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Frances Nicholas April 18th, 2011

The Relationship Between Income and Depression Severity in 12 Developing Countries

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Abstract

The Relationship Between Income and Depression Severity in 12 Developing Countries
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Mental health is an issue that has been gaining increasing attention on global agendas in the last decade or so. However, studies from developing countries on the depression-income relationship are limited, primarily due to lack of data. This paper uses nationally representative, individual-level data from the World Health Organization (WHO) World Health Surveys (WHS) on the adult population of 12 develoing countries to explore this relationship at a variety of income and depression levels. To control for potential reverse causality, two stage least squares (TSLS) and instrumental variable (IV) methods are used. My analysis reveals that income and depression have a significant inverse relationship in the low-income developing countries and below the median income level in the middle-income developing countries. For the lowest income bracket, the depression-income relationship is large and gets increasingly smaller until a threshold income level. Above this point, income is an insignificant determinant of depression. Because my results find those under the median income to be the most severely affected by the income-depression relationship, I argue that policies aimed at raising the incomes of the extreme poor would have the largest impact on reducing depression severity. This analysis reveals that there does appear to be a relationship between income and depression in the developing world, and that this relationship seems to vary based on income and development level.

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Introduction

Mental health is an issue that has been gaining increasing attention on global agendas in the last decade or so. In 2001, the World Health Organization (WHO) released a report, *Mental Health: New Understanding, New Hope,* which highlighted the importance of focused efforts to reduce the burden from mental disorders. Not only do mental health issues affect an individual's well-being and quality of life, they also have a profound impact on the family and community of the mentally ill individual, and they can have a significant effect on the economic productivity of a country. Additionally, mental disorders are becoming increasingly widespread in both high and low-income nations. The Global Burden of Disease Study projects unipolar major depression to be the largest contributor to morbidity on a global level by the year 2030. When looking specifically at developing regions, unipolar major depression is still projected to be one of the most significant contributors to years of life lost to disability (Health Statistics and Informatics, WHO 2008).

Individuals who suffer from depression are less likely to be highly educated or to obtain well-paying jobs, among other things. A study utilizing the same World Health Organization (WHO) World Health Surveys (WHS) used in my analysis found depression to have a larger effect on an individual's health than chronic conditions such as arthritis, diabetes, and asthma, noting that, "consistently across countries and different demographic characteristics, respondents with depression…had the worst health scores of all the disease states." (Moussavi et al. 2007, 851). Studying the link between income and mental health is of particular importance in developing countries, where a healthy, productive and educated labor force is crucial for economic growth.

It is generally accepted that income and depression are related, however; the specifics of this relationship remain widely debated. This is partially because the appropriate data on

depression were not available until recently, and partially because of the inherent econometric problems that arise when estimating this relationship. Economic theory posits that low income will result in increased risk of depression, and that depression often leads to lower attained education and employment status, which consequently result in lower income (Zimmerman 2005; Ettner 1996). Due to this reverse causality, it is difficult to isolate income's effect on depression.

Numerous studies in populations of developed countries have shown a clear relationship between income and poor mental health, even when measures controlling for endogeneity are introduced[1]. It is of equal importance to explore this relationship in developing countries for several reasons. First, it is generally acknowledged that depression has a negative impact on educational attainment and occupational status, as well as contributing to the morbidity of other diseases. Exploring the association between income and depression in the developing world can provide insight into policy measures to decrease the prevalence of this mental disorder, thereby positively impacting on education and employment. This is of particular importance for low-income nations, where a healthy and educated labor force is of paramount importance for economic growth and development.

Secondly, exploring the relationship between income and mental health in the developing world will help to unravel whether the association found in the developed world is a phenomenon of wealthy countries, or whether the relationship seems to be universal. In developed countries, it has been shown that income and depression have a strong inverse relationship, with income generally having a stronger effect on depression for individuals in the

[1] Case 2000; Zimmerman 2005; Costa-Font and Gil 2005; Ettner 1996; Wildman 2003; Patel and Kleinman 2003; Pickett, James and Wilkinson 2006; and Akhtar-Danesh and Landeen 2007 are just a few examples.

lower end of the income distribution (Wilkinson 2006; Akhtar-Danesh and Landeen 2007). Lastly, exploring the effect of higher income on mental health can have important policy implications relating to the distribution of income. For example, if depression is found to differentially impact the lowest income bracket, then policies aimed at raising these individuals' income may have a more significant effect than policies aimed at raising incomes in the entire population.

This paper seeks to provide preliminary research on the association between income and depression severity, controlling for potential reverse causality, to show that these two variables are significantly associated in the developing world. My paper also discusses how the depression-income relationship varies by income level, with those below the median income showing a strong inverse relationship between socioeconomic status (SES) and mental health and an insignificant relationship for individuals above the median income. This result is similar to much of the previous research on this topic, which is discussed in the following section.

Literature Review

Studies from developing countries on the depression-income relationship are limited, primarily due to lack of data. The World Health Organization (WHO) World Health Surveys (WHS) provide the only large-scale, standardized, individual-level data that include developing countries, to my knowledge. However, methods and evidence can be drawn from literature on high-income nations, as well as the few community-level studies from specific developing countries that are available.

Wilkinson's *Impact of Inequality* (2006) presents evidence that an individual's susceptibility to depression is influenced in part by the degree of inequality in their society. In other words, the distribution (or maldistribution) of income in a society affects the prevalence of mental health. It is important to note that Wilkinson's (2006) study analyzes inequality on the country and state level only, not on the individual level. His study provides evidence that inequality negatively impacts on mental health for all individuals, not just those in the lowest income bracket. This relationship between socioeconomic disparity and mental health has been supported by a number of other studies[2]. A paper by Wildman (2003) uses time-series data from Great Britain in 1992 and 1998 to decompose the inequality in mental health prevalence and explore its underlying causes. The paper concludes that subjective financial status, more so than absolute income, is a major determinant of mental health. In Wildman's (2003) study, he divides his sample by gender, finding there to be an effect of relative deprivation on mental health for women but not for men. This result indicates that, for women in Great Britain, part of the income-depression relationship is related to low-income individuals comparing themselves to those around them and finding their incomes too low to sustain a similar lifestyle. If an

[2] Wagstaff and van Doorslaer 2000; Pickett, James and Wilkinson 2006; Wildman 2003; Ettner 1996; Costa-Font and Gil 2008; Zimmerman and Katon 2005.

individual's income is insufficient to meet their basic needs[3], then they may feel inferior in comparison to their neighbors. These feelings of inferiority increase the risk for depression. If relative status in society has an impact on depression in the developing world, one would expect those in the lower income brackets to have a differentially severe depression-income relationship.

Ettner (1996) uses three different surveys on American health to estimate the impact of income on depression with both ordinary least squares (OLS) and instrumental variable (IV) regressions, concluding that increases in income significantly improve mental health. Based on the author's IV estimates-, which control for gender, age, race, ethnicity, marital status, number of household members, education, metropolitan residence, and presence of children in the household- increasing monthly income by one standard deviation (roughly a $2,000 increase) reduces weekly depressive-symptom days by 3.82. Ettner does not distinguish between different income levels in her paper, and thus the effect of relative status is not explored.

In a survey of 115 studies in epidemiological literature spanning 33 low- and middle-income countries, 79% of multivariate community analyses found associations between poor mental health and low income (Lund et al. 2010). This pattern was stronger when socioeconomic characteristic variables such as education, food insecurity, housing, or social class were substituted for a nominal income measure. This likely indicates inconsistencies in income measurement in the surveys, which is accounted for in my regressions through the use of an index of household assets rather than a household expenditure measure.

