childcare Regulations

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Abstract

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By Laura Lessard

Early childhood obesity is an emerging public health concern. In the United States, 26.2% of children ages 2-5 are either overweight obese and research has shown that children who are overweight at an early age are at higher risk of negative health outcomes throughout life. One promising avenue for intervention with this age group is changing the childcare environment, a setting where many young children spend time. While interventions delivered in this setting have impact on child behavior while in childcare, the overall impact of these interventions on child weight status rests in the combination of their behavior in that setting and at home; the extent to which these interventions impact the home environment has yet to be determined. This research considered the extent to which childcare-based obesity prevention interventions have a spillover effect on the home environment first through a review of the published literature and second through original research considering the effect of a policy-level intervention on the home nutrition, physical activity and screen viewing environment of young children in New York City.

This exploration into the possible spillover effect of childcare-based obesity prevention interventions showed that there is little evidence to support the translation of program effect into the home. Across twelve existing studies and the two original studies, there were little data to support a spillover effect of programs without direct-to-parent components. The review considered twelve studies of ten different interventions designed to intervene in exercise, nutrition and/or screen viewing and the two original studies considered the potential impact of one all-encompassing environmental intervention on the home nutrition environment and the home physical activity/screen viewing environment. Thus across eleven interventions, very little impact was seen on the home environment of participating children. In the review paper, only seven intervention studies assessed the home environment and only three found a significant spillover effect. In both the original studies, there was no effect of the intervention on the home environment. Some reasons for the lack of spillover may be the focus of the interventions (e.g. target behavior), inadequate measurement of spillover, and unknown or unmeasured neighborhood factors.

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Introduction:

Overview:

While there has been an increase in early childhood prevention interventions designed for the childcare setting, there is much to be learned about the impact of these interventions on child-level behavioral outcomes. To address this gap in the literature, this research considered the extent to which childcare-based obesity prevention interventions have a spillover effect on the home environment first through a review of the published literature on interventions and secondly through original research considering the effect of a policy-level intervention on the home nutrition, physical activity and screen viewing environment of young children in New York City.

Childhood Obesity:

Childhood obesity is of serious concern in the United States where over 33% of children and youth (ages 2-19) are either overweight or obese; this percentage has grown steadily over the past ten years.[1] Research has shown that children who are overweight at an early age are at higher risk of numerous negative health outcomes throughout life; this realization has led to a growing body of research on early childhood obesity.[2] In fact, 26.2% of children in the United States ages 2-5 are either overweight or obese; this percentage ranges from 24% of non-Hispanic black children to 32.6% of Mexican-American children.[1] Numerous behaviors are linked to weight gain and obesity among children; among them is poor diet,[3] lower rates of physical activity[4], and high screen (including television) viewing time.[5]

Obesity in children is of significant concern due to the numerous adverse short- and long-term health effects associated with excess weight.[6] In the short-term, overweight children may face stigma, negative stereotyping, discrimination, teasing or social marginalization.[5] In the mid-term, young children who are overweight or obese are more likely to be obese later in childhood and into adolescence; in one national study, children that were obese at least once during the preschool years

were 5 times as likely to be obese at age 12.[7] Deleterious long-term health effects, some of which manifest themselves in adulthood and others in childhood, include hypertension, metabolic syndrome, atherosclerosis, insulin resistance, type 2 diabetes, asthma, obstructive sleep apnea, nonalcoholic fatty liver disease, depression, and polycystic ovary syndrome.[2] Many of these conditions previously thought to afflict only adults have been increasingly identified in children.

Risk Factors for Obesity:

While obesity is fundamentally caused by an energy imbalance, the literature commonly describes the risk factors for obesity within three domains: physical activity, screen viewing, and diet. There are established connections between the levels of physical activity and weight gain in young children. Several studies have found an association between physical activity intensity and weight among young children; these studies suggest that vigorous activity is an especially important determinant of weight status among this age group.[8, 9] One study found that the preschool children attend is a significant predictor of physical activity levels and that both opportunities and facilities for physical activity were likely contributors. According to the authors, "[the findings] suggest that school policies and practices directed toward providing preschool-aged children with physical activity have the potential to influence greatly the overall physical activity levels of young children in the United States" (p1261).[10]

Research demonstrates that television viewing is an important risk factor for obesity among young children, likely mediated through an increase in blood pressure,[11] a reduction in physical activity,[12] a decrease in resting energy expenditures,[13] and an increase in unhealthful eating, in part because of exposure to advertising of unhealthful foods.[5, 14-16] Other studies have shown that there is an increased risk of being overweight or obese among preschool children watching more than two hours per day as compared to those watching less than two hours per day (OR = 1.34; 95% CI [1.07, 1.66]).[17] The American Academy of Pediatrics (AAP), in fact, recommends zero television time for children under age 2 and no more than 1-2 hours per day of educational media viewing (including

television, videos, video games, and computer use) for older children.[18] Despite these guidelines, one study of low-income young children found that approximately half the children ages two through four watched more than 2 hours per day of television, and four-year olds in the sample watched an average of 18.4 hours of television per week (or 2.6 hours per day).[19] Each hour of television was associated with a 6% increase in the odds of being obese among the sample, comparable to research on older children.[19]

While research on the connections between nutrition and obesity among young children is sparse,[3] significant associations have been found between obesity and sugar-sweetened beverage consumption.[20-22] Sugar-sweetened beverage (SSB) consumption is associated with obesity among children as young as preschool age.[20, 21, 23] One study found that preschool-age children who consume these beverages between meals are twice as likely to be overweight as compared to children who do not consume these.[21] To combat consumption of these beverages, recommendations now typically support provision of water, instead of other beverages, to young children.[24, 25]

Obesity Prevention:

Despite a growing prevalence of overweight and obesity among young children, the science of prevention has not advanced significantly in this population. In a 2006 international review of programs for the prevention and control of childhood overweight and obesity, Flynn and colleagues noted a significant lack of evidence to support programming for children under six years of age[26]. Indeed one of the primary conclusions of the review quantified this absence:

> *The majority of programmes targeted children aged 6-11 years, while only 6% of programmes addressed the 0-5 year age range thereby indicating a lack of intervention at this early life stage where upward crossing of weight centiles is recognized as a risk for obesity. (p33)*[26]

Another review of obesity prevention programs, which focused exclusively on interventions designed to prevent or treat obesity among preschool-aged children found just seven eligible interventions, including two intervention studies conducted outside the United States.[27] The

authors concluded that additional study of obesity prevention interventions among young children is warranted, but that, "it seems prudent to recommend that interventions for children include parents and other adult role models" (p1371).[27]

Several recent reports have suggested that school- and childcare-based interventions have the potential to impact both nutrition and physical activity levels in children.[5, 28-30]Childcare settings in particular could prove to be an effective place to intervene in the lives of young children; 41% of children under the age of five are in childcare 35 or more hours per week.[31, 32]With such a large amount of time spent in these settings, childcare could be a powerful location in which to improve health and wellbeing of young children by promoting healthier environments.[31]These environments can facilitate positive changes in obesity-related outcomes with minimal involvement of the children themselves.[26, 33] Interventions designed to change these environments can be implemented through site-level policy or via wider city-, county- or state-wide policy and these policies can have broad impact on children in numerous settings. Especially of relevance to young children is intervening to improve the quality of the childcare environment, a place where a large number of young children spend their time.[32]

Spillover:

Clearly, though children are in childcare settings for a large portion of their day, there are eating and exercise opportunities (or a lack thereof) to be found before and after childcare as well as on weekends and vacations. In fact previous research has suggested that the home environment is the source of much of the unhealthy eating in young children's lives. One study found that the meals brought from home by children in childcare centers commonly contained chips, packaged cookies and desserts, items not served in centers providing food. The overall conclusion from this study was that food brought from home was significantly less healthful than the food served in the centers surveyed.[34] Another smaller study of the nutritional intake of preschool children found that children enrolled in Head Start consumed significantly more fat and calories despite being provided healthier

food during the daytime. According to the authors, "Since the [Head Start] children ate breakfast, lunch and an afternoon snack at school, their elevated food energy intake relative to the [university-run preschool] children was clearly due to the dinner and snacks that were later available at home."[35]

The cumulative effect of interventions delivered in childcare settings on child obesity includes changes in child behavior in the childcare setting combined with changes in behavior at home. In order for researchers to fully understand the effect of these interventions there needs to be an understanding of behavior in both settings. Thus it is important to consider whether interventions delivered in childcare settings can impact the home environment if the positive gains in obesity prevention are to be realized. This 'spillover effect' could consist of parents following suit when changes or education is offered during the childcare day, or parents providing less healthy food at home because they know their children receive healthy meals during the day. In order for intervention programs to be effective, according to one author, "the underlying assumption is that the children's parents will plan meals and snacks for times before and after their child's day at the child-care center to complement the center menu and reinforce healthful food choices modeled in child-care meal patterns" (p950).[36] Though this author focuses on the *positive* spillover effect of these interventions, the potential exists for either no effect or a *negative* effect as well.

There is evidence supporting negative spillover in the realm of early childhood obesity prevention. In one study conducted with parents of young children, participants cited the perceived healthfulness of the meals in childcare centers as an opportunity to provide *less* healthy foods in the evenings. One participant noted, "They eat breakfast, a good lunch, and snack so in the afternoon if we go to Burger King I don't feel that bad about it because I know that they have been eating good during the day" (p5).[37]These studies suggest that there is a powerful rationale for exploring this potential negative impact on the home; children who are not given unhealthy foods and drinks during the day may demonstrate an increased affinity for and/or increased access to these foods at home. As

described above, this mechanism is manifest directly by parents who may think that because their child is served healthy meals during the day they can offer them less nutritious meals at home.

There is also evidence from research conducted with school-aged children that changes to the school environment have no effect on behavior outside school. One study conducted with a sample of middle school children, some of whom attended schools with strict regulations on nutritional quality of the food served and some of whom did not.[38] The researchers found that while the children in the intervention schools significantly decreased their consumption of unhealthful snacks at school, there was no change in their consumption of these snacks at home.[38]

The potential for policies in one setting to "spillover" into another has been explored in other public health areas. For example, in the smoking-prevention literature, the potential for workplace-based interventions to spill over into the home has been examined. This example provides initial justification for the potential compensation effect for obesity. Over the past decade, several jurisdictions have implemented smoke free indoor air policies restricting smoking inside, and sometimes outside, workplaces across the country. Researchers have examined the extent to which these changes in the workplace have any impact on smoking rates at home or on household smoking bans for employees. One recent review of the literature on these interventions found that few had any effect on the home, either on consumption or household policies,

> *Evidence is sparse that more pervasive restrictions on smoking in the workplace might influence the extent to which persons voluntarily restrict smoking in their own homes (i.e., domestic environments). These relationships might not be strong and might be influenced by concomitant tobacco control strategies (e.g., media campaigns); further research in this area is warranted.* [39]

Another review agreed, saying that there is, "conflicting evidence about whether [workplace smoking bans] decrease prevalence of smoking or overall consumption of tobacco by smokers" due to the potential compensatory effect of these bans.[40] Other researchers have examined these potential spillover effects; one study of hospital employees found that 43.8% of the smokers surveyed reported increasing their cigarette use before and/or after coming to work, with an average increase

of 20% over their initial consumption before the ban.[41] Thus there is evidence from another public health field that changing one environment can cause a compensatory change in another environment.