In their paper, Costa-Font and Gil (2008) seek to measure the degree of socioeconomic disparity in the determinants of depression using data from the 2003 Spanish National Health

[3] For the purposes of this analysis, 'meeting basic needs' is assumed to refer to living at a level

Survey. When IV estimates were used to control for endogeneity, income was found to account for 53% of overall disparity in depression prevalence across different socioeconomic levels. Akhtar-Danesh and Landeen (2007) find income-related disparity in depression prevalence in Canada, with the lowest income quintile (those under $10,000) manifesting the highest rates of depression. The relationship appears to be non-linear, with prevalence rates decreasing until a threshold income of about $30,000, after which depression prevalence appears to level off.

The literature in this review seems to generally conclude that there is a relationship between income and the prevalence of poor mental health. The studies, particularly the Akhtar-Danesh and Landeen (2007) Canadian study, seem to indicate that absolute income is related to depression only up to a threshold income level. Above this point, the relationship becomes insignificant. This disparity in depression prevalence based on income level is also seen in analyses by Wildman (2003), Zimmerman and Katon (2005), and Costa-Font and Gil (2008). Overall, my paper contributes to this body of literature by providing support for the idea that income and depression are related, even in the developing world, and that the income-depression relationship is not the same across all income levels.

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dictated as acceptable by one's community, not a universal definition.

Data

Mental health has been steadily gaining international attention in the last few decades. The 1996 Global Burden of Disease study, which for the first time included disability measures in its disease severity calculations, was the first major study to identify depression as a significant contributor to global illness (Murray and Lopez 1996). Since this landmark publication, studies including mental health have increased in prevalence. However, data on the prevalence of mental disorders in developing regions are still uncommon. The few surveys that have been done are primarily limited to small community samples. In 2003, however, WHO conducted nationally representative World Health Surveys (WHS) in its 180 member countries, which included measures of self-reported depression and depression-related variables such as difficulty sleeping, feelings of excessive worry and difficulties with personal relationships.

These surveys collected information about the health, health determinants, and demographic characteristics of adults age 18 and older in face-to-face interviews. All questions were standardized according to WHO protocols, translated, and back-translated to ensure quality. WHO provided technical support and training to member countries, who then implemented the surveys using their own survey takers. Data from these nationally representative individual-level surveys are now available for 71 countries, encompassing one randomly selected individual from each participating household. In order to attain a nationally representative sample, the WHS sampling frame was considered to include 100% of eligible individuals (adults 18+) in the country. The sample size of each WHS was 5,000 persons, selected through single-stage random sampling from the sampling frame of each country. It is important to note that some countries, particularly low-income developing nations, may not have the resources to accurately include all members of the population in a census, and thus some ethnic or cultural groups, as well as individuals living in remote rural locations, may be

underrepresented. Additionally, because the sample size is limited to 5,000 individuals from each country, some countries (such as Mexico, which has a large population) may not have a fully representative sample. However, due to limited resources, these surveys are as large-scale and nationally representative as is feasible.

For a number of individuals, data was not collected for all of the variables included in my regressions. Thus, for the purposes of this analysis, only those individuals for whom information was available for each variable used in my regressions were included. For example, in the lower 50% of the low-income developing nations the number of observations is only 598, and 2443 for the upper 50% IV regressions (see Tables 5A-C for further information). This could be due to some type of sampling characteristic, such as location, which influenced which individuals were included in the WHS, and which individuals fully answered all of the questions included in the surveys. It is important to keep in mind when analyzing my results that there could be some unique characteristics of individuals who fully answered all the survey questions that may also influence the income-depression relationship. For example, if it is easier to survey individuals in urban areas, and those in urban areas tend to have higher incomes, then the results may be skewed based on the sampling parameters. Because developing nations have such limited resources, however, these WHS are as nationally-representative as is feasible, and are therefore the most large-scale and standardized data available with which to do this analysis[4].

This paper focuses on 12 developing countries with a range of income and development levels. The World Bank separates developing nations into low, middle, and higher-income

[4] For further information on sampling methods, refer to http://www.who.int/healthinfo/survey/en/index.html.

categories, and I will look at a selection of countries in different geographical regions within these classifications, listed below in Table 1[5].

Table 1. List of Countries

	Sub-Saharan Africa	**Asia**	**Europe and Central Asia**	**Middle East and North Africa**	**Americas**
Low-income	Ghana, Burkina Faso	Bangladesh, Vietnam			
Middle	South Africa	Philippines	Bosnia and Herzegovina	Morocco	Ecuador
Upper-middle		Malaysia	Czech Republic		Mexico

Table 2 contains a summary of country characteristics including Gini Index, Human Development Index (HDI), unemployment rate, real GDP growth rate, and the percentage of the population below the poverty line. Also included is the country's mean depression severity rating from the WHS. The Gini Index measures the degree of inequality in the distribution of income within a country, ranging from 0 (perfect equality, each individual has the same amount of income) to 100 (all income is concentrated in the hands of one individual) (The World Factbook 2003). The countries analyzed in this paper range in their distribution of income from the Czech Republic at 25.4 to South Africa's index measure of 59.3. As discussed in the literature review, several studies have found inequality in a society to negatively impact on a country's depression rates (Wildman 2003, Danesh et al. 2007, van Doorslaer 1997, Wilkinson 2006). Although issues of inequality are not analyzed in this paper because of the difficulty in measuring inequality on the individual level, it is worth keeping in mind this evidence, as it has

[5]It is important to note that none of these countries were involved in conflict during or just before the World Health Surveys were conducted.

important policy implications and could also explain some of the inconsistencies in this analysis.

Table 2. Descriptive Statistics[6]

Country	Gini Index	HDI	Unemployment Rate	Real GDP Growth Rate	Population Below Poverty Line	Depression Severity Rating
Bangladesh	33.6	0.432	40%	4.4%	35.6%	18.05
Bosnia&Herzegovina	56.2	0.698	40%	2.3%	25%	13.85
Burkina Faso	48.2	0.285	77%	4.5%	45%	14.64
Czech Republic	25.4	0.838	9.8%	1.5%	NA	13.67
Ecuador	43.7	0.676	7.7%	3.3%	70%	13.78
Ghana	40.7	0.443	20%	5.8%	31.4%	14.46
Malaysia	49.2	0.726	3.8%	4.2%	8%	10.98
Mexico	53.1	0.727	3%	1%	40%	14.56
Morocco	39.5	0.536	19%	3.2%	19%	14.17
Philippines	46.2	0.619	10.2%	4.6%	40%	15.64
South Africa	59.3	0.587	37%	3%	50%	15.01
Vietnam	36.1	0.540	25%	6%	37%	10.89

The HDI, ranging from 0 to 1, is a measure calculated by the United Nations Development Programme (UNDP) to combine life expectancy, educational attainment and income into one index (UNDP n.d.). Encompassing life expectancy at birth, adult literacy rate, school enrollment rates, and GDP per capita, this index is intended to give a holistic measurement of a country's development. The Czech Republic, Malaysia, and Mexico all have HDI values over 0.7, indicating relatively high levels of human development. On the other hand, Burkina Faso has a very low level of human development, with a value less than 0.3. While the statistics reported in Table 2 are aggregated to the country-level and thus may not be directly relevant to my individual-level empirical regressions, I still feel they are valid to present to highlight the variation in development levels in my sample. This has two purposes. First, it shows that my sample covers a range of regions, income levels and development stages. Second,

it helps to highlight why the income-depression relationship is not visible across all of my regressions. With such variation in countries, it is unsurprising that my results are not consistent across regressions.

When looking at the last column of Table 2, one can see that Bangladesh has the highest depression severity rating at 18.05, and Vietnam has the lowest at 10.89. Neither of these countries are at the extreme in terms of Gini index, HDI, unemployment rate or poverty level, suggesting that unique characteristics within an individual's community are more related to their mental health than aggregated measures of development. Also interesting to note is that the World Bank categorizes both of these countries in the lowest income bracket. This suggests that development level, at least at the aggregated country level, is not in itself a determinant of depression severity for the population.

Self-reporting could cause bias in measures of mental health, leading to an underestimate of the prevalence of depression. However, three separate studies find that while reporting bias does tend to underestimate the prevalence of psychiatric disorders, it does not alter observed correlations between mental health and socioeconomic characteristics (Vernon et al. 1982, Hunt et al. 2003, Gove et al. 1977). Therefore, I do not anticipate reporting bias to substantially influence my results.

Table 3 defines the variables used in my analysis and Table 4 lists sample means for each. To measure depression, I constructed a depression severity index, ranging from 8-40. This index was constructed using 8 questions asked to individuals in which they ranked the severity of each depression symptom from 1-5 in the last 30 days, with 1 being no manifestation of that symptom and 5 indicating severe, debilitating experience with that symptom. These questions

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[6] Statistics were compiled from the UNDP Human Development Report from the time the World Health Surveys were conducted, and also from the CIA World Factbook (2003).

included difficulty with community participation[7] or personal relationships, difficulty with conflict or tension with others, difficulty falling asleep or staying asleep, difficulty feeling rested, problems with feeling sad or depressed, problems with worry or anxiety, feelings of being unable to control the important things in life, and feeling unable to cope with daily tasks. Because different countries and cultures manifest depression in different ways, it is important to include numerous measures of depressive symptoms instead of simply asking individuals if they are depressed. This is likely to lead to a more accurate reading of depression in a society.

Instead of using a nominal measure of income, which may be subject to substantial measurement error, this paper will use a permanent income index, in the style of Fotso and Kuate-Defo (2005). This index, ranging from 0-11, sums up 11 dummy variables indicating a household's possession of certain assets, including whether a household has electricity, a bicycle, clock, bucket, washing machine, dishwasher, refrigerator, fixed line telephone, cellphone, TV, and computer. In low-income nations, where a household may have a relatively high level of expenditure but little to no savings, or all of their expenditure is going towards meeting essential needs such as food or clothing, a nominal income measure may not give an accurate picture of an individual's poverty status. Thus, a household assets index is likely to provide a more accurate idea of a household's income level.

Also controlled for in the regressions are presence of children under 5 in the household, gender, age, years of education, employment status, rural vs. urban location, self-rated health (ranked from 1-5), feelings of safety in the community (ranked from 1-5), number of alcoholic drinks per week, and marital status. Individuals are classified as employed if they have a job, are

[7] It is important to keep in mind that difficulty with community participation may be related to the availability of institutions (social clubs, churchers, etc…) as well as an individual's emotional state.

in school or training, are a homemaker, or are retired. Otherwise, they are considered to be unemployed. Age is divided into 5 brackets: 18-29, 30-39, 40-49, 50-59, and 60+. Feelings of safety in the community, measured by ranking how safe an individual feels walking down the street, are used to proxy for social mistrust and the condition of an individual's neighborhood.

Table 3.
Definition of Analysis Variables

Variable	Definition
Depression Severity Index	Scale of depressive symptoms (40= most, 8=fewest)*
Permanent Income Index	Index of goods owned by household (0=fewest, 11=most)*
Age	
18-29	=1 if individual is aged 18-29, 0 otherwise
30-39	=1 if individual is aged 30-39, 0 otherwise
40-49	=1 if individual is aged 40-49, 0 otherwise
50-59	=1 if individual is aged 50-59, 0 otherwise
60+	=1 if individual is aged 60+, 0 otherwise
Employment	Employment=1 if individual is employed, homemaker, studying or training, or retired. =0 if individual has looked but cannot find a job, not working because of ill health, or unemployed for an unspecified reason.
Marital Status	= 1 if individual is currently married, 0 otherwise
Rural vs. Urban	=1 if rural, 0 otherwise
Children Under 5	=1 if household has young children, 0 otherwise
Gender	1= female, 0=male
Education Years	Years of formal schooling completed
Self-Rated Health	Assessment of own health, (1= best, 5=worst)
Safety on Street	Assessment of security walking alone down the street (1=very safe, 5=not safe)
Alcohol Consumption	Drinks per week on average
Previous Occupation	= 1 if legislator, senior official, manager, professional, technician or armed forces; 0 otherwise*
Average Education Level of Household	Ranked 1-7 (1= no formal schooling, 7= post graduate degree)
Number of Children Born to Respondent's Mother	

* see body of paper for a more thorough definition of this variable.

As discussed previously, there is the likelihood of substantial reverse causality in the relationship between income and depression which would bias the coefficients in my OLS regressions. Thus, the parameters are re-estimated using instruments, which are assumed to be correlated with income but not with depression in two-stage least squares (TSLS) regressions. These instruments should generate unbiased predictions of the permanent income variable, which can then be used to isolate the effect of income on depression. In these TSLS regressions,

previous occupation, average household education level, and number of children a respondent's mother gave birth to are used as instruments for income.

Previous occupation is a dummy variable, with a '1' value indicating that an individual has an upper-level job, including legislator, senior official, manager, engineer, doctor, teacher, clergy, technician, associate professional, or is a member of the armed forces. A '0' value is assigned to respondents who had an elementary or labor-intensive job, such as secretary, cashier, service or sales worker, agricultural or fishery worker, craft or trades worker, equipment assembler, sewing machine operator, driver, street food vendor, shoe cleaner, etc… Average household education is ranked from 1-7, with indicating no formal education and 7 indicating every member of the household possessing a postgraduate degree.

The 12 countries analyzed in this paper are grouped according to level of development, as classified by the World Bank. As such, Ghana, Burkina Faso, Bangladesh and Vietnam are grouped into a low-income category; South Africa, the Philippines, Bosnia and Herzegovina, Morocco and Ecuador are grouped as middle-income developing countries; and Malaysia, the Czech Republic and Mexico are grouped into an upper-income category. Additionally, each income category (low-, middle-, and upper-income) is further divided into the lower 50% and upper 50%, i.e., those individuals below the median income level, and those above it. Regressions are run on each of these categories, to facilitate comparisons. Sample means are provided in Table 4 on the following page.

Table 4.
Sample Means

	Low Income		**Middle Income**		**High Income**	
	Lower 50%	*Upper 50%*	*Lower 50%*	*Upper 50%*	*Lower 50%*	*Upper 50%*
Depression Severity Index	15.66	11.003	15.05	15.23	15.25	13.47
Permanent Income Index	2.91	4.92	4.69	5.08	3.79	5.596
Children Under 5	0.66	0.38	0.99	0.99	0.83	0.89
Sex	0.51	0.54	0.55	0.53	0.74	0.34
Age	38.74	39.46	38.86	37.77	34.09	36.395
Education Years	5.36	7.76	8.03	9.19	7.08	5.13
Employment Status	0.299	0.11	0.35	0.37	0.71	0.25
Safety	2.89	2.46	3.53	3.32	--	3.18
Alcohol Consumption	6.84	8.08	3.41	3.44	3.39	8.23
Marital Status	0.71	0.65	0.64	0.696	0.93	0.44
Rural vs. Urban	0.79	0.71	0.502	0.36	0.88	0.502
Self-Rated Health	2.56	2.36	2.33	2.34	2.95	2.498
Previous Occupation	0.05	0.08	0.04	0.07	0.01	0.07
Average Household Education	1.95	3.17	2.73	2.97	3.26	3.34
Number of Children Born to Mother	6.23	5.42	5.58	6.26	9.08	7.03

In the low- and high-income categories, as can be expected, the lower 50% of respondents reported higher levels of depression, at 15.66 and 15.25 vs. 11.003 and 13.47, respectively. In the middle-income category, however, depression rates were very close for both those above and below the median income. Interestingly, the lowest depression severity was reported by the wealthier half of the least developed countries. This could indicate that the wealthier individuals in these countries are substantially better off relative to their poorer neighbors, and thus they are relatively happier. It is also interesting to note that the mean permanent income measure for these respondents is higher than the mean in the lower 50% of the high-income nations, at 4.92 versus 3.79, although this fact is not likely to be problematic in interpreting my results. Mean self-rated health scores do not vary significantly across HDI and

income levels, despite the varying depression scores. This could indicate that physical health issues play a more important role than psychological health in determining an individual's perception of their health, or that other factors (education, income, etc…) vary the depression ratings.