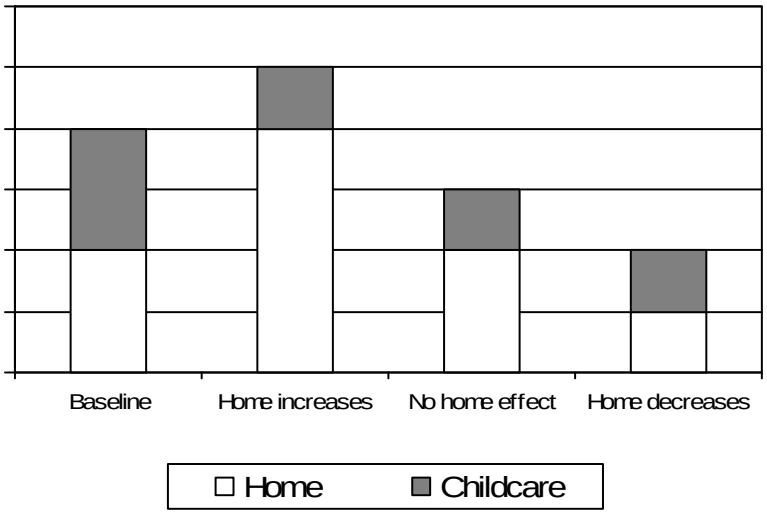
The smoking literature, though helpful in conceptualizing the potential effect of childcare based environmental changes on the home, has a number of differences which may minimize its applicability to this situation. For one, the targets in the workplace bans are the same individuals that would be changing the home environment (e.g. adults); in childcare the children are the primary targets of the intervention and the parents are a secondary, non-targeted audience. Even despite this difference, the smoking literature provides a strong case for the exploration of this mechanism.

Two potential mechanisms through which this change would occur are articulated in the literature on a number of health topics. One potential mechanism through which changes to the childcare environment might impact the home is through changing child preferences that are then communicated to the parent(s). As described above, young children are more likely to try novel foods when they are offered again and again; if the children are offered more nutrition foods and beverages in the childcare setting they may be more likely to be willing to request or eat them at home which may impact parent purchasing and offering behavior. Similar conclusions can be drawn about preferences for being physically active.

The other potential mechanism is through direct parent education about the policy. As part of some interventions, parent newsletters, pamphlets and other communication are sent home to parents. This is the most direct connection between childcare environmental change and the home because it involves direct communication with the parents. Centers may also provide direct-to-parent education in other forms, including parent workshops and recipes provided to parents. While these educational campaigns may have a small effect, they are worth describing because coupled with the other mechanism previously discussed; these may contribute to the rationale for examining the home environment.

These studies reveal a potential challenge for childcare-based environmental change interventions. As depicted in the figure below, assuming any childcare-based environmental change intervention is effective at reducing the amount of unhealthy food the children consume during their time in childcare, for example, there are three options for their overall consumption. The first option is that despite a reduction in consumption at childcare, the children actually consume more unhealthy food at home and therefore overall consumption *increases*. This option was described aptly in the quote above from North Carolina parents. The second option is that there is no change in consumption at home and overall consumption *decreases* solely due to the changes in childcare. The third option is that there are simultaneous decreases in consumption at home and at childcare, and the potential impact of the intervention is even higher. Of course another set of options arises if the intervention fails to even reduce intake at childcare.

Figure 1: Potential Effect on Consumption of Unhealthy Foods



There is much to be learned about the extent to which obesity prevention interventions have a spillover effect on the home (positive, negative or neutral). Determining this impact is critical to understanding the overall impact these interventions have on childhood obesity as any potential gains made during the child's time at childcare can be essentially undone at home.

Home Environment:

In order to explore the effect of these interventions on the home, it is important to consider the components of the home amenable to change. These interventions could have an impact on the home environment via changes in 1) household rules, 2) parental modeling, and/or 3) the physical environment.[42-44]Household rules are composed of the implicit and explicit policies within the home regarding eating, physical activity and/or television viewing. For example, parents may have rules about when or where children can play outdoors or about the amount of television a child is allowed to watch per day. Parental modeling comprises behaviors that are observable to children, which may influence child's perceptions and/or behavior. For example, parents who exercise regularly with their children or parents who eat fruits and vegetables as snacks. Lastly, the physical environment comprises the access and availability of items that promote or prohibit healthy behavior both within the household and in the neighborhood. Neighborhood safety, availability of healthy food and safe play spaces nearby the home and availability of televisions are among the characteristics that comprise this construct. These three components of the home environment can be applied to each of the key behavioral areas (i.e. nutrition/eating, physical activity, and television viewing). Each of these pathways are amenable to influence through intervention, including policy interventions delivered in childcare settings and thus each component should be examined when looking at whether these spillover effects are occurring with a given intervention. In the case of some interventions, while parents were not the direct target of the intervention, changes in children's behavior occurring during the day may influence parent behavior at home or vice-versa.

While these three components are described as independent constructs, in the reality of the home there may be blurring across categories. For example, given that preschool aged children are not in full control of their activities, the line between parental modeling and household rules may be blurred if a child is forced to eat the same food as the parents and/or forced to go on walks or other exercise activities with a parent.

New York City Context:

New York City provides an excellent opportunity to explore the possibilities of spillover effects in a real-world context. In 2006, in recognition of a growing childhood obesity problem, the New York City Department of Health and Mental Hygiene (DOHMH) amended the New York City Health Code to require licensed group childcare centers to comply with certain requirements related to nutrition, physical activity and screen time. The policy specifies that childcare centers can only serve non- or low-fat (1%) milk, water, and up to 6 ounces of 100% juice to each child each day and that they may not serve any sugar sweetened beverages such as flavored milk, soda or fruit drinks; that children be scheduled to participate in at least 60 minutes of physical activity per day, of which 30 minutes must be teacher-led, and that viewing of television, videos, and other visual recordings shall be limited to no more than 60 minutes per day of educational programs or programs that actively engage child movement (See Table 1, below for full text of regulations).

Table 1: Full Text of New York City Regulation, 2006

Domain	**Component of the Regulation**
Physical Activity	(i) Children ages 12 months or older attending a full-day program shall be scheduled to participate in at least 60 minutes of physical activity per day. Children attending less than a full day program shall be scheduled to participate in a proportionate amount of such activities. For children ages three and older, at least 30 of the 60 minutes shall be structured and guided physical activity. The remainder of the physical activity may be concurrent with other active play, learning and movement activities. (ii)Structured and guided physical activity shall be facilitated by teachers and/or caregivers and shall promote basic movement, creative movement, motor skills development, and general coordination. A program of structured and guided physical activity shall be developed in accordance with guidelines provided or approved by the Department. (iii)Day care operators shall document physical activities and make such documentation available to the Department upon request. This documentation shall be included in the program daily schedule and program lesson/activity plans. (iv)Children shall not be allowed to remain sedentary or to sit passively for more than 60 minutes continuously, except during scheduled rest or naptime.

Domain	Component of the Regulation
Television Viewing	Television viewing. Television, video and other visual recordings shall not be used with children under two (2) years of age. For children ages two (2) and older, viewing of television, videos, and other visual recordings shall be limited to no more than 60 minutes per day of educational programs or programs that actively engage child movement. Children attending less than a full day program shall be limited to a proportionate amount of such viewing.
Nutrition	Food supplied to children shall be wholesome, of good quality, properly prepared in accordance with nutritional guidelines provided or approved by the Department, age-appropriate in portion size and variety, and served at regular hours at appropriate intervals. (i) Beverages with added sweeteners, whether artificial or natural, shall not be provided to children. (ii) Juice shall only be provided to children eight (8) months of age and older, and shall not be provided in a bottle. Only 100% juice shall be permitted and children shall receive no more than six (6) ounces per day. (iii) When milk is provided, children ages two and older shall only be served milk with 1% or less milk-fat unless milk with a higher fat content is medically required for an individual child, as documented by the child's medical provider. (iv) Water shall be made available and shall be easily accessible to children throughout the day, including at meals. When parents or other responsible persons provide meals, such foods shall be properly refrigerated and the operator shall provide such persons with age-appropriate nutritional guidelines approved or provided by the Department.

Effective in 2007, the regulations are currently being enforced through health department procedures, which involve scheduled visits to childcare providers to assess compliance. The health department also provides training and technical assistance to centers to support compliance. While New York City was used as the study site for much of this research, numerous other jurisdictions are either exploring or implementing similar regulations across the country making the exploration of these effects relevant to a wide audience of stakeholders.

Specific Aims:

This study assessed the impact the New York City regulations have on the home environment, including parent behavior, physical environment and household policies related to physical activity, nutrition and screen time through the following three aims:

1. Produce a critical literature review on whether and how published intervention studies on childcare-based obesity prevention consider behavior outside the childcare environment as outcomes, and why researchers might consider these connections.
2. Evaluate the impact of the childcare regulations on aspects of the home environment related to nutrition, including parent knowledge and behavior, attributes of the physical environment related to nutrition, and household policies related to meals and feeding.
3. Evaluate the impact of the childcare regulations on aspects of the home environment related to screen viewing and physical activity, including parent knowledge and behavior, attributes of the physical environment related to screen viewing and physical activity, and household policies related to screen viewing and physical activity.

Due to the breadth of the policy, a two-phase research design was used. First, a critical review of the literature was conducted to assess the state of the field related to potential impacts of childcare-based environmental interventions on the home environment. To address aims two and three, a cross-sectional study of parents was used to assess parent behavior and household policies related to physical activity and screen time. Data were analyzed using a combination of Rasch Modeling and Hierarchical Linear Modeling.

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Unintended Consequences: The potential effect of childcare-based obesity prevention interventions on the home

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Introduction: Several recent reports have suggested that childcare-based interventions have the potential to impact both nutrition and physical activity levels in children. Most of the research on these interventions has not considered behavior outside of these target environments as outcomes, however, despite studies showing that the majority of consumption and physical activity occurs outside of these environments. This review considers the extent to which published intervention studies targeting these populations consider behavior outside the childcare setting.

Methods: This critical review utilized a multi-stage search strategy to identify papers for review. Intervention studies were eligible for the review if they involved primary prevention of obesity among children age 5 and younger conducted in the preschool or childcare environment, were published between 1966 and January 2010 and were published in English.

Results: Twelve papers describing 10 different interventions were ultimately included in the review. The literature reviewed showed that most evaluations exclude behavior outside the targeted setting as primary outcomes, and only three (25%) found significant program effects on behavior outside of the childcare setting.

Conclusions: An intervention's potential effect on behavior away from the primary setting should be considered in future research evaluating the effect of childcare-based environmental change interventions.

Introduction:

Childhood obesity is of serious concern in the United States and globally. In the U.S. over 33% of youth (ages 2-19) are either overweight or obese; this percentage has grown steadily over the past ten years.[1] Research has shown that children who are overweight at an early age are at higher risk

of numerous negative health outcomes throughout the lifespan; this concern has led to a growing body of literature on early childhood obesity.[2] In fact, 26.2% of children in the United States ages 2-5 are either overweight or obese; this percentage ranges from 24% of non-Hispanic black children to 32.6% of Mexican-American children.[1]

Obesity in children is of significant concern due to the numerous adverse short- and long-term health effects associated with excess weight.[3] In the short-term, overweight children may face stigma, negative stereotyping, discrimination, teasing or social marginalization.[4] In the mid-term, young children who are overweight or obese are more likely to be obese later in childhood and into adolescence; in one national study, children that were obese at least once during the preschool years were 5 times as likely to be obese at age 12.[5] Deleterious long-term health effects, some of which manifest themselves in adulthood and others in childhood, include hypertension, metabolic syndrome, atherosclerosis, insulin resistance, type 2 diabetes, asthma, obstructive sleep apnea, nonalcoholic fatty liver disease, depression, and polycystic ovary syndrome.[2] Many of these conditions previously thought to afflict only adults have been increasingly identified in children.