In addition to the issue of reverse causality between the dependent variable and income explanator, another potential problem is multicollinearity, where the independent variables are correlated with each other. To show that this is not an issue in this data set, a correlation matrix is included in the appendix (see appendix: Tables 8A-C). All of the correlation coefficients are below ± 0.7, and so I do not anticipate multicollinearity to be a factor in my regressions (Stock and Watson 2003).

Methods

For this paper, I first conduct a simple cross-sectional analysis utilizing ordinary least squares (OLS) regression methods. As mentioned previously, these results suffer from reverse causality, due to the effect income has on depression and vice versa, which likely yields biased parameter estimates. To correct for this bias, I then reestimate the equation with two-stage least squares (TSLS) methods and instrumental variables.

I. Measurement of Depression

Depression is commonly modeled as:

$$D = f(Age, Gender, Income, Education, MaritalStatus, OccupationStatus, Genetics)$$ [8]

As mentioned earlier, this analysis uses a depression severity index, summing up 8 different symptoms of depression, as the dependent variable in my regressions. It is generally acknowledged that women are disproportionately affected by depressive disorders (Danesh et al. 2007, Kaji et al. 2010). Additionally, low income, low educational attainment, and unemployment are considered to increase the risk for depression. However, Danesh et al. (2007) find that depression and education, while related, vary in a non-linear pattern. In their study, those at the lowest end of the education spectrum did not have the highest depression levels, as might be expected. Marital status has also been found to have an effect on an individual's risk for depression, although being married does not always decrease the risk of depression, as might be expected (Costa-Font and Gil 2008). Previous research has found age to account for some of

[8] Costa-Font and Gil 2008; Danesh et al 2007.

the variation in depression prevalence, but the relationship is relatively ambiguous. Danesh et al. (2007) find younger adults in Canada to be more likely to report depression than the elderly, while Kaji et al. (2010) find increased age to be associated with more severe depression in Japan. This seems to suggest that unique cultural factors in each country interact differently with age and its effect on depression manifestation. Lastly, genetics plays some role in an individual's susceptibility to mental illness, although these are largely unobservable traits (Costa-Font and Gil 2008). It is important, also, to take note of the effect depression has on several of these variables; namely income, education, and labor status. The reverse causality in these instances requires caution when interpreting parameter estimates.

II. Ordinary Least Squares

The model is estimated with the following equation:

$$(1)\ Depression_i = \alpha + \beta_1 income_i + \beta_2 X_i + U_i$$

Where i represents each individual, α is the intercept of the equation, X_i is a set of sociodemographic control variables for each individual, and U is the error term. Thus, β_1, our coefficient of interest, measures the change in depression severity predicted by a one standard deviation increase in an individual's permanent income index.

III. Instrumental Variables

As stated above, a basic OLS regression of income on depression is likely to have substantial bias due to endogeneity of several explanatory variables, including the explanator of interest, income level. Two-stage Least Squares (TSLS) regressions should prevent this reverse causality from biasing the parameter estimates, as long as the instruments are valid and not weak. In the first stage of TSLS, instruments are used to generate unbiased estimates of the endogenous explanator (income). Because the instruments are thought to be correlated with income but not with depression, the predicted values of income generated in this first stage regression are assumed to remove the influence of depression on income. In the second stage of TSLS, these unbiased income estimates are used in an OLS regression of the original equation (Equation 1) to generate unbiased estimates of the influence of income on depression. Instruments must satisfy two conditions in order to be considered useful.

1. The instrument(s) must be relevant, i.e. $corr(Z_i Income_i) \neq 0$, where Z is the instrumental variable(s) and *Income* is the variable of interest. In other words, the instrument(s) used must be correlated with an individual's permanent income index.
2. The instrument(s) must be exogenous, or $corr(Z_i U_i) = 0$, where U is the error term of the equation.

To check the validity of my instruments, I use three different tests. The first is a first-stage F-test, which checks that my instruments are correlated with income, and thus will generate good estimates of the endogenous variable. The first-stage F-statistic, which should be greater than 10, is reported at the bottom of Tables 5A-C (Stock and Watson 2003). Secondly, I include the instruments as explanators in my original equation (Equation 1) to ensure that they are insignificant (uncorrelated with depression) and therefore do not belong in the original

equation. Lastly, in situations where I use more than one instrument for income, I perform a test of over-identifying restrictions. Over identification is when the number of instruments exceeds the number of endogenous regressors. The test of over-identifying restrictions is intended to check whether all of the included instruments are exogenous, i.e., uncorrelated with the error term. If one or more of the instruments are endogenous, they are not appropriate to include in the TSLS regressions. The null hypothesis of the over-identifying restrictions test is that all the instruments are exogenous. The over-identifying p-value is included at the bottom of Tables 5A-C to demonstrate that for each regression in which multiple variables were used to instrument for income, the test failed to reject the null hypothesis (Stock and Watson 2003).

It is difficult to find instruments for income that do not intuitively seem to be also correlated with depression. This paper will utilize three different instruments: an individual's previous occupation, the average education level of the household, and the number of children a respondent's mother gave birth to. The World Health Surveys include data on both an individual's current occupation, and their occupation in the last 12 months. It can be argued that previous occupational status will not affect current depressive symptoms, and will likely be an indicator of an individual's income level. Additionally, the education level of the other members of the household likely will not affect an individual's depression, but will affect their income status. Although there are certainly many factors that contribute to family size decisions, it is generally acknowledged that there is an inverse association between socioeconomic status and fertility rate (Schorr 1965). Families that rely on subsistence agriculture to survive have an incentive to have a greater number of children to contribute to the family farm. Low-income families, particularly in developing countries, may not have access to adequate medical services, and thus childhood mortality leads to a higher fertility rate. Assuming a parent's income level is

indicative of their child's, the greater the number of children a respondent's mother gave birth to the more likely it is that the respondent has a relatively low income level[9]. It should be pointed out that depression is a heritable condition, and so if a parent's depression status influences the number of children he or she has, then this instrument may not be exogenous. However, I could find no studies linking depression to the number of children an individual has, and so I do not anticipate this genetic link significantly confounding this instrument. Based on this logic, theoretically, my instruments should be related to an individual's income status but not their depression severity and should be valid for this analysis.

In a two-stage least squares (TSLS) regression, the first part of the regression computes predicted values of the variable of interest, permanent income, using the following equation:

$$(2)\ \hat{Income}_i = \alpha + \beta_1 Z_i + \beta_2 W_i + u_i$$

where $\hat{Income}_i$ is the predicted value of permanent income for each individual based on the instrumental variables used. Z_i is the set of instruments used, W_i is the set of sociodemographic control variables (these include age, sex, presence of children under 5, marital status, education, etc…)[10], and u_i is the error term. The second stage then uses these predicted values in the original equation:

$$(3)\ Depression_{i,TSLS} = \alpha_{TSLS} + \beta_{1,TSLS}\hat{Income} + \beta_{2,TSLS} W_i + U_{i,TSLS}$$

where $\beta_{1,TSLS}$ is the second stage coefficient on the predicted values of income, and $\beta_{2,TSLS}$ represents the two-stage least squares coefficients for the set of sociodemographic explanators.