Despite a growing prevalence of overweight and obesity among young children, the science of prevention has not advanced significantly in this population. In a 2006 international review of programs for the prevention and control of childhood overweight and obesity, Flynn and colleagues noted a significant lack of evidence to support programming for children under six years of age.[6] Indeed one of the primary conclusions of the review quantified this absence: "The majority of programmes targeted children aged 6-11 years, while only 6% of programmes addressed the 0-5 year age range thereby indicating a lack of intervention at this early life stage where upward crossing of weight centiles is recognized as a risk for obesity" (p33).[6] Another review of obesity prevention programs, which focused exclusively on interventions designed to prevent or treat obesity among preschool-aged children found just seven eligible interventions, including two intervention studies conducted outside the United States.[7] The authors concluded that additional study of obesity

prevention interventions among young children is warranted, but that, "it seems prudent to recommend that interventions for children include parents and other adult role models" (p1371).[7]

Several recent reports have suggested that school- and childcare-based interventions have the potential to impact both nutrition and physical activity levels in children.[4, 8-10] Childcare settings in particular could prove to be an effective place to intervene in the lives of young children; 41% of children under the age of five are in childcare 35 or more hours per week.[11, 12] For young children (ages 2-5), the American Dietetic Association[13] recommends that childcare settings provide their proportional share of required nutrients, one-third for children in part-day programs and one-half to two-thirds in full-day programs. Interventions delivered in the childcare setting thus have to the potential to have an impact on child's energy intake and expenditure in these settings.

Clearly, though children are in childcare settings for a large portion of their day, there are eating and exercise opportunities (or a lack thereof) to be found before and after childcare as well as on weekends and holidays. In fact previous research has suggested that the home environment is the source of much of the unhealthy eating in young children's lives. One study found that the meals brought from home by children in childcare centers commonly contained chips, packaged cookies and desserts, items not served in centers providing food. The overall conclusion from this study was that food brought from home was significantly less healthful than the food served in the centers surveyed. [14] Another smaller study conducted by researchers from Rutgers University examined the nutritional intake of preschool children at a Head Start center and a local university-run preschool.[15] The researchers found that children enrolled in Head Start consumed significantly more fat and calories despite being provided healthier food during the daytime. According to the authors, "Since the [Head Start] children ate breakfast, lunch and an afternoon snack at school, their elevated food energy intake relative to the [university-run preschool] children was clearly due to the dinner and snacks that were later available at home."[15]

Thus it is important to consider whether interventions delivered in childcare settings can impact the home environment if the positive gains in obesity prevention are to be realized. This

'spillover effect' would consist of parents following suit when changes or education is offered during the childcare day. In order for intervention programs to be effective, according to one author, "the underlying assumption is that the children's parents will plan meals and snacks for times before and after their child's day at the child-care center to complement the center menu and reinforce healthful food choices modeled in child-care meal patterns" (p950).[16] Though this author focuses on the *positive* spillover effect of these interventions, the potential exists for either no effect or a *negative* effect as well.

This spillover has been explored in the smoking prevention literature, where multiple studies have examined the extent to which changes in workplaces (most commonly smoking bans) impact employees' home smoking practices. The literature suggests that instead of supporting quitting or reducing smoking in the evenings and weekends, these interventions may cause smokers to smoke *more* in their out-of-work time,[17, 18] demonstrating a negative spillover into their home lives. Back in the realm of early childhood obesity prevention, there is evidence to suggest that parents may have a similar negative reaction to changes in the food served in childcare. In one study conducted with parents of young children, participants cited the perceived healthfulness of the meals in childcare centers as an opportunity to provide *less* healthy foods in the evenings. One participant noted, "They eat breakfast, a good lunch, and snack so in the afternoon if we go to Burger King I don't feel that bad about it because I know that they have been eating good during the day" (p5).[19]

There is also evidence from research conducted with school-aged children that changes to the school environment have no effect on behavior outside school. One study conducted with a sample of middle school children, some of whom attended schools with strict regulations on nutritional quality of the food served and some of whom did not.[20] The researchers found that while the children in the intervention schools significantly decreased their consumption of unhealthful snacks at school, there was no change in their consumption of these snacks at home.[20]

These studies show that there is much to be learned about the extent to which obesity prevention interventions have a spillover effect on the home (positive, negative or neutral).

Determining this impact is critical to understanding the overall impact these interventions have on childhood obesity as any potential gains made during the child's time at childcare can be essentially undone at home. This review will assess the extent to which this potential effect has been measured in published obesity prevention intervention studies conducted in the childcare setting to attempt to assess whether and how these interventions spill over into the home.

Methods:

A multi-stage comprehensive search strategy was used to identify papers to include in the review. First, a search of relevant scientific databases (PubMed, CINAHL, PsycINFO, ERIC and EMBASE) was conducted using the following query: (childcare or daycare or "child care" or "day care" or preschool or "head start") and (obesity or nutrition or "physical activity" or exercise) and (intervention or program or effect or policy). Articles were limited to those published in English from 1966 through January 2010. Second, existing reviews of obesity prevention programs were collected from the published literature[6, 7, 21-28] and cross-checked to ensure all eligible intervention papers were included in the review. Lastly, a review of each eligible paper's citations and a search of any contemporary papers citing the papers were conducted.

Studies were eligible for review if they 1) were published in English; 2) involved primary prevention of obesity (including physical activity, nutrition, and/or screen time components) among children age 5 and younger; 3) had at least one component that was conducted in the preschool or childcare environment; and 4) were conducted in the United States. Studies that address only one component of obesity prevention (e.g. nutrition alone) were included. Age five was used as the upper cutoff for 'young children' because older children are often in school the majority of the time and thus have different social and educational settings.

Studies were excluded if they 1) did not measure any child-level outcomes (e.g. training childcare staff or parents); or 2) did not include an evaluation of the intervention (e.g. strictly descriptive).

Table 1: Excluded papers by reason

Reason excluded	N
Not focused on obesity	40
No childcare setting component	14
Not an intervention study (e.g. clinical, policy, review)	67
Not conducted in the United States	39
No child-level measurement	20
No evaluation (descriptive only)	17
Total discards	*197*

Search strategies resulted in 209 unique papers; all resulting abstracts were reviewed by the author, a researcher with expertise in early childhood obesity, in order to assess eligibility. Twelve papers were ultimately deemed eligible for review (information about excluded papers is provided in Table 1). The 12 resulting papers represented studies of 10 different interventions. Thus for analysis related to the intervention design, there were only 10 unique interventions; analysis related to study design includes all 12 papers as they represented different studies even though they assessed the same intervention.

Eligible papers were coded by the author for 1) intervention description; 2) study design and sample; 3) primary outcome measures; 4) findings; 5) whether and how authors measured consumption and/or activity outside the childcare setting; and 6) findings about behavior outside the childcare setting, if applicable.

Table 2: Papers included in Review

Paper	Intervention	Study Design & Sample	Primary Outcomes	Findings – Primary Outcomes	Measurement – Outside childcare	Findings – Outside Childcare
Bellows[29]	Food Friends Get Movin' and Mighty Moves: 18-week intervention designed to impact gross motor development, physical fitness, and physical activity. Materials sent home to parents.	Preschool children attending Head Start centers in one state; randomly assigned to treatment (n=4) or control (n=4) Pre- and post-intervention data collections n=96 children in intervention sites, 61.5% Hispanic; n=105 children in comparison sites, 53% Hispanic. Average age 52 months	Child body mass index (BMI), physical fitness, gross motor skills assessment, physical activity (pedometer measured step count over 6 days)	Significant improvement in gross motor skills and fitness levels	Daily step counts over 6 days recorded by parents using pedometer	No significant differences over time
Cason[30]	12 lesson (40 minutes per lesson) curriculum delivered by preschool teachers; covers healthy snacking, fruit and vegetable identification, and the Food Guide Pyramid.	Preschool children attending daycare facilities in one state (n=229) Baseline and immediate post-test data collections; no comparison group n=6,102 children 63% African American; 37% White. Average age 52 months	Pictorial knowledge and item instrument (identification of fruits and vegetables, the healthiest snack; and a measure of willingness to taste foods)	Significant increase in identification of fruits, vegetables, and healthy snack choices; Significant increase in willingness to taste foods at post-test	Parent survey of eating habits and food attitudes	Significant increase in consumption of fruits, vegetables, meat, dairy and bread; significant decrease in consumption of fats, oils and sweets; significant increase in the number of fruits and vegetables children liked.

Davis et al[31]	Nutrition education curriculum designed for preschool children. Contains 35 different nutrition-related activities, sample parent newsletters and a list of resources integrated into a 6-week unit.	Caregivers (n=48) from diverse preschools (n=16). Children within centers were also included (number unknown)	Child knowledge measured by self-administered survey; child behavior (e.g. willingness to taste) measured by self-report	Significant increase in knowledge from pre-test to post-test (no comparison group); no changes in behavior.	N/A	N/A
Dennison et al[32]	Brocodile the Crocodile: 7 session intervention designed to reduce screen viewing. Sessions were delivered by study staff directly to children, childcare staff and/or parents. Materials were sent home to parents to support activities conducted in the childcare setting.	17 childcare centers (8 intervention and 9 comparison) in one state n=43 children in intervention sites; n=34 in comparison sites	Parent report of television/screen viewing and home environmental characteristics related to television and other screen viewing; child BMI	Significant reduction in TV/video viewing on weekdays and Sundays; Significant increase in number of children reporting <2 hours of television per week (as recommended); no differences in child height or weight	Parent report of television/screen viewing and other home environmental characteristics related to screen viewing	Significant reduction in TV/video viewing on weekdays and Sundays; significant increase in number of children reporting <2 hours of television per day (as recommended)

Fitzgibbon et al[33]	Hip-Hop for Health, Jr: 14-week intervention delivered by trained study staff focused on healthy eating and physical activity. Lessons provide a combination of physical activity and in-class activities. Weekly newsletter was sent home to parents reinforcing the topics covered in class. Parents were also assigned small 'homework' assignment and were rewarded for completing them.	Head Start centers in one city (n=12). Six matched pairs were randomly assigned the intervention or a general health intervention (comparison group). Baseline, immediate post-test, one-year and two-year follow-up data collections. n=197 children in intervention sites; 99% African American; Average age 48.6 months n=212 children in comparison sites; 80.7% African American; Average age 50.8 months	Child BMI	At one-year and two-year follow-ups, significant difference in the increase in mean BMI between intervention and comparison children	Parent report of percent of total calorie intake from fat and saturated fat (via 24-hour recall); parent report of physical activity and screen viewing	Significant difference in saturated fat intake at one-year follow-up; No other significant differences on parent-reported diet, physical activity or screen time.

Hafetz[34]	Go!Kids Obesity prevention program: 24 session program designed to increase child and parent knowledge of healthy eating, nutrition, and physical activity. Also includes optional parent workshops.	3 childcare centers in one city. Baseline and immediate post-test data collection points n=129 parents (94% female) n=128 children (mean age = 3.6 years; 61% female)	Parent Lifestyle Survey; child knowledge of health and nutrition measured by self-report; child BMI	No significant difference in parent knowledge from pre- to post-test; Significant improvement in child knowledge of health and nutrition	Parent report of child behavior (19 items on parent lifestyle survey)	No significant differences due to small sample sizes and low attendance at parent workshops
Hannon & Brown[35]	Installation of portable playground equipment in outdoor play space	One university-run preschool n=64 children ages three through five	Child's physical activity at preschool measured using accelerometers; Observational System for Recording Physical Activity in Children – Preschool Version (OSRAC-P)	Significant decrease in sedentary behavior; significant increase in light, moderate and vigorous physical activity	N/A	N/A
Johnson et al[36]	Food Friends: 12-week program including nutrition activities, food-related stories, opportunities to try new foods, an activity outline to guide the teachers and parent newsletters.	One classroom from each of four Head Start centers (2 intervention and 2 comparison) in one state. n=26 children at experimental sites; n=20 children at comparison sites	Food preference assessment; teacher observation of food preference	Significant change in rank order of liking; significant difference in refusals between intervention and comparison sites	N/A	N/A

Qiu[37]	Physical activity focused intervention: 8-week intervention designed to increase moderate and vigorous physical activity in childcare settings. Consists of classroom-based curriculum and Planned Energetic Play.	Three classrooms from one university-run preschool in one state. Four data collection points (baseline, mid-point, immediate post, 4 months post) n=50 children; ages 3 through 6	Accelerometer-measured physical activity; observation of physical activity; child BMI	Significant increase in physical activity over time	N/A	N/A
Williams et al[38]	Healthy Start: Combination food service modification (focused on aligning center with the USDA meal pattern) and nutrition education intervention.	Head Start centers in one state (6 intervention sites and 3 comparison sites). Baseline, one-year and two-year follow-up data collections. N=1,296 children; 41% African American; 33% Latino; Average age 3.4 years	Dietary intake at center meals measured by direct observation of child consumption	For the subset of children enrolled in the centers for two years, significant difference in intake of saturated fat, percent of energy from total fat, iron consumption and magnesium consumption. No other significant differences for consumption between intervention and comparison children.	Parent report of home consumption for a 24-hour period	No significant differences for consumption between intervention and comparison children.