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[9] A potential issue with this instrument is that in Muslim countries, SES may not be a significant factor in family size decisions.

The use of instruments means that the predicted values are uncorrelated with the error term, and thus $\beta_{1,TSLS}$ is unbiased.

[10] For a full listing of these variables, refer to Table 3.

Results

Tables 5A-C present the results from both the OLS and TSLS regressions for the low-, middle-, and high-income categories, respectively. As mentioned earlier, these categories are further subdivided into two groups based on the median income level in the sample. For simplicity, Table 7 at the end of the results section summarizes which instruments were used in each regression, although this information is also included in the body of the text.

The potential instruments include an individual's previous occupation, average education level of the household, and number of children a respondent's mother gave birth to. As discussed above, in order for an instrument to be valid it must satisfy two conditions: it must be relevant (i.e. correlated with the endogenous regressor) and exogenous (uncorrelated with the error term). Due to these conditions, not every instrument is valid for each regression. This is not surprising, because in countries with highly varied levels of development, the determinants of income are likely to be very different. Therefore, different instruments were used to proxy for permanent income in each regression, conditional on several tests (elaborated on earlier in the Methods section).

I. Low-income Developing Countries (Bangladesh, Vietnam, Ghana, Burkina Faso)

As can be seen in Table 5A, the relationship between permanent income and depression severity in low-income developing countries is significant at less than the 1% level for OLS and IV regressions in both categories- those below the median income level and those above it. For the regression using individuals below the median income, income was instrumented using both previous occupation and average education level of the household. For the upper 50%, only average household education level was used. As discussed above, there are a number of

conditions instruments must satisfy in order to be considered valid and not weak. Thus, different instruments were used to generate consistent and valid TSLS estimates.

The relationship between income and depression in the low-income developing nations is consistently strong and negative ($p<0.01$), indicating that an increase in income is associated with a decrease in depression severity. This is not unexpected, and supports previous research outlined in the literature review above. Interestingly, the coefficient becomes larger when instruments are used, indicating that when the reverse causality stemming from depression's effect on income is removed, income's effect on depression severity increases. This may seem counterintuitive- if poor mental health decreases income, and lower income decreases mental health, then one would expect the coefficients of the OLS estimates to be larger. However, Ettner (1996) had a similar result in her paper, and argues that "second-order effects [could have] changed the direction of the expected bias." (Ettner 1996, 79). The relationship between income and depression may be affected by the correlation of income with other explanatory variables such as education level, employment status, etc… When consistent estimates are generated using instruments for income, the influence of these other explanators is controlled for, isolating the effect of income on depression. The fact that the results are consistently negative and significant, irrespective of whether instruments are used to proxy for income or not, provides support for the theory that increasing income has a positive effect on depression.

For the lower 50% of individuals, the increase in the income coefficient between OLS and IV estimates is quite significant, changing from -0.838 to –6.417. This TSLS result predicts that a one standard deviation increase in the permanent income index will decrease depression severity by about 6.4 units, a 20% decrease. For the upper half of the income distribution, this increase is less pronounced, with a TSLS estimate of -0.684 compared to -0.4504 (see Table

5A). This result suggests that income increase has a stronger effect on depression severity for those in the lower income bracket. There are a variety of possible causes for this difference. It is possible that there is a threshold income level-the point at which basic needs are met and an individual is able to satisfactorily participate in local community-above which income becomes relatively less important in depression severity. It is also possible that there is some psychological effect of being above the median income level, i.e. being better off than your neighbors reduces your distress at your financial situation. This would also negatively affect the lower half of the community, magnifying the interaction between income and depression for these individuals.

Old age also appears to have a significant ($p<0.01$) effect on depression, in both income brackets increasing depression severity in OLS and IV estimates. Although no consistent pattern emerges for the age brackets below 60+, individuals who are 60 or older seem to have consistently worse depression ratings than their younger counterparts (the reference group is individuals 18-29), all other factors constant. Additionally, in both regressions the coefficients become slightly larger when IV estimates are introduced, indicating that the effect of old age on depression increases when bias is controlled for.

Surprisingly, education does not have a consistent relationship with depression severity, as might be expected. However, evidence does suggest that there could be some reverse causality between depression and educational attainment, and so this may be the cause of the inconsistency. Due to this potential endogeneity, parameter estimates should be interpreted with caution. An individual's employment status, i.e. whether they were working or not at the time of the survey, has a negative effect ($p<0.01$) on the depression index for the lower income bracket, indicating that those who are employed have lower depression severity. Surprisingly, this

variable becomes insignificant when instrumental variables are introduced for those in the upper 50% income level, indicating that, once the endogeneity between income and depression is removed, employment status ceases to be a factor in depression severity for the wealthiest half of the population. However, as with education, employment status and depression may have some reverse causality and thus parameter estimates may be unreliable. Unsurprisingly, feelings of safety in one's community has a significant relationship with depression severity, with individuals who report greater feelings of safety while walking alone in their community having consistently lower ($p<0.01$) depression scores (safety was ranked 1-5, 1=very safe and 5= not safe).

Beyond this, there are a number of differences between the factors affecting depression in the lower income bracket and the upper when looking at the TSLS regressions (5A). For example, living in a rural location has a significant ($p<0.01$) effect on lowering depression severity for the lower 50%, but an insignificant effect for the upper 50%. As individuals increase in age in the upper 50% income distribution, their depression severity rating steadily rises. Presence of children under 5 in the household and being female also increase depression severity for these individuals, but both of these variables are insignificant in IV estimates in the lower income bracket. These results indicate that different socio-demographic variables interact with depression in varying ways, depending on which income category an individual falls into. This paper primarily focuses on the income-depression relationship, and so these additional explanatory variables, while important to be controlled for in regressions, are only summarily addressed in this analysis. The additional issues of potential endogeneity of some of these variables also prevent detailed analysis of their parameter estimates.

Table 5A.
LOW INCOME COUNTRIES

Depression Severity Index	**Lower 50%** OLS *Coefficient (std. error)*	IV	**Upper 50%** OLS	IV
Permanent Income Index	-0.838***	-6.417***	-0.4504***	-0.6836***
	(0.137)	(1.902)	(0.041)	(0.255)
Children Under 5	0.072	-1.2663	0.4414***	0.3673***
	(0.072)	(0.884)	(0.092)	(0.121)
Sex	1.012	0.5387	0.5826**	0.5744***
	(0.599)	(1.785)	(0.206)	(0.209)
Age 30-39	0.061	0.0737	0.7164***	0.7661***
	(0.371)	(1.127)	(0.215)	(0.243)
Age 40-49	0.254	0.3122	1.2358***	1.2601***
	(0.383)	(1.206)	(0.231)	(0.249)
Age 50-59	-1.071	-6.655**	1.4118***	1.4444***
	(0.548)	(2.669)	(0.256)	(0.275)
Age 60+	3.469***	3.6634***	1.0298***	1.2227***
	(0.429)	(1.344)	(0.312)	(0.393)
Years of Education	-0.213***	1.2687***	-0.091***	-0.0495
	(0.042)	(0.396)	(0.0183)	(0.049)
Employment Status	-3.399***	-7.4624***	-0.3126*	-0.304
	(0.491)	(2.301)	(0.188)	(0.193)
Safety	1.273***	1.641***	0.3507***	0.3526***
	(0.121)	(0.385)	(0.06)	(0.062)
Alcohol Consumption	0.026	0.0419	0.0206***	0.0206***
	(0.009)	(0.033)	(0.006)	(0.006)
Marital Status	-0.372	1.1966	-0.90698***	-0.8657***
	(0.377)	(1.256)	(0.231)	(0.235)
Rural vs. Urban	-2.851***	-4.1297***	0.1478	0.0015
	(0.374)	(1.147)	(0.132)	(0.203)
Constant	15.125***	24.4741***	8.4387***	9.4119***
	(0.795)	(4.71)	(0.381)	(1.121)
No. of Observations	598	598	2467	2443
Adj. R-Squared	0.3666	--	0.2991	--
SER	4.657	--	2.7124	--
First State F-statistic	--	12.44	--	58.41
Over identifying p-value	--	0.1804	--	--