Williams et al[39]	Healthy Start (same as above)	Head Start centers in one state (3 received both food service modification and nutrition education; 3 received just the food service modification; 3 comparison sites). Baseline, one-year and two-year follow-up data collections. n=787 children; 47% African American; 30% Hispanic	Child BMI, blood pressure and serum lipids	Significant difference in the change in total serum cholesterol between both intervention groups and comparison group; Children with elevated cholesterol at follow-up who were in the intervention groups were significantly more likely to have normal cholesterol levels at follow-up	N/A	N/A
Witt[40]	Color me Healthy: 12 lesson nutrition program designed to increase fruit and vegetable consumption. Six packets containing home-based activities were sent home to parents during the program.	Fourteen childcare centers (10 intervention classrooms; 7 control classrooms). Baseline, one week follow-up and 3 month follow-up data collections. n=165 children at experimental sites; n=98 at control sites; age 4-6 years	Intake of fruits and vegetables at the center (observation); parent survey containing a 3-day food diary, food frequency questionnaire; child height and weight	Significant increase in fruit and vegetable consumption during snack at child care center;	Parent survey containing a 3-day food diary, food frequency questionnaire	No significant differences due to small sample sizes and low response rates

Results:

Overview: Of the twelve papers describing ten different interventions that were ultimately included in the review, eight were traditional primary prevention interventions involving a combination of nutrition education and physical activity. One other intervention contained a combination of education and changes in the food served at the childcare center; the last intervention consisted of provision of portable playground equipment. Thus the interventions focused primarily on increasing knowledge, attitudes and/or the child's willingness to try new foods rather than changes in the environment such as the food served at the childcare center or the amount of physical activity scheduled during the day.

All twelve papers reported a significant impact on at least one primary outcome of interest. These outcomes ranged from changes in knowledge (e.g. identification of fruits and vegetables) to changes in behavior (e.g. decreases in sedentary behavior or reductions in television viewing). Seven papers measured child BMI as a primary outcome measure, but only one paper[33] found a significant program effect on BMI. Fitzgibbon and colleagues found that at one- and two-year follow-ups there was a significant difference in the increase in mean BMI between intervention and comparison children (total n=409 children) after their 14-week intervention delivered in Head Start centers.[33]

Consideration of spillover effect:

Seven of the papers measured behavior outside the childcare setting. Three of the seven found significant program effects on these behaviors.[30, 32, 33] Cason found a significant increase in consumption of fruits, vegetables, meat, dairy and bread from baseline to immediate follow-up among program participants (n=6,102). No comparison group was used, however, so these changes may simply be due to participant maturation over the course of the intervention.[30] Dennison and colleagues found a significant reduction in TV/video viewing on weekdays and Sundays and a significant increase in children meeting recommendations for television viewing (<2 hours per day).[32] This study used 8 intervention sites and 9 comparison sites, however, only 43 children were assessed at intervention sites and only 34 children were assessed at comparison sites. These small samples may

be prone to selection bias, particularly given that blinding to treatment was not possible in this study. Fitzgibbon and colleagues found a significant difference in saturated fat intake at one-year follow-up between intervention and control groups (n=409 children total).[33] However, there were no differences on other outcome measures including parent report of physical activity and screen viewing or differences between participants and comparison group children at the immediate follow-up or two-year follow-up time points. These null results suggest that the effect of the program may be limited.

The other four papers that measured behavior outside the childcare setting found no significant effect.[29, 34, 38, 40] Bellows measured physical activity outside the childcare environment via a pedometer used to track each child's steps. Parents were asked to record daily step counts as measured by these pedometers. This study involved 201 children from eight different Head Start centers, randomly assigned to intervention or a control group.[29] Both Hafetz and Witt similarly found no effect of the program on parent-reported child behavior.[34, 40] However, the null effect here may have been due to extremely small sample sizes and/or low response rates. Williams and colleagues also measured child behavior outside the childcare environment and found no programmatic effect.[38] Their measure, a 24-hour recall of child consumption, was the only measure of this behavior used.

While consideration of spillover implies that the intervention was limited to the childcare setting, this review revealed that many interventions included a direct-to-parent component. Six of the ten interventions included this component, primarily in the form of parent newsletters (5 interventions) or parent workshops (1 intervention) (See Table 2). These were often a small component of the intervention, however, as none of the interventions reviewed had large parent components. Of the five interventions that *did not* include a direct-to-parent component, one found a significant positive spillover[32] and the other four did not.

Discussion:

The results of this review show that there is much to be learned about the potential spillover effect of interventions delivered in childcare settings. While over half the eligible papers (7 of 12)

included measurement of behavior outside the target environment, only three found significant effects on these behaviors and all three of these impacts suggested a positive spillover effect on the home with parents supporting the work done in the childcare setting. Cason's study found a positive spillover effect on food consumed at home, with children consuming more healthy foods and fewer unhealthy foods at home;[30] Fitzgibbon and colleagues found a similar positive spillover demonstrated by a reduction in saturated fat intake at follow-up.[33] Dennison and colleagues found a positive spillover of their intervention on television watching behaviors at home.[32] The four other papers that measured a potential spillover effect found no effect, lending support to the possibility that these interventions have no impact on the home. None of the papers found a negative spillover effect on any of the behavioral targets despite some suggestion in the literature that a negative effect may be possible in this population. However, given the small number of papers eligible for this review, additional research is needed to further examine whether negative spillover effects can be found with childcare-based obesity prevention interventions.

The focus of the interventions may have impacted the potential for a spillover effect. Of note, none of the papers found a spillover effect for any measures of physical activity or active play, even though three papers found a significant effect on children's physical activity in the childcare setting.[29, 35, 37] Only one of these papers measured behavior at home, and found no impact of the intervention.[29] While it is important to consider whether the behavioral target of the interventions (e.g. physical activity, healthy eating) impacts the extent to which an intervention has a spillover effect, again given the small number of interventions eligible for review no conclusions can be drawn about possible connections between these attributes. Future reviews may want to consider whether nutrition-based interventions, for example, are more likely to produce a spillover effect as compared to those targeting only screen time or active play.

This review revealed that five of the twelve papers did not measure behavior outside the childcare environment. One reason researchers may be reluctant to include behavior outside the target environment is the challenges inherent in measuring these behaviors. Many of the

interventions designed for young children in childcare settings are modeled after or similar to interventions delivered to older children in school settings. In these cases, children's behavior both at school and outside of school can be directly assessed using self-report. These methods may not be applicable to young children, who cannot accurately report their behavior. The overwhelming majority of studies that looked at behavior outside the childcare setting used parent report of child behavior, with varying success. The validity of these parent reports, especially at the level of estimating portions, is unknown. One study had such a low response rate for the parent report portion of the measurement that analysis of the resulting data was impossible.[40] These measurement challenges and others detailed in the literature[41, 42], though considerable, should not be used as a reason to avoid assessing the potential impact of obesity prevention and control programs on the home environment. As highlighted by numerous reviews of these interventions, parental involvement is one key to obesity prevention in this population and spillover of positive changes into the home will be critical to supporting and sustaining changes made in the childcare setting throughout the child's life.

Another conclusion to be made is that there is a considerable lack of research on the efficacy of obesity prevention interventions conducted in childcare settings. Despite a comprehensive search strategy that included unpublished dissertations among other sources, only 10 interventions (12 studies) were eligible for review. Since another 17 papers were eligible save for a lack of evaluation of the intervention, perhaps in the future these interventions and others can be evaluated for their effectiveness in preventing obesity among young children.

Finally, this review showed that interventionalists and researchers indeed consider parents to be an important part of a childcare-based strategy for obesity prevention, even if many did not specifically measure behavior at home. This is demonstrated by the overwhelming majority of papers (10/12) that included some direct-to-parent component. In the future, this interest may be translated into additional measurement and research questions targeting parental involvement in the success of obesity prevention interventions.

This study has a number of limitations that may have influenced the results. First, while the search strategy was designed to be inclusive of interventions studies with no effect, we can assume publication bias may have impacted the extent to which interventions that showed no effect appeared in the literature. Secondly, the coding was limited to measurement reported in the papers; any researchers who measured behavior outside the target environment but did not include it in these papers were coded incorrectly. Thirdly, the eligibility criteria purposefully excluded papers that did not mention measurement of program effect. This may partially explain the finding that most papers found at least one significant program impact, as those with null findings may have been written up without mention of the evaluation. Even with these limitations in mind, the results of this review provide powerful rationale for a continued emphasis on obesity prevention interventions delivered in childcare settings.

With an increasing focus on childcare-based obesity prevention interventions, future research should consider behavior outside the childcare environment as an important measure of the success of an intervention. Without information about whether and how behavior at home is impacted by these interventions, we could be incorrectly classifying interventions as ineffective.

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The impact of childcare regulations on aspects of the home nutrition environment

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Abstract: Early childhood obesity is an emerging public health concern. In the United States, 26.2% of children ages 2-5 are either overweight or obese. One promising avenue for intervention with this age group is changing the childcare environment, a setting where many young children spend time. While interventions delivered in this setting have direct impact on child behavior while in childcare, the overall impact of these interventions on child weight status rests in the combination of their behavior in that setting and at home; the extent to which these interventions impact the home environment has yet to be determined. This study explored whether one policy intervention targeting New York City (NYC) childcare centers had a significant impact on the home nutrition environment. This multilevel cross sectional study consisted of a self-administered survey given to parents of young children at childcare centers in low-income neighborhoods in NYC where licensed group childcare centers are required to comply with certain requirements related to nutrition, physical activity and screen time. Parent respondents were asked questions assessing the home nutrition environment. Information about each center's level of compliance with the policy was gathered through interviews and on-site observations. Data were analyzed using an Item Response Theory model and Hierarchical Linear Modeling, to adjust for the clustered sampling.

In total, 1,487 parents from 111 centers completed the survey. The models suggest that there is no significant relationship between increasing compliance with the policy and the home nutrition environment in this sample; thus this study does not support the assumption that changes in the childcare environment spillover into the home. Future interventions delivered in the childcare environment may need to more explicitly include parents and caregivers in order to encourage concomitant changes at home.

In the United States, reducing childhood obesity is among the nation's top health priorities. In 2007-2008, 10.4% of children ages 2-5 were obese.[1] Data from the Pediatric Nutrition Surveillance System shows that the prevalence of obesity in low-income children ages 0-5 rose over the past 20 years, growing from 9.1% in 1988 to the 14.1% in 2008.[2] These data suggest that it is important to create environments that support healthy behaviors with children early in life.

Obesity in children is of concern due to the numerous adverse health effects associated with excess weight.[3] In early childhood, overweight children may face stigma, negative stereotyping, discrimination, teasing or social marginalization.[4] Long-term effects of childhood obesity include hypertension, type 2 diabetes, and asthma.[5] Most importantly, overweight young children are more likely to become overweight as adolescents and adults, so starting early with obesity prevention is important to preventing these negative health effects.[6]

Children's nutritional intake is one key component of obesity prevention interventions among children. While research on the connections between nutrition and obesity among young children is sparse,[7] significant associations have been found between obesity and sugar-sweetened beverage consumption.[8-10] Sugar-sweetened beverage (SSB) consumption is associated with obesity among children as young as preschool age.[8, 9, 11] One study found that preschool-age children who consume these beverages between meals are twice as likely to be overweight as children who do not consume SSBs.[9] To combat consumption of these beverages, recommendations now typically support provision of water, instead of other beverages, to young children.[12, 13]

The evidence suggests that changing the environments that young children find themselves in may support healthy eating; these environments can facilitate positive changes in obesity-related outcomes with minimal involvement of the children themselves.[14, 15] Interventions designed to change these environments can be implemented through site-level policy or via wider city-, county- or state-wide policy and these policies can have broad impact on children in numerous settings. Especially of

relevance to young children are interventions to improve the quality of the childcare environment, a place where a large number of young children spend their time.[16]

These possibilities and recognition of a growing childhood obesity problem led the New York City health department to implement a citywide obesity prevention policy in childcare settings starting in January, 2007.[17] These regulations specify that childcare centers can only serve non- or low-fat (1%) milk, water, and up to 6 ounces of 100% juice to each child each day and that they may not serve any SSBs such as flavored milk, soda or fruit drinks.[18] Effective in 2007, the regulations are currently being enforced via scheduled visits to childcare providers to assess compliance, and supported through training and technical assistance provided to centers to encourage compliance.

While this and other similar policies recently enacted at the state- and local-level may impact children's obesity-related behaviors during the time they spend in childcare, there are eating opportunities before and after childcare as well as on weekends. In fact, the overall impact of these policies on child health rests on the combination of behavior during childcare and at home. Assessing the potential impact of these interventions on child and parent behavior outside the target setting is important to understanding the true effect of these interventions.

There is reason to believe these interventions could have an impact on children outside of the childcare environment through changes in the home environment. These impacts could be felt in there domains, through 1) household rules, 2) parental modeling, and/or 3) the physical environment.[19-21] Household rules are composed of the implicit and explicit policies within the home regarding eating. Parental modeling comprises behaviors that are observed by children which may influence child behavior. Lastly, the physical environment comprises the access and availability of items that promote or prohibit healthy behavior both within the household and in the neighborhood. Each of these pathways are amenable to influence through intervention, including policy interventions delivered in childcare settings, and thus each component should be examined when looking at whether these spillover effects are occurring with a given intervention. In the case of the

NYC policy, while parents were not the direct target of the intervention, changes in children's behavior occurring during the day may influence parent behavior at home or vice-versa.

The potential for obesity-related environmental change interventions to produce behavior change outside the target environment has been explored in a limited fashion among older children. One study examined this effect in a sample of middle school children, some of whom attended schools with strict regulations on nutritional quality of the food served and some of whom did not.[22] Researchers found that while the children in the intervention schools significantly decreased their consumption of unhealthful snacks at school, there was no change in their consumption of these snacks at home. According to the authors, "there was no evidence of a compensatory increase in consumption at home of the snacks that had been removed at school" (p9).[22] No existing publication has examined this effect among young children though many have hinted at the assumption that concomitant changes at home are expected; according to one author, "the underlying assumption is that the children's parents will plan meals and snacks for times before and after their child's day at the child-care center to complement the center menu and reinforce healthful food choices modeled in child-care meal patterns" (p950).[23] This assumption remains untested. In the broader public health literature, spillover effects have been examined related to smoking cessation and prevention with mixed results.[24-26]

This study explored the extent to which the NYC policy is associated with changes in the home nutrition environment of children. While New York City was used as the study site, many other jurisdictions are either exploring or implementing similar regulations across the country making the exploration of these effects relevant to a wide audience of stakeholders.

Methods:

Sampling: To explore this question, a multilevel cross-sectional study was conducted. We sampled both childcare centers operating in low-income neighborhoods and parents of children attending these centers. Further details about the sampling at both levels are provided in previous publications.

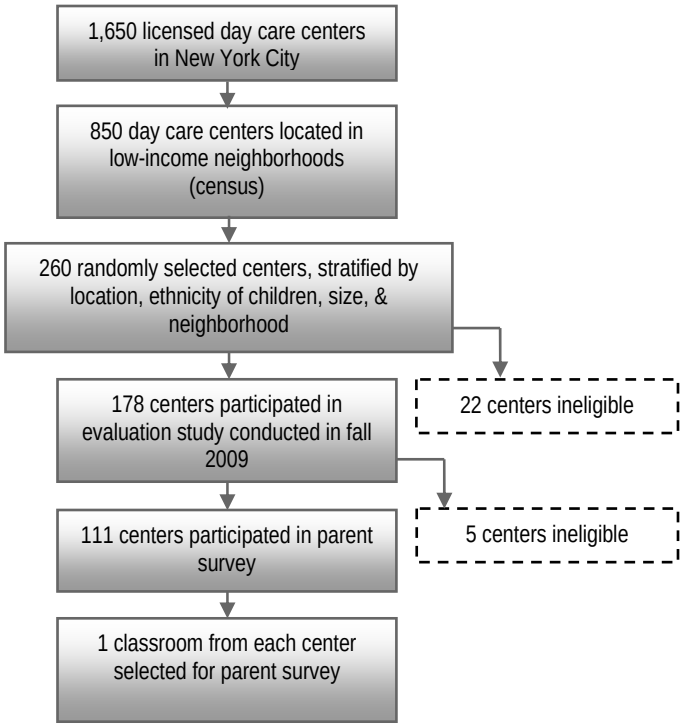

Figure 2: Sampling Methodology, Parent Survey, 2010

Briefly, of the 1,650 licensed day care centers in New York City, the 850 located in low-income neighborhoods (40% of the households earn less than 200% of the federal poverty level) were identified. From these, a random sample of 260 was selected and approached to participate in an evaluation study being conducted of the policy in the fall of 2009. In the spring of 2010, centers were again approached to participate in additional data collection, including a parent survey. Of the 173 sites eligible for inclusion into the parent study, 111 sites participated in the study (center response rate = 64%). At each center, one classroom of three and/or four-year old children was randomly selected and the parents of all the children in that classroom were eligible for the study. Letters were sent home to selected parents describing the study. An information sheet described the parent component of the study, and asked parents to complete a written survey and return it to the childcare center in a sealed envelope. These materials were available in both English and Spanish. Parents were offered a 4-ride voucher for the New York City subway system (Metrocard) as an incentive. Completed surveys were received from 1,487 parents, resulting in an average response rate of 78% per childcare center. Individual- (e.g. parent) and group-level data are described in turn.

Center-level data: In order to assess children's exposure to the policy, each center's compliance with the policy was determined using several types of data collection methodologies. This measure was used as an exposure proxy to test the assumption that increasing levels of compliance with the

regulations would result in a larger impact on the home environment. Information about compliance was collected via an interviewer-administered survey of the director, two randomly selected teachers and the food service staff person; an observational assessment/site inventory of the center; and review of center records. Data collection instruments focused on assessing compliance with each component of the policy. These data were then used to comprehensively classify each center's level of compliance with the policy with a six-level categorical variable. Thus the exposure variable of interest used in this analysis was a compliance score calculated as an index of each center's level of compliance in three areas: television (1-2), nutrition (1-5), and physical activity (1-3) (the total compliance score ranged from 3 to 10). In the sample, the score for total compliance ranged from 3 through 8. For entry into the multi-level models, scores were translated into a 1-6 ordinal variable.

Parent Survey: Information was collected from parents to classify the home nutrition environment. The instrument was designed to cover the three domains of the home nutrition environment described above (household rules, parental modeling, and the physical environment) and all nutrition-related components of the NYC policy under study (e.g. milk, water, juice, and sugar drinks) (See Table 1).

The survey consisted of 46 items in six areas: demographic information about the child, information about the parent and family; beverage consumption and rules at home; physical activity at home; television viewing at home; and information about the child's daycare center. This paper will specifically focus on the 14 items related to the home nutrition environment along with key demographic variables. Some of the items were adapted from two existing instruments that have been used with this age group,[19, 27] and others were developed specifically for this study. The survey was pilot tested (n=4) with parents from one daycare center in NYC similar to those eligible for the study.

Table 1: Items assessing the home nutrition environment

Component	***Household Policy (6 items)***	***Modeling (6 items)***	***Physical Environment/Access (4 items)***
Milk (4 items)	• What type of milk does your child usually drink at home? • How often does your child drink fat free or low-fat milk at home?	• What type of milk do you usually drink at home? • How often do you drink fat free or low-fat milk at home?	
Water (3 items)	• How often does your child drink water at home?	• How often do you drink water at home?	• Do you have rules about how much or how often your child can drink water?
Juice (3 items)	• How often does your child drink 100% juice at home?	• How often do you drink 100% juice at home?	• Do you have rules about how much or how often your child can drink 100% juice?
Sugar Drinks (4 items)	• How often does your child drink soda at home? • How often does your child drink sports drinks, kool aid, lemonade, fruit drinks or flavored milk at home?	• How often do you drink soda at home? • How often do you drink sports drinks, kool aid, lemonade, fruit drinks or flavored milk at home?	• Do you have rules about how much or how often your child can drink regular soda? • Do you have rules about how much or how often your child can drink sports drinks, kool aid, lemonade, fruit drinks or flavored milk?

Statistical Analysis: Multilevel modeling was used to examine the research questions of interest, adjusting for the clustered sampling design. To compute a composite outcome variable consisting of the 14 items used to describe the nutrition-related home environment, a partial credit Rasch model (PCRM) was used. This model allows for a logistic transformation of each parent's responses, which places each respondent on an interval scale (in logits – or log odds). The model is useful in cases where raw scores alone may not be the best representation of the underlying value of each respondent on the latent variable (in this case, the nutrition-related home environment).[28] The model produced estimates of the nutrition-related home environment for each respondent. It is important to note that in this PCRM, the estimates were intentionally centered on zero. This means that while

the relative position of each respondent's score is meaningful, the actual values for each person are arbitrary. FACETS for Windows was used for the Rasch model. Data were entered into PASW 17.0 (2009) for exploratory analyses including simple frequencies and cross-tabulations.

In order to account for the clustered sampling used in the study, a two-level hierarchical linear model was used to test the primary study questions, namely the relationship between level of compliance and the home environment among participating children. Child- and parent-level covariates such as race/ethnicity and gender were entered at level 1 and center-level compliance was entered at level 2. The models simultaneously tested the associations between individual- and group-level factors on the home environment score. HLM 6.0 for Windows was used for HLM modeling.

All procedures were approved by both the Emory University and New York City Department of Health and Mental Hygiene Institutional Review Boards.

Results:

One hundred forty seven surveys were discarded because children were over age 5 (82 respondents) or because respondents skipped entire pages (65 respondents); the total sample used for analysis was 1,340. The majority of the children whose parent responded to the survey were either Black/African-American (43.9%) or Hispanic/Latino (42.2%) (See Table 1). Parent respondents reported their highest level of education, with a high school diploma being most common (30.3%), followed by some college (27.6%). Approximately half the respondents (52.1%) reported speaking only English at home, with 10.9% reporting using only another non-English language. Approximately half the participants were born in the United States (50.8%).