* significant at 10% level; ** significant at 5%; *** significant at 1%
Self-rated health was also controlled for, but is not included in the regression output

II. Middle-income Developing Countries (South Africa, Philippines, Morocco, Ecuador, Bosnia and Herzegovina)

When looking at the association between income and depression in the middle-income developing world, an interesting result appears. For regressions involving only those below the median income level, previous occupation, average household education and number of children born to an individual's mother were all used as instruments. For those in the upper income bracket, average education level of the household and number of children born to the respondent's mother were used. For those below the median income level, permanent income appears to have a significant negative effect on depression severity, with a p-value slightly above 0.01 (p=0.017). This effect is not large, with an IV estimate coefficient of -0.6358. For those above the median income, IV estimates become insignificant. This could indicate that in middle-income developing countries, those above the median income are fully able to meet their basic needs, and thus income ceases to play a role in depression. For the purposes of this analysis, 'meeting basic needs' is assumed to mean meeting the basic living standards in one's own community, rather than a universal definition of human basic needs.

As mentioned above, it is also possible that the upper half of the income bracket receive a psychological boost from being in the wealthier proportion of the population, and thus their income level does not have as significant an impact on their mental health as it does for the poorer half. This result is consistent with Akhtar-Danesh and Landeen's (2007) research on depression prevalence in Canada, which found that depression prevalence showed an inverse relationship with income until a threshold income of about $30,000 was reached, after which depression prevalence leveled off.

As seen in the low-income countries, being older than 60 and feeling unsafe in your community had a strong effect on increasing depression severity across the board. Additionally, in both income brackets, increasing age is associated with worsening depression severity, compared to the reference group of 18-29 year olds. Living in a rural location rather than an urban one also has an interesting relationship to depression in these countries. For the lower income bracket, living in a rural location significantly *decreases* depression symptoms (p-value close to 0.01 at 0.012). For the upper half of the population, rural living increased depression symptoms ($p<0.01$). This could be because a larger proportion of the poor tend to live in rural areas, and thus being around individuals in a similar economic situation has a psychological effect. It could also be that the poor are better able to meet their basic needs, such as being able to grow their own food or collect wood for fuel, at a lower cost in rural areas, thereby decreasing their mental distress. On the other hand, decreased opportunities for wealthier individuals in rural areas may increase their depression symptoms.

Table 5B.
MIDDLE INCOME COUNTRIES

Depression Severity Index	**Lower 50%** OLS *Coefficient (std. error)*	IV	**Upper 50%** OLS	IV
Permanent Income Index	-0.351***	-0.6358**	-0.1719***	0.1709
	(0.041)	(0.257)	(0.032)	(0.239)
Children Under 5	--	--	0.2226***	0.2647***
	--	--	(0.054)	(0.063)
Sex	0.697***	0.4881**	1.3234***	1.4598***
	(0.21)	(0.229)	(0.158)	(0.179)
Age 30-39	1.017***	1.0529***	0.5496***	0.624***
	(0.214)	(0.281)	(0.178)	(0.184)
Age 40-49	0.879***	0.995***	1.14403***	1.1574***
	(0.245)	(0.303)	(0.195)	(0.197)
Age 50-59	1.369***	1.4549***	1.6114***	1.5886***
	(0.332)	(0.362)	(0.254)	(0.259)
Age 60+	2.406***	2.4625***	2.9541***	2.8527***
	(0.363)	(0.406)	(0.292)	(0.309)
Years of Education	0.042**	0.0853*	0.0186	-0.0631
	(0.023)	(0.048)	(0.019)	(0.057)
Employment Status	0.566**	0.7587***	0.0543	-0.0327
	(0.221)	(0.231)	(0.166)	(0.178)
Safety	0.294***	0.2661***	0.1273**	0.1113**
	(0.063)	(0.099)	(0.054)	(0.056)
Alcohol Consumption	0.029**	0.037***	-0.0121	-0.0084
	(0.012)	(0.013)	(0.007)	(0.008)
Marital Status	0.008	0.2425	-0.6145***	-0.5998***
	(0.204)	(0.277)	(0.168)	(0.171)
Rural vs. Urban	-0.68***	-1.0945**	0.5572***	0.6735***
	(0.171)	(0.422)	(0.129)	(0.158)
Constant	10.241***	11.6271***	10.7925***	9.7295***
	(0.468)	(1.566)	(0.401)	(0.872)
No. of Observations	2614	2614	5081	5061
Adj. R-Squared	0.2273	--	0.1064	--
SER	4.645	--	4.3564	--
First State F-statistic	--	22.53	--	14.43
Over identifying p-value	--	0.8245	--	0.8129

* significant at 10% level; ** significant at 5%; *** significant at 1%
Self-rated health was also controlled for, but is not included in the regression output

III. High-income Developing Countries (Malaysia, Mexico, Czech Republic)

When instruments are introduced, permanent income becomes insignificant in both income brackets. For the lower 50%, previous occupation and average household education were used as instruments. For the upper 50%, previous occupation was used (see Table 7 for a summary of instruments used). This result provides evidence to support the theory that above a certain wealth level, income does not play a role in the determination of depression. This result does not support the theory of income disparity playing a role in depression. If this were the case, one would expect the poorer half of the individuals to have a significant association between income and depression. Instead, these results appear to support the theory that absolute rather than relative income is a determinant in depression severity; once individuals are able to meet their basic needs and fully participate in their societies, income decreases in importance in determining depression.

Instead, sociodemographic factors such as age, sex and marital status are significant in these regressions. Even within these factors, however, no clear pattern emerges. This seems to suggest that the factors affecting depression are extremely variable from country to country and possibly even from individual to individual. Although generalizations can be made, what actually determines depression severity appears to be highly individualistic, and dependent on a number of factors and the interactions between them.

Table 5C.
HIGH INCOME COUNTRIES

Depression Severity Index	**Lower 50%** OLS *Coefficient (p-value)*	IV	**Upper 50%** OLS	IV
Permanent Income Index	-0.0854	-2.7062	-0.1857***	0.1237
	(0.308)	(0.31)	(0.002)	(0.851)
Children Under 5	-0.9387***	-1.1106***	--	--
	(0)	(0.002)	--	--
Sex	1.1143**	-0.0453	1.0463***	1.1273***
	(0.03)	(0.976)	(0)	(0.001)
Age 30-39	3.0025***	5.1095**	-1.0675***	-1.095***
	(0)	0.029	(0.005)	(0.003)
Age 40-49	3.7373***	4.8288***	0.34196	0.2459
	(0)	(0.002)	(0.4)	(0.595)
Age 50-59	2.8441***	5.266*	0.0842	-0.1885
	(0)	(0.052)	(0.849)	(0.793)
Age 60+	2.5762***	4.9161*	-0.0319	-0.3822
	(0)	(0.055)	(0.917)	(0.632)
Years of Education	0.0216	0.504	-0.1316**	-0.0416
	(0.64)	(0.312)	(0.013)	(0.834)
Employment Status	-1.5663***	0.6471	-0.0529	-0.0536
	(0.007)	(0.796)	(0.89)	(0.872)
Safety	--	--	0.8968***	0.0482**
	--	--	(0)	(0.01)
Alcohol Consumption	0.0111	0.0685	0.0425***	0.8547***
	(0.849)	(0.592)	(0.003)	(0)
Marital Status	-2.86202***	-3.4893***	0.3029	0.6236
	(0)	(0.001)	(0.273)	(0.401)
Rural vs. Urban	3.2625***	-2.925	-0.0104	-0.0503
	(0)	(0.648)	(0.967)	(0.853)
Constant	-38.3607	-260.1841	6.6582	4.2815
	(0.87)	(0.61)	(0)	(0.406)
No. of Observations	324	324	1569	1569
Adj. R-Squared	0.4804	--	0.3076	--
SER	2.6854	--	4.5241	--
First State F-statistic	--	14	--	13.13
Over identifying p-value		0.8716	--	--

* significant at 10% level; ** significant at 5%; *** significant at 1%
Self-rated health was also controlled for, but is not included in the regression output

When looking at the results from all 6 regressions as a whole, i.e. looking at the developing world as a whole, an interesting pattern of depression-income association emerges. Table 6 below summarizes the coefficients on the permanent income index variable from each regression, once reverse causality is controlled for with IV estimates.

Table 6.
Permanent Income Coefficients

	Low-income		**Middle-income**		**Upper-income**	
	Lower 50%	*Upper 50%*	*Lower 50%*	*Upper 50%*	*Lower 50%*	*Upper 50%*
Permanent Income Index (IV coefficient)	**-6.417*** **	**-0.684*** **	**-0.6358** **	0.1709	-2.7062	0.1237

* significant at 10% level; ** significant at 5%; *** significant at 1%
Coefficients in bold are significant.

For those below the median income level (i.e. all individuals in low-income developing countries, and the lower 50% in middle-income countries), permanent income has a strong inverse relationship with depression severity, which actually increases when IV estimates are used, indicating that income has a larger effect on depression severity when consistent parameters are estimated and reverse causality is controlled for. Above this point, income has an insignificant effect on depression. I have hypothesized that this result could have two explanations. First, below the median income individuals have difficulty meeting their basic needs (as dictated by their community) and thus the income-depression relationship is strong. Secondly, there could be some psychological boost from being in the upper half of the income distribution which lessens the effect on income on worsening depression severity. Further research could look at those above and below the median income level in individual countries, to see if these results hold.

It may seem somewhat surprising that in my analysis it is the least developed countries that seem to have such a strong connection between income and depression. One might expect that these least developed countries, which grapple with a larger burden from both infectious and chronic disease when compared with higher income nations, would have a stronger relationship between depression and other health problems, or between depression and issues with food and income insecurity, than income level. However, my results may indicate that issues related to extreme poverty-such as inability to meet basic needs-are the factors linking income and depression. Thus, above a threshold income level--the point at which an individual can successfully meet their basic needs and participate in society--income becomes an insignificant factor in depression severity. This would also explain why the depression-income relationship is insignificant in the more highly developed countries, where individuals are more likely to have an easier time meeting their basic needs. For the purposes of this analysis, 'meeting basic needs' is assumed to refer to living at a level dictated as acceptable by your community, and not a universal definition.

As hypothesized by Case (2000), it appears from these results that the determinants of depression do vary widely based on level of development. There is no one variable that significantly affects depression in all of the regressions. In fact, some of the variables (such as rural vs. urban living, or age) appear to significantly increase depression severity in some regressions, and have the opposite effect in others. This could either indicate inconsistencies in measurement, or it could indicate that depression and SES variables interact in highly variable ways, and this is why no consistent pattern emerges.

Table 7.
Instruments Used

	Average Household Education Level	**Number of Children Born to Respondent's Mother**	**Respondent's Previous Occupation**
Low-income			
Lower 50%	**X**		**X**
Upper 50%	**X**		
Middle-income			
Lower 50%	**X**	**X**	**X**
Upper 50%	**X**	**X**	
High-income			
Lower 50%	**X**		**X**
Upper 50%			**X**

Conclusion

The relationship between income and depression has significant policy implications, particularly in the developing world. Developing countries suffer from a multitude of obstacles to sustained economic growth, many of which have connections with the mental health of the population. For example, high rates of unemployment, low educational attainment, poor health, and difficulty meeting basic needs are all issues which hamper development and have been linked to depression. Mental disorders like depression have a substantial effect on an individual's quality of life, as well as the well-being of their families and communities. Additionally, these developing countries suffer from the dual burden of both infectious and chronic disease, sometimes causing mental health issues to be overlooked. With limited resources, money is often diverted towards physical health issues that are considered to be more pressing. There are often extremely low numbers of psychiatrists and other mental health professionals in developing countries. However, the Global Burden of Disease (GBD) study, which includes disability measures alongside mortality figures, forecasts depression to be one of the most significant contributors to years of life lost due to disability in developing countries by 2030 (Health Statistics and Informatics, WHO 2008). Based on these predictions, a strong case can be made for the necessity of mental health-focused interventions in the developing world. Due to the limited availability of data, however, little research has been done on the relationship between income and depression in the developing world.

The results in this paper provide evidence that there is in fact a relationship between income and depression in developing nations. My analysis finds that individuals in the low-income developing countries, as well as those below the median income level in middle-income developing nations, have a significant inverse relationship between depression and income. Above the median income in middle-income developing countries and in upper-income

developing nations this relationship is insignificant. Thus, looking at the entirety of my developing world sample, there is a clear divide between those in the bottom half of the income distribution and those in the upper half. For those in the bottom, an increase in income has a significant effect on depression severity. For those at the top, an increase in income does not significantly alter depression. However, when looking within the different development categories rather than at the developing world as a whole, this pattern is not consistent. Overall, though, my results find those under the median income to be the most severely affected by the income-depression relationship, and so I would argue that policies aimed at raising the incomes of the extreme poor would have the largest impact on mental health.

These results seem to provide evidence for the absolute income hypothesis outlined in Wagstaff and van Doorslaer's (2000) paper, which posits that once an individual is able to successfully meet their basic needs and fully participate in their community, income's effect on depression is substantially lessened. However, future research should explore this possibility in more detail, possibly by exploring this relationship on a country-by-country basis.

The results of this paper also correspond with those of Akhtar-Danesh and Landeen (2007), who found that lower income levels are differentially affected by depression. In my analysis, in the lower income countries both income brackets have a significant association between depression and income, although the coefficient is substantially larger for the lower income bracket, at -6.417 versus -0.6951. For the middle-income categories, there is a division, with the income coefficient being significant for the lower 50% but not for the upper. In the upper-income countries, however, both income brackets have an insignificant association between income and depression. If there were a psychological effect of relative status in society, one would expect the lower 50% in each category to have a strong inverse association between

income and depression. However, these results are categorized based on development level, not on an individual country basis. It is possible that, when looking at each country individually, a relative status pattern emerges, similar to that presented by Wildman (2003). Future research could explore this possibility by running regressions for each developing country individually.

Although my analysis does not explore the inequality factor in any depth, my very basic exploration of the disparity in depression severity across income levels does show that there is variation. On a country level, the Gini Index can be used to measure inequality, ranging from 0 (perfect equality, each individual has the same amount of income) to 100 (all income is concentrated in the hands of one individual), but on the individual level it is complex to capture inequality and its effect. (World Factbook 2003). My regressions do find there to be disparity in depression severity based on income level. There are numerous potential causes for this disparity- there could be a psychological effect of being in the upper or lower half of the income distribution, there could be inequality in distribution of resources, unequal access to healthcare, etc… This result could also be related to an individuals below the median income have a comparatively more difficult time meeting their basic needs than those above the median.