Table 2: Demographics of respondents, Parent Survey, New York City, 2010

Characteristic (n=1,340)	Frequency N (%)
Child ethnicity	
Black or African-American (not Hispanic/Latino)	570 (43.9)
White (not Hispanic/Latino)	19 (1.5)
Hispanic/Latino	547 (42.2)
Other, including multi-racial	161 (12.4)
Respondent sex (female)	1161 (98.2)
Respondent highest education	
Less than high school	211 (16.3)
High school diploma	392 (30.3)
Some college	358 (27.6)
College degree or higher	334 (25.8)
Language spoken at home	
English only	672 (52.1)
English some of the time	476 (36.9)
Other language only	141 (10.9)
Respondent born in the United States	663 (50.8)
Language of survey (Spanish)	213 (15.9)

This analysis used the estimates from the PCRM in place of raw item scores or a summed scale score. Fourteen items were included in the PCRM, which was then used as a continuous outcome measure in the HLM models used to test the primary study hypotheses. The overall mean estimate of the home nutrition environment was 0.53 with an interquartile range of 0.56 (See Table 3). Over half the centers were classified in the highest two categories of compliance and only one center was classified at the lowest level. When examining the bivariate association between compliance and the home nutrition environment, the lowest level of compliance was correlated with the lowest mean value for the home environment (0.35) though the highest level of compliance did not correlate with the highest mean value for the home nutrition environment (0.53). Respondents whose children attended centers with moderate compliance (4 through 5) showed above average home environment scores while the remaining levels of compliance showed average or below average home environment scores.

Table 3: Descriptive statistics on the estimates of the home nutrition environment

	Estimate		
Mean	0.53		
Standard Error	0.12		
Center-level Compliance	**Centers N (%)**	**Mean Estimate**	**Standard Error**
1 (lowest)	1 (1.0)	0.35	0.081
2	3 (2.9)	0.52	0.087
3	12 (11.4)	0.45	0.041
4	27 (25.7)	0.53	0.026
5	33 (31.4)	0.54	0.023
6 (highest)	29 (27.6)	0.53	0.022

To test the effect of the intervention on the home nutrition environment, multiple HLM models were run. An unconditional model showed that 16.2% of the variability in the nutrition-related home environment was due to center-level factors, however, the multilevel models examining the effect of center-level compliance on the nutrition-related home environment did not suggest an effect of the policy on the home environment (p=0.52). In fact, compliance only explained 10.56% of the center-level variability (1.7% of the overall variability). These models controlled for child ethnicity, respondent's education level and the language spoken at home. Due to these null findings, additional post-hoc analyses were conducted using only the nutrition component of the compliance score (1-4 score); this model similarly showed no impact of compliance on the home nutrition environment (data not shown; available from first author on request).

Table 4: Association of Compliance with the Home Nutrition Environment, HLM Model

Attribute	**Coefficient**	**Standard Error**	**p-value**
Level – 2 (Center-level)			
Compliance	0.0078	0.011	0.52
Level – 1 (Respondent-level)			
Born outside U.S.	0.195	0.034	<0.001
African-American race	-0.075	0.035	0.04
White or other race	-0.086	0.042	0.67
Less than high school education	-0.049	0.036	0.20
College degree or higher	0.080	0.037	0.01
Speak some English at home	0.070	0.046	0.05
Speak other language at home (no English)	-0.035	0.056	0.53

Note: The reference category is parents born in the United States, reporting Hispanic/Latino ethnicity, High School diploma, and speak only English at home.

Conclusion:

Our analysis found no effect of increasing compliance with the policy on the home nutrition environment in this sample. Thus this study suggests that these environmental change interventions may not have reach beyond the childcare setting, supporting the findings of other studies of older children cited above.[22] On the positive side, we did not find evidence of a *negative* spillover effect involving more unhealthy home environments making up for the lack of unhealthy items served during the childcare day, which has been suggested in the literature.[29] At the very least, these children are receiving more healthy foods and beverages during the day, even if those selections are not carried over into the home. However, these results suggest that the impact of these interventions might be limited to these changes in the childcare setting and that additional work needs to be done to translate these changes into the home environment.

This study has a number of limitations. Firstly, because there were many public health interventions occurring in New York City during the time period under study, it is possible that the variability in the home environment was limited, making it difficult to attribute specific components of the childcare environment to parent behavior. Secondly, while the survey was anonymous, social desirability may have impacted responses making the associations between compliance and the home more difficult to uncover. This may be especially likely given emphasis the city has had on obesity prevention which may translate into stronger social pressure to respond in a certain manner. This limitation is common for any self-reported instrument of behavior related to obesity and was partially addressed through study procedures designed to protect respondents' confidentiality. Finally, there may be certain neighborhood-level factors such as access to healthy foods that may have played a role in these relationships; these factors were not assessed.

Even given these limitations, this study provides a framework for future examination of the potential for these environmental change interventions to spill over into the home. Future policies may need to incorporate more direct-to-parent activities to encourage parents to support the healthy choices

made for childcare settings and evaluations of these policies should explicitly examine the effect of these additional activities on the home environment of participating children.

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The impact of childcare regulations on aspects of the home environment related to screen time and physical activity

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Abstract: Research suggests that interventions to improve the physical activity environment during the childcare day may be effective tools to increase physical activity and reduce screen time among young children. Despite the promise these interventions show in improving behavior during the childcare day, little research has examined whether improving the childcare environment spills over into the home environment. This study examined this connection by exploring New York City's (NYC) regulations related to obesity prevention in childcare which have requirements for both physical activity and screen time.

A self-administered study was given to parents of children ages 3-4 from 111 licensed childcare centers in low-income neighborhoods in New York City. The survey assessed attributes of the home physical activity and screen viewing environment as well as demographic characteristics of parents and children. A composite score of the home environment was calculated using a partial credit Rasch model. Data categorizing each center's compliance with the NYC regulations using a 1-6 point index were used to capture children's exposure to the intervention. We used a hierarchical linear model to test the association between center-level compliance with the NYC regulations and the home environment.

In total, 1,487 parents from 111 centers returned surveys. Multi-level models showed that the center's level of compliance with the regulations was unrelated to the home environment in this sample ($p=0.54$). While many have assumed that policy and environmental change interventions in childcare settings affect the home environment, this assumption may not be warranted. Additional research is needed to directly target parents and the home environment to curb obesity among young children.

Childhood obesity is of serious concern in the United States, where over 33% of children and youth (ages 2-19) are either overweight or obese; this percentage has grown steadily over the past ten years.[1]Children who are overweight at an early age are at higher risk of numerous, negative health outcomes throughout life; this realization has led to a growing body of research on early childhood obesity.[2] In fact, 26.2% of children in the United States ages 2-5 are either overweight or obese; this percentage ranges from 24% of non-Hispanic black children to 32.6% of Mexican-American children.[1] Numerous behaviors are linked to weight gain and obesity among children; among them is poor diet[3], lower rates of physical activity[4], and high screen (including television) viewing time.[5]

There are established connections between the levels of physical activity and weight gain in young children. Several studies have found an association between physical activity intensity and weight among young children; these studies suggest that vigorous activity is an especially important determinant of weight status among this age group.[6, 7]One study found that the preschool children attend is a significant predictor of physical activity levels and that both opportunities and facilities for physical activity were likely contributors. According to the authors, " school policies and practices directed toward providing preschool-aged children with physical activity have the potential to influence greatly the overall physical activity levels of young children in the United States" (p1261).[8]

Television viewing is an important risk factor for obesity among young children, likely mediated through an increase in blood pressure[9], a reduction in physical activity[10], a decrease in resting energy expenditures[11], an increase in unhealthful eating, in part because of exposure to advertising of unhealthful foods.[5, 12-14]Other studies have shown that there is an increased risk of being overweight or obese among preschool children watching more than two hours per day as compared to those watching less than two hours per day (OR = 1.34; 95% CI [1.07, 1.66]).[15] The American Academy of Pediatrics (AAP), in fact, recommends zero television time for children under age 2 and no more than 1-2 hours of educational media viewing (including television, videos, video games, and computer use) for older children.[16] Despite these guidelines, one study of low-income young children

found that approximately half the children ages two through four watched more than 2 hours per day of television, and four-year olds in the sample watched an average of 18.4 hours of television per week (or 2.6 hours per day).[17] Each hour of television was associated with a 6% increase in the odds of being obese among the sample, comparable to findings from older samples.[17]

To address these important determinants of obesity among young children, there is increasing interest in policy and environmental changes aimed at creating healthful surroundings for children and families.[18] Childcare settings in particular could prove to be an effective place to intervene in the lives of young children, as 41% of children under the age of five are in childcare 35 or more hours per week.[19] With such a large amount of time spent in these settings, childcare could be a powerful location in which to improve health and wellbeing of young children by promoting healthier environments.[20] Several previous interventions conducted in the childcare setting have successfully improved child behavior related to nutrition, physical activity and screen viewing within that setting.[21-24]

The extent to which environmental interventions delivered in childcare settings impact other settings, including the home environment, has yet to be understood. A handful of studies have examined this connection, via an exploration of nutrition-related components of obesity prevention programs delivered in school or childcare setting. One study concluded that while an intervention succeeded at reducing middle school students' consumption of unhealthy snacks at school, there was no impact on their consumption outside of school.[25]For young children, changes in parental behaviors or household routines related to television viewing and physical activity behaviors could be the mechanism through which environmental changes from school or childcare settings impact the home. These changes may result from changes in child preference for television viewing and physical activity which may result from these policies. The cumulative effect of these interventions on child obesity includes changes in child behavior in the childcare setting combined with changes in behavior

at home. In order for researchers to fully understand the effect of these interventions there needs to be an understanding of behavior in both settings.

New York City provides an excellent opportunity to explore these assumptions in a real-world context. In 2006, the New York City Department of Health and Mental Hygiene (DOHMH) amended the New York City Health Code to require licensed group childcare centers to comply with certain requirements related to nutrition, physical activity and screen time. The policy requires that children be scheduled to participate in at least 60 minutes of physical activity per day, of which 30 minutes must be teacher-led, and that viewing of television, videos, and other visual recordings shall be limited to no more than 60 minutes per day of educational programs or programs that actively engage child movement.[26] Effective in 2007, the regulations are currently being enforced through DOHMH procedures city-wide. Because of these regulations, New York City is an excellent setting to explore whether environmental change interventions delivered in the childcare setting can improve the home environment related to physical activity and screen viewing.

Methods:

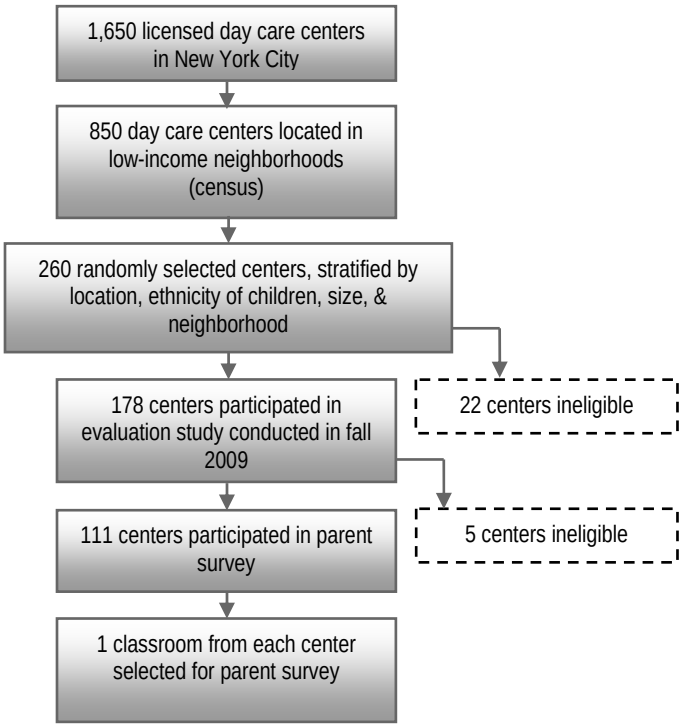


Figure 1: Sampling Methodology, Parent Survey, 2010

Sampling: To explore this question, a multilevel cross-sectional study was conducted. We sampled both childcare centers operating in low-income neighborhoods and parents of children attending these centers. Briefly, of the 1,650 licensed day care centers in New York City, the 850 located in low-income neighborhoods (40% of the households earn less than 200% of the federal poverty level) were identified.

From these, a random sample of 260 was selected and approached to participate in an evaluation study being conducted of the policy in the fall of 2009. In the spring of 2010, centers were again approached to participate in additional data collection, including a parent survey. Of the 173 sites eligible for inclusion into the parent study, 111 sites participated in the study (center response rate = 64%). At each center, one classroom of three and/or four-year old children was randomly selected and the parents of all the children in that classroom were eligible for the study. Letters were sent home to selected parents describing the study. An information sheet described the parent component of the study, and asked parents to complete a written survey and return it to the childcare center in a sealed envelope. These materials were available in both English and Spanish. Parents were offered a 4-ride voucher for the New York City subway system (Metrocard) as an incentive. Completed surveys were received from 1,487 parents, resulting in an average response rate of 78% per childcare center. Individual- (e.g. parent) and group-level data are described in turn.

Center-level data: In order to assess children's exposure to the policy, each center's compliance with the policy was determined using several types of data collection methodologies. This measure was used as an exposure proxy to test the assumption that increasing levels of compliance with the regulations would result in a larger impact on the home environment. Information about compliance was collected via an interviewer-administered survey of the director, two randomly selected teachers and the food service staff person; an observational assessment/site inventory of the center; and review of center records (e.g. menus, schedules). Data collection instruments focused on assessing compliance with each component of the policy. These data were then used to comprehensively classify each center's level of compliance with the policy with a six-level categorical variable. Thus the exposure variable of interest used in this analysis was a compliance score calculated as an index of each center's level of compliance in three areas: television (1-2), nutrition (1-5), and physical activity (1-3) (the total compliance score ranged from 3 to 10). In the sample, the score for total compliance ranged from 3 through 8. For entry into the multi-level models, scores were translated into a 1-6 ordinal variable.

Parent-level data:

Information was collected from parents to understand the quality of the home physical activity and screen time environment (our outcome of interest). Because the literature predominately describes the relationship between screen viewing and obesity as being mediated through physical activity,[10] this study looked at these behaviors together.

The survey consisted of 46 items in six areas: demographic information about the child, information about the parent and family; beverage consumption and rules at home; physical activity at home; television viewing at home; and information about the child's daycare center. This paper will specifically focus on the items related to the home physical activity environment (including screen viewing) along with key demographic variables used to control for confounding. Some of the items were adapted from two existing instruments that have been used with this age group,[27, 28] and others were developed specifically for this study. Items were chosen or designed to cover the home environment and all components of the NYC policy under study (e.g. frequency of physical activity, access to and use of outdoor play spaces, frequency of screen viewing, household rules about screen viewing) (See Table 1 for all items). The survey was pilot tested (n=4) with parents from one daycare center in NYC similar to those eligible for the study.

Table 1: Survey Items Assessing the Home Physical Activity and Screen Time Environment

Component	Items on Parent Survey
TV duration (5 items)	• On a typical week day (Monday – Friday) at home, how much time does your child spend watching TV, DVDs or videos? • On a typical weekend day (Saturday or Sunday) at home, how much time does your child spend watching TV, DVDs or videos? • On a typical week day (Monday – Friday) at home, how much time do you spend watching TV, DVDs or videos? • On a typical weekend day (Saturday or Sunday) at home, how much time do you spend watching TV, DVDs or videos? • Is there a working television in your child's bedroom?
TV content (3 items)	• Do you have household rules about what your child can watch on TV? • While your child is watching TV at home, how often does he/she watch educational shows or videos? • How often do you watch television with your child?
Physical Activity (6 items)	• On a typical week day (Monday – Friday) at home, how much time does your child spend actively playing or exercising? • On a typical weekend day (Saturday or Sunday) at home, how much time does your child spend actively playing or exercising? • On a typical week day (Monday – Friday) at home, how much time do you spend exercising? • On a typical weekend day (Saturday or Sunday) at home, how much time do you spend exercising? • Do you have access to a safe outdoor space where your child can exercise? • How often in a given week do you take your child to exercise outdoors?

Statistical Analysis: To compute a composite outcome variable consisting of the 14 items used to describe the home physical activity environment (See Table X), a partial credit Rasch model (PCRM) was used. This model allows for a logistic transformation of each parent's responses, which places each respondent on an interval scale (in logits – or log odds). The model is useful in cases where raw scores alone may not be the best representation of the underlying value of each respondent on the latent variable (in this case, the home physical activity environment).[29] The model produced estimates of the home environment for each respondent, with estimates centered on zero. FACETS for Windows was used for the Rasch model. Data were entered into PASW 17.0 (2009) for exploratory analyses including simple frequencies and cross-tabulations.

In order to account for the clustered sampling used in the study, a two-level hierarchical linear model was used to test the primary study questions, namely the relationship between level of compliance and the home environment among participating children. Child- and parent-level covariates such as race/ethnicity and gender were entered at level 1 and center-level compliance was entered at level 2. The models simultaneously tested the associations between individual- and group-level factors on the home environment score. HLM 6.0 for Windows was used for HLM modeling.

All procedures were approved by both the Emory University and New York City Department of Health and Mental Hygiene Institutional Review Boards.

Results:

One hundred forty seven surveys were discarded because children were over age 5 (82 respondents) or because respondents skipped entire pages (65 respondents); thus the available sample size for analysis was 1,340. The majority of the children whose parent responded to the survey were either Black or African-American (43.9%) or Hispanic/Latino (42.2%) (See Table 2). Most of the parent respondents were female (98.2%), and a small number of surveys were completed in Spanish (15.9%).

Table 2: Socio-demographic characteristics of respondents

Characteristic (n=1,340)	**Frequency N (%)**
Child ethnicity	
Black or African-American (not Hispanic/Latino)	570 (43.9)
White (not Hispanic/Latino)	19 (1.5)
Hispanic/Latino	547 (42.2)
Other, including multi-racial	161 (12.4)
Respondent gender (female)	1161 (98.2)
Respondent highest education	
Less than high school	211 (16.3)
High school diploma	392 (30.3)
Some college	358 (27.6)
College degree or higher	334 (25.8)
Language spoken at home	
English only	672 (52.1)
English some of the time	476 (36.9)
Other language only	141 (10.9)
Respondent born in the United States	663 (50.8)
Language of survey (Spanish)	213 (15.9)

Descriptive statistics describing the exposure of interest, compliance with the policy, were examined. The compliance score showed a moderate amount of variability across centers; only one center was

classified in the lowest category (1) while 29 centers (27.6%) were classified in the highest category of compliance (See Table 3).

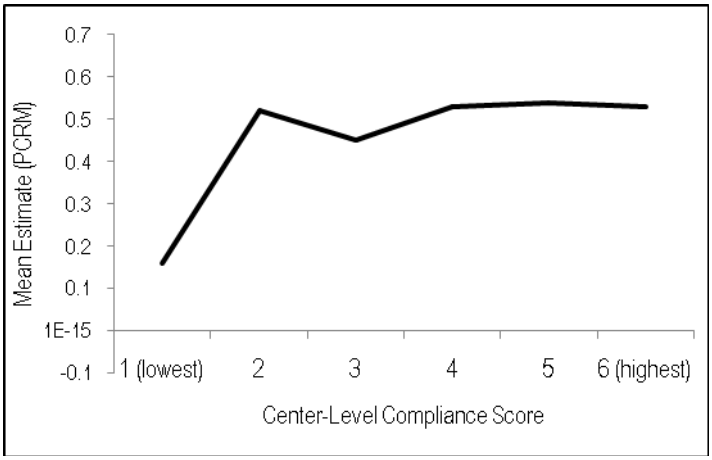
Table 3: Description of compliance distribution and bivariate relationship between compliance and PCRM estimates, Parent Survey, 2010

Center-level Compliance	**Centers N (%)**	**Mean PCRM Estimate**	**Standard Error of Estimate**
1 (lowest)	1 (1.0)	0.16	0.15
2	3 (2.9)	0.58	0.08
3	12 (11.4)	0.46	0.05
4	27 (25.7)	0.47	0.03
5	33 (31.4)	0.49	0.02
6 (highest)	29 (27.6)	0.52	0.03

This analysis used the estimates from the PCRM in place of raw item scores or a summed scale score. Fourteen items covering physical activity and screen viewing at home were entered into the PCRM to create a single measure of the home environment related to these two components (See Table 1 for list of items). The overall average score was 0.49 logits with a range of -1.91 to 4.03 logits (interquartile range = 0.61). Model fit statistics used in PCRM were reviewed and the model showed adequate fit.

The relationship between compliance and the estimates of the home environment were examined (See Figure 2). The graphical depiction indicates that there may be a linear relationship between compliance and the home environment. The lowest level of compliance was associated with the lowest estimate of the home environment (0.16), though the highest level of compliance was not associated with the highest estimate (0.52) (See Table 3).

Figure 2: Relationship between compliance and the home environment, Parent Survey, 2010



Multi-level modeling was used to test the associations between compliance and the measure of the home environment, controlling for individual level characteristics (e.g. race). These models showed that 29.2% of the variance in the home environment, a moderately high amount, could be explained using center-level factors. The center-level compliance variable was not significantly associated with the home environment in the models, however ($p>0.05$). Due to these null findings, additional post-hoc analyses were conducted using only the physical activity and screen time components of the compliance score (2-5 score); this model similarly showed no impact of compliance on the home environment.

Table 4: Association of Compliance with the Home Environment, HLM Model

Attribute	Coefficient	Standard Error	p-value
Compliance	0.012	0.02	0.54
African-American race	0.011	0.14	0.94
White or other race	0.052	0.28	0.85

Note: Hispanic/Latino ethnicity served as the referent group

Conclusions:

The results of this study suggest that despite changes in the childcare environment, increasing levels of compliance with an obesity prevention policy are not associated with the home physical activity environment in this sample. This may contradict commonly held beliefs that efforts to change environments in which children learn, through things like increasing physical education time in high schools, removing televisions from elementary schools and, like New York City, limiting the amount of television time children view in childcare centers change the children and their parents and make them more amenable to or appreciative of healthful living. Our findings do not support these assumptions; instead, more comprehensive programming targeting the home environment along with other key environments may remain the best solution to creating places where children can live active lives.

Increases in center-level compliance with the policy did not seem to be associated with the measure used to encapsulate the home environment related to physical activity and screen viewing. Descriptive statistics suggested that while there was variability in the composite home environment score, the scores did not increase along with compliance. This supports previous research suggesting that nutrition-related changes do not spillover into the home and extends these findings to physical activity and screen viewing behaviors.[25]In our sample, parents whose children had limited access to television viewing during the time they spend in childcare did not allow their children to compensate for this time by watching additional television during the evenings and weekends, nor did those children with higher amounts of exercise during the day show less during evenings and weekends. Thus while these null findings suggest that more could be done to impact home physical activity and screen viewing behaviors, they also do not support the possibility that these policies have a negative spillover effect, one that could be detrimental to the overall impact of these policies.

This study supports previous findings about group-level impacts on obesity behaviors in urban settings. For example, the high proportion of variance in our home environment measure associated with center-level factors supports the assumption that neighborhood-level attributes are particularly important for physical activity and screen viewing behaviors for young children at home because parents likely send their children to childcare centers in their home neighborhoods. This is not surprising as access to outdoor play spaces may impact the frequency of exercise and by extension the frequency of television viewing among residents of a given neighborhood. In part due to these impacts in an urban setting such as New York City, it may be unreasonable to think that changes in the childcare setting would be able to continue at home in the face of neighborhood characteristics such as safety and availability of safe play spaces.