My paper finds the developing countries explored in this analysis to have a similar pattern to the developed countries included in the literature review, with the lower end of the income spectrum having a differentially severe depression-income association. However, this similar pattern does not necessarily indicate the same mechanisms interacting in the income-mental health relationship in developing as developed countries. Because SES is so different between these two categories of countries, I argue that those above the median income level in my sample have an insignificant relationship between income and depression because they are able to satisfactorily meet their basic needs. In developing countries, meeting basic needs may

only extend to feeding and clothing one's children, or having tap water. In developed countries, the definition of "meeting basic needs" is likely to be different, with developed country individuals probably requiring a larger number of material goods to consider themselves living a satisfactory lifestyle. Issues of inequality, complexity of social relationships, insecurity and uncertainty are all likely to be different depending on if you are living in a developed or developing country. Further decomposition of the determinants of depression in developing countries would be an interesting addition to this analysis.

This analysis is too preliminary to draw any overarching conclusions, but my results do indicate that there is a relationship between income and depression in the developing world, that the relationship is somewhat similar to the patterns seen in research on developed country populations, and that there is some disparity between income levels.

My study has a number of limitations, which should be kept in mind when reaching conclusions. First of all, the permanent income index is not necessarily the best measure of income in the developing world. For individuals living in extreme poverty, it might provide a more accurate picture of a household's socioeconomic status to look at factors such as housing quality, toilet facilities, cooking fuel, and the household's proximity to a water source (is there running water in the house, a community tap, etc…) When these variables were included in my income index, no valid instruments could be found. Thus, I have limited my permanent income index to only household assets. Another limitation is in my instruments. As mentioned briefly above, the number of children born to an individual's mother may be more related to religious beliefs than to socioeconomic status, particularly in Muslim countries, and so this instrument may not be valid. Additionally, there are issues of the heritability of depression that may

confound this instrument. Finding stronger and more consistent instruments for income could improve these regressions.

There are also issues related to how nationally representative the individuals included in my regressions are. With limited resources to conduct censuses, it is possible that not all of the eligible participants from each country were included in the sampling frame. Additionally, there could be unique characteristics influencing which individuals answered all of the questions in the surveys, which would render the sample non-representative. However, because low-income developing nations have such limited resources with which to conduct surveys, these WHS are the best available large-scale standardized individual-level data.

Additionally, it is difficult to control for all of the variables that are likely to have an effect on depression, because many of these characteristics are difficult to capture or are not included in the available data. For example, I was unable to control for other household members having depression, a history of depression in the family, or any type of traumatic events occurring in the recent past which would explain an individual's depressive symptoms, to name a few. I have tried to control for the latter by not including any countries in my analysis that were involved in conflict around the time of the World Health Surveys, but it was impossible to control for individual traumatic experiences. Thus, my results are likely to have some type of omitted variable bias. It would also provide a more accurate picture if instruments could be found which are valid for all regressions. Because I have used different instruments in each IV regression, there are possibly some inconsistencies in drawing comparisons between regressions. Additionally, as briefly mentioned in the introduction, depression likely has an effect on several of the socioeconomic control variables, particularly education, marital status,

and employment status. Due to this endogeneity, there could be some bias which requires caution in interpreting parameter estimates.

There are many areas of future research related to this topic, first and foremost being to increase the availability and quality of data on mental health issues in the developing world. With a greater array of higher quality, more nationally representative data, researchers could explore in more detail the specifics of the relationship between income and mental health in these countries. If time-series data on these variables were available, researchers could have the opportunity to perform analyses controlling for country-specific effects. Scaling up the number of countries data are available from would facilitate country-level cross-sectional analyses, which might prove more informative than comparisons across development levels. Additionally, further subdividing income into quartiles would allow researchers to look at the disparity in depression severity related to income distribution. The role inequality plays in depression is also an interesting and relevant issue.

Overall, the results of this paper suggest that permanent income does play a role in depression severity in the developing world, that this relationship appears to vary based on income level, and that this issue merits further research.

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Appendix

Table 8A.

Low-Income Countries Correlation Matrix

	Depression	Income	Children Under 5	Sex	Age	Education	Employment	Safety	Alcohol	Marital Status	Rural v. Urban	Self-Rated Health
Depression	1											
Income	-0.3387	1										
Children Under 5	0.2166	-0.1524	1									
Sex	0.0145	-0.0345	-0.0167	1								
Age	0.1116	0.019	-0.137	-0.0013	1							
Education	-0.2825	0.5315	-0.128	-0.1017	-0.1906	1						
Employment	-0.0509	0.1167	-0.0776	0.0866	0.1707	0.1088	1					
Safety	0.2423	0.0493	0.0968	0.0327	-0.0475	0.0176	0.0123	1				
Alcohol	0.0638	-0.0849	0.0228	-0.117	0.0587	-0.1323	-0.0451	-0.0324	1			
Marital Status	-0.0205	-0.0492	0.035	-0.0884	0.4494	-0.1229	-0.083	-0.1059	0.0807	1		
Rural v. Urban	0.026	-0.3148	0.0229	-0.0344	0.0382	-0.3008	-0.0412	-0.1389	0.1562	0.0865	1	
Self-Rated Health	0.3582	-0.1474	-0.0176	0.0016	0.321	-0.1857	0.0739	0.1323	0.0435	0.1529	0.0662	1

Table 8B.
Middle-Income Countries Correlation Matrix

	Depression	Income	Children Under 5	Sex	Age	Education	Employment	Safety	Alcohol	Marital Status	Rural v. Urban	Self-Rated Health
Depression	1											
Income	-0.1141	1										
Children Under 5	-0.0032	-0.0873	1									
Sex	0.1043	-0.0163	-0.0331	1								
Age	0.1728	-0.0616	-0.1159	-0.0087	1							
Education	-0.0808	0.4299	-0.085	0.0597	-0.2463	1						
Employment	0.0828	0.0282	-0.0159	0.4841	0.0041	0.0374	1					
Safety	0.056	0.0439	0.0286	0.1045	-0.0088	0.017	0.1043	1				
Alcohol	-0.025	-0.0407	-0.0194	-0.1707	0.0439	-0.035	-0.1214	-0.0667	1			
Marital Status	0.0317	-0.1098	0.1356	0.0556	0.3307	-0.1517	-0.0596	0.0351	0.0453	1		
Rural v. Urban	0.0881	-0.2361	-0.058	-0.0255	0.043	-0.1637	-0.051	-0.0912	0.0046	-0.0139	1	
Self-Rated Health	0.2553	-0.0592	-0.0504	0.007	0.1612	-0.1093	0.0228	-0.0059	0.031	0.0884	0.0689	1

Table 8C.
High-Income Countries Correlation Matrix

	Depression	Income	Children Under 5	Sex	Age	Education	Employment	Alcohol	Marital Status	Rural v. Urban	Self-Rated Health
Depression	1										
Income	-0.0987	1									
Children Under 5	-0.127	-0.173	1								
Sex	-0.1422	-0.1867	0.2377	1							
Age	0.1432	-0.0435	-0.2527	-0.1353	1						
Education	-0.0299	0.5786	-0.0591	-0.1986	-0.3211	1					
Employment	-0.1937	0.0397	-0.1167	0.4287	0.0558	-0.0313	1				
Alcohol	0.1662	0.0152	-0.0566	-0.1953	-0.1296	0.1676	-0.1352	1			
Marital Status	-0.2355	-0.0216	-0.0107	0.2003	0.2856	-0.1387	0.0455	-0.2592	1		
Rural v. Urban	0.1983	-0.5795	0.1577	0.0431	-0.0791	-0.2922	-0.0622	0.1077	-0.1683	1	
Self-Rated Health	0.4952	-0.0964	0.0004	-0.1414	0.1752	-0.0474	-0.1099	0.1517	-0.086	0.0471	1

* Note that the safety variable is not included in the correlation matrix, as the data was only available for the upper 50% of the population. Correlations of this variable were performed for this subset and found to be below ± 0.7, but results are not shown.