This study has a number of limitations that may have impacted the conclusions about the impact of the regulations on the home environment. Firstly, the measure of center-level compliance showed less variability than what is likely present in centers. Only one center was classified in the lowest

compliance level and only 27.6% were classified in the highest grouping. It is possible that with a more sensitive measure of compliance, there would be an association with the home environment in this sample. In addition, there were a number of obesity prevention interventions underway in New York City during the time period under study. These interventions may have the cumulative effect of reducing the variability in the measure of the home environment, which would also make it more difficult to show significant associations with compliance. These additional public health efforts may have also introduced social desirability bias into the results as parents may be more likely to feel social pressure to report more healthful behaviors at home.

Despite these limitations, this study suggests that one should not assume that policy-level changes implemented in childcare settings will spill over into the home environment. Additional components may need to be added to this and similar interventions in order to reach parents and address the home environment.

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Conclusion:

This exploration into the possible spillover effect of childcare-based obesity prevention interventions showed that there is little evidence to support the hypothesis that program effects translate into the home environment. Overall, this exploration considered both the published evidence and collected new primary data to understand these connections and similar results were found across these data sources.

First, a review of the published literature on the topic found that there is much to be learned about the potential spillover effect of interventions delivered in childcare settings. While over half the eligible papers (7 of 12) included measurement of behavior outside the target environment, only three found significant effects on these behaviors and all three of these impacts suggested a positive spillover effect on the home with parents supporting the work done in the childcare setting. The four other papers that measured a potential spillover effect found no effect, lending support to the possibility that these interventions have no impact on the home. None of the papers found a negative spillover effect on any of the behavioral targets despite some suggestion in the literature that a negative effect may be possible in this population.

Second, data collected from nearly 1,500 parents in New York City suggested that there is no relationship between increasing levels of compliance with a daycare environmental change policy and attributes of the home environment related to nutrition. Thus this study suggests that these environmental change interventions may not have reach beyond the childcare setting, supporting the findings of other studies of older children. On a positive note, we did not find evidence of a *negative* spillover effect involving more unhealthy home environments making up for the lack of unhealthy items served during the childcare day, which has been suggested in the literature. At the very least, these children are receiving more healthy foods and beverages during the day, even if those selections are not carried over into the home. However, these results suggest that the impact of these

interventions might be limited to these changes in the childcare setting and that additional work needs to be done to translate these changes into the home environment.

Third, additional data from New York City suggested that despite changes in the childcare environment related to physical activity and screen viewing, increasing levels of compliance were not associated with the home physical activity environment. This may contradict commonly held beliefs among public health workers that efforts to change environments in which children learn, like New York City limiting the amount of television time children view in childcare centers, somehow change the children and their parents and make them more amenable to or appreciative of healthful living. Our findings do not support these assumptions; instead, more comprehensive programming targeting each environment and its determinants may be the only solution to creating places where children can grow up healthy.

Across twelve existing studies and the two original studies completed for this exploration, there were little data to support a spillover effect of programs without direct-to-parent components. The review considered twelve studies of ten different interventions designed to intervene in exercise, nutrition and/or screen viewing and the original studies considered the potential impact of one all-encompassing environmental intervention. Thus across eleven interventions, very little impact was seen on the home environment of participating children. In the review paper, only seven intervention studies assessed the home environment and only three found a significant spillover effect. Some reasons for the lack of spillover may be the focus of the interventions (e.g. target behavior), lack of measurement of spillover, and unknown or unmeasured neighborhood factors.

The focus of the interventions studied here may have impacted the potential for a spillover effect. Of note, none of the papers found a spillover effect for any measures of physical activity or active play, even though three papers found a significant effect on children's physical activity in the childcare setting. Only one of these papers measured behavior at home, and found no impact of the intervention. While it is important to consider whether the behavioral target of the interventions (e.g.

physical activity, healthy eating) impacts the extent to which an intervention has a spillover effect, again given the small number of interventions eligible for review no conclusions can be drawn about possible connections between these attributes. Future research may want to consider whether nutrition-based interventions, for example, are more likely to produce a spillover effect as compared to those targeting only screen time or active play.

Lack of spillover might have simply been due to a lack of *measurement* of spillover. This review revealed that five of the twelve papers did not measure behavior outside the childcare environment. One reason researchers may be reluctant to include behavior outside the target environment is the challenges inherent in measuring these behaviors. Many of the interventions designed for young children in childcare settings are modeled after or similar to interventions delivered to older children in school settings. In these cases, children's behavior both at school and outside of school can be directly assessed using self-report. These methods may not be applicable to young children, who cannot accurately report their behavior. The overwhelming majority of studies that looked at behavior outside the childcare setting used parent report of child behavior, with varying success. The validity of these parent reports, especially at the level of estimating portions, is unknown. One study had such a low response rate for the parent report portion of the measurement that analysis of the resulting data was impossible. These measurement challenges and others detailed in the literature, though considerable, should not be used as a reason to avoid assessing the potential impact of obesity prevention and control programs on the home environment. As highlighted by numerous reviews of these interventions, parental involvement is one key to obesity prevention in this population and spillover of positive changes into the home will be critical to supporting and sustaining changes made in the childcare setting throughout the child's life.

Lastly, neighborhood characteristics might better explain obesity-related behavior at home. The conclusions of the original studies support previous findings about group-level impacts on obesity behaviors in urban settings. For example, the relatively high proportion of variance in our home

environment measures associated with center-level factors supports the assumption that neighborhood-level attributes are particularly important for physical activity and screen viewing behaviors and somewhat important for nutrition behaviors among young children at home. This is not surprising as access to outdoor play spaces impacts both the frequency of exercise and by extension the frequency of television viewing among residents of a given neighborhood and access to healthy foods might impact nutrition behaviors among residence with similar access to food stores. In part due to these impacts in an urban setting such as New York City, it may be unreasonable to think that changes in the childcare setting would be able to continue at home in the face of neighborhood characteristics such as safety and availability of safe play spaces.

On a positive note, none of the interventions studied in this exploration found a negative spillover effect. In the two original studies, parents whose children had limited access to television viewing during the time they spend in childcare did not allow their children to compensate for this time by watching additional television during the evenings and weekends, nor did those children with higher amounts of exercise during the day show less during evenings and weekends. Thus while the overall null findings suggest that more could be done to impact home physical activity and screen viewing behaviors, they also do not support the possibility that these policies have a negative spillover effect, one that could be extremely detrimental to the overall impact of these interventions.

Limitations:

The review paper suffered from a number of limitations that may have influenced the results. First, while the search strategy was designed to be inclusive of interventions studies with no effect, we can assume publication bias may have impacted the extent to which interventions that showed no effect appeared in the literature. This issue was addressed partially by the inclusion of unpublished dissertations in the review, but the impact of this bias on the results is unknown. Secondly, the coding was limited to measurement reported in the papers; any researchers who measured behavior outside the target environment but did not include it in these papers were coded incorrectly. Thirdly,

the eligibility criteria purposefully excluded papers that did not mention measurement of program effect. This may partially explain the finding that most papers found at least one significant program impact, as those with null findings may have been written up without mention of the evaluation.

For Aims 2-3, because the project is connected to a larger evaluation study of the effect of the regulations on centers in New York City, many potential methodological limitations were avoided through the use of complex, multi-stage sampling methods designed to address potential selection bias. However, the project does have a small number of limitations. Firstly, the external validity of the study outside of New York City is limited given the unique characteristics of the regulations, the study sample and the context of New York City. Though other jurisdictions, including other cities but also counties and states, are considering implementing similar measures in childcare settings, the results from this study cannot necessarily be generalized outside of the context of a large urban setting. The sampling frame also precludes the results from being generalized to middle- or higher-income communities within urban settings as all participants in the research live in low-income communities within New York City. Secondly, because there were many public health interventions occurring in New York City during the time period under study, it is possible that the variability in the home environment was limited, making it difficult to attribute specific attributes of the childcare environment to parent behavior

There were also limitations due to the nature of data collection (e.g. self-administered written surveys). Firstly, since the survey was only administered in written English and Spanish, participants were limited to those who can read and write in one of those two languages. Secondly, while the survey was anonymous, social desirability may have impacted responses making the associations between compliance and the home more difficult to uncover. This may be especially likely given emphasis the city has had on obesity prevention which may translate into stronger social pressure to respond in a certain manner. This limitation is common for any self-reported instrument of behavior related to obesity and was partially addressed through study procedures designed to protect

respondents' confidentiality. Secondly, the assessment of the home environment was done through self-reported measures (e.g. parent survey) and did not include observation or other potentially more objective measures. While more objective measures would improve the internal validity of the study, given the current lack of research on this topic these measures were considered exploratory and thus self-report was an acceptable measure of the home environment.

In addition, the measure of center-level compliance showed less variability than what is likely present in centers. This measure, while central to exploring the relationship between the NYC policy and the home environment, was dictated by the larger RWJ study. The compliance score was not designed to be used in conjunction with these parent surveys and thus was not ideally suited to these analyses. While variability in compliance across the entire policy is likely given that certain components are determined by the teacher, others by the director and others through physical access issues, the compliance score simply categorized compliance via a simple 1-8 index. Using this measure, only one center was classified in the lowest compliance level and only 27.6% were classified in the highest grouping. It is possible that with a more sensitive measure of compliance, there would be an association with the home environment.

Finally, there may be certain neighborhood-level factors such as access to healthy foods that may have played a role in these relationships; these factors were not assessed. It appeared in preliminary analyses as though these neighborhood factors were particularly important to the home environment related to physical activity and screen viewing where the intra-class correlation was particularly substantial. While there were two items assessing whether the parent had access to a safe place to take their child to play and the frequency with which they took their child outside to play, these may not have adequately captured both access to and use of neighborhood resources needed for families to eat healthy and exercise. These factors may have confounded the relationship between centers and the home environment; future research could expand upon the measures of the neighborhood that might be relevant to these relationships.

Future Research:

Though the conclusion overwhelmingly reached by this research is that changes made in the childcare setting have little effect on the home environment, additional study is warranted. As with much quantitative survey research, further qualitative study to understand how and why the home environment is not impacted by these interventions would be extremely valuable. While there were survey items asking about the presence or absence of household rules and policies regarding television viewing, future qualitative work could be done to understand the content and rationale for these rules. One survey respondent, after responding 'yes' to the question about whether they have household rules about what their child can watch on television wrote in the margin "he only likes action movies with a little bit of horror". Future qualitative work could explore the ways in which parents construct their household rules for screen viewing in this young population which could then inform intervention efforts to reduce television viewing. Other items assessed the presence or absence of restrictions on beverage consumption and similar qualitative work should be done to explore the ways in which parents construct these policies and ways they are enforced within the home. This research identified that many parents have rules about obesity-related behaviors in the home but the content and enforcement of these rules remains to be studied. This qualitative work could provide the depth and understanding necessary to design, implement and enforce future interventions designed to target the home environment.

The limited number of published studies reviewed for this research that measured the home environment found mixed results, often with less than ideal methods. Future research should consider measuring home behavior in addition to behavior in childcare settings in order to fully understand the effect of their interventions on child behavior. Indeed with additional study we may find some changes in children in some way that might help understand how and why these interventions might spillover into the home. Since there may be an expansion of jurisdictions implementing policy-level changes requiring changes in the childcare environment, additional study

of the impact of these interventions might be especially warranted. To improve the quality of data on the potential spillover effect of these policies, jurisdictions wanting to implement these policies could collect baseline data or use comparison groups to improve the likelihood that any changes made in the home environment would be captured.

This research did not explore the issue of child agency related to nutrition and physical activity behavior. The survey instrument used to address aims two and three asked about the home environment but did not cover the ways in which children impact their parents' behavior and their own choices in the home. While children at this young age may be primarily subject to their parents' decisions, it is possible that child preferences for certain foods or activities may have been impacted by these policies. For example, children may experience changes in preference for healthier foods or exercise and may express these preferences to their parents in some way. Future research could assess parents' perception of their children's preferences for certain behaviors or foods and the extent to which these preferences change with interventions.