Published in final edited form as:
Soc Sci Med. 2011 January ; 72(1): 100–107. doi:10.1016/j.socscimed.2010.09.040.

Do Early-Life Conditions Predict Functional Health Status in Adulthood? The Case of Mexico

Cheng Huang, PhD,
Emory University, Rollins School of Public Health, Atlanta, United States

Beth J Soldo, PhD, and
University of Pennsylvania

Irma T Elo, PhD
University of Pennsylvania

Abstract

Relatively few researchers have investigated early antecedents of adult functional limitations in developing countries. In this study, we assessed associations between childhood conditions and adult lower-body functional limitations (LBFL) as well as the potential mediating role of adult socioeconomic status, smoking, body mass index, and chronic diseases or symptoms. Based on data from the Mexican Health and Aging Study (MHAS) of individuals born prior to 1951 and contacted in 2001 and 2003, we found that childhood nutritional deprivation, serious health problems, and family background predict adult LBFL in Mexico. Adjustment for the potential mediators in adulthood attenuates these associations only to a modest degree.

Keywords

Mexico; Functional Limitations; Early Life Conditions; BMI; Health Behavior; Life course

Introduction

Functional limitations, that is, difficulties in fulfilling basic physiological functions, such as walking and lifting (Verbrugge & Jette, 1994), are key indicators of adult health and well-being (Berkman & Gurland, 1998). Most prior research on the determinants of functional status has focused on the role of adult socioeconomic status (SES), psycho-social characteristics and health behaviors (Balfour & Kaplan, 2002; House, Lantz, & Herd, 2005; Lynch, Kaplan, & Salonen, 1997). Relatively few researchers have assessed early-life antecedents of physical disability. Those who have examined the role of childhood characteristics have used data primarily from developed countries (Guralnik, Butterworth, Wadsworth, & Kuh, 2006; Haas, 2008; Kuh, Hardy, Butterworth, Okell, Richards, Wadsworth, et al., 2006; Luo & Waite, 2005). The evidence from these studies points to the potential importance of early-life circumstances in shaping physical health in adulthood. For example, based on data from the 1946 British birth cohort, Guralnik, Butterworth, Wadsworth, and Kuh (2006) found that parents' socioeconomic status (SES) predicted their

Corresponding author contact details: chuan23@sph.emory.edu.

children's physical performance in midlife. Children of fathers who were manual laborers and of less educated mothers had significantly poorer physical performance in midlife than children of nonmanual workers and better educated mothers. These findings were robust to controls for health behaviors and adult SES (Guralnik et al., 2006). Similarly, based on the Health and Retirement Study (HRS), Luo and Waite (2005) as well as Haas (2008) found that childhood SES remained an independent predictor of functional performance in adulthood in the United States, controlling for both childhood health status and adult SES.

Whether such findings from developed countries can be generalized to low- and middle-income countries is undetermined. For example, children of poor British families have access to medical services through the country's universal health-care system; but such coverage is rarely available for individuals in less developed countries. Moreover, during "nutrition transition," when societies move from a high prevalence of malnutrition to increased food availability, individuals from higher SES backgrounds may be at a greater risk of obesity, a known risk factor in functional limitations, compared to their lower SES counterparts because of a high-sugar and high-fat "Western diet" among the higher SES groups (Kapoor & Anand, 2002; Kim, Symons, & Popkin, 2004).

In the present study, we assessed whether early-life conditions are associated with adult lower-body functional limitations (LBFL) in Mexico, a middle-income country with substantial inequalities in educational achievement and economic resources. Specifically, we investigated whether childhood health and SES predict adult LBFL and whether adult SES, chronic diseases, and health behaviors mediate these associations.

Mechanisms Underlying Childhood Conditions and Adult Functional Limitations

Early-life conditions may be associated with adult functional performance through a series of biological, social, and behavioral mechanisms operating across the life course (Kuh, Ben-Shlomo, Lynch, Hallqvist, & Power, 2003; Power & Hertzman, 1997). One biological pathway through which early-life conditions may influence functional limitations is adult chronic diseases (Aletaha & Ward, 2006; Dunlop, Semanik, Song, Manheim, Shih, & Chang, 2005; Figaro, Simonsick, Kritchevsky, Goodpaster, Resnick, Newman, et al., 2006; Volpato, Ferrucci, Blaum, Ostir, Cappola, Fried, et al., 2003). Researchers have hypothesized, for example, that insufficient fetal nutrition and consequent growth retardation may increase the risk of chronic diseases in adulthood through "biological programming" (Barker, 1993; Barker & Clark, 1997). This mechanism may be particularly important in developing countries where the poor have experienced nutritional deprivation in early life (Adair & Prentice, 2004).

Intergenerational transmission of SES is likely another important link between early-life conditions and adult functional performance. Childhood SES is an important predictor of adult SES in both developed and developing countries (Blackwell, Hayward, & Crimmins, 2001; Case, Fertig, & Paxson, 2005; Huang & Elo, 2009). Adult SES in turn is associated with functional health. Particularly relevant are work-related hazards, which have been associated with poor functional performance (Sekine, Chandola, Martikainen, Marmot, & Kagamimori, 2006) among agricultural and construction workers because of a high risk of work-related falls or injuries (Gillen, Faucett, Beaumont, & McLoughlin, 1997; Mazza, Lee, Gunderson, & Stueland, 1997).

Early-life conditions have also been associated with health behaviors that affect later-life health outcomes. People raised in lower SES families are not only more likely to adopt risky behaviors, such as alcohol abuse and smoking (Lynch et al., 1997; Power, Graham, Due,

Hallqvist, Joung, Kuh, et al., 2005; van de Mheen, Stronks, Looman, & Mackenbach, 1998), but they are also more likely to continue these behaviors into adulthood (Minh, Ng, Wall, Stenlund, Bonita, Weinehall, et al., 2006). These unhealthy behaviors in turn may pose a threat to adult functional performance. Heavy drinking may lower bone mineral density (BMD) and therefore increase the risk of falls and fractures (Cawthon, Fink, Barrett-Connor, Cauley, Dam, Lewis, et al., 2007). In addition, limited physical exercise and an unhealthy diet, which are more common among low-income individuals (Lynch et al., 1997) may also contribute to weight gain and obesity, posing an increased risk of functional limitations later in life, partly through their association with joint problems and knee osteoarthritis (Kondo, Tanaka, Hirota, Kawamura, Miura, Sugioka, et al., 2006).

The Mexican Setting

During the first half of the last century, Mexico achieved dramatic improvements in population health (Carolina & Gustavo, 2003). Life expectancy at birth increased from 30 years in 1900 to around 50 years in 1950 (Partida-Bush, 2005). These achievements were made partially through public health campaigns, such as the Rockefeller Foundation-supported campaign of 1921–1951, aimed at the eradication of infectious diseases. Subsequent efforts to eliminate malaria were launched in the 1950s (Gueto, 2005); however, attitudes toward health campaigns varied across social groups, and a resultant equal benefit for all Mexicans was unlikely (Armus, 2005; Laveaga, 2007). Indigenous groups, for example, were less receptive to the messages of these campaigns because of conflicts between indigenous beliefs and modern health practices. As a result, social and regional differences in the prevalence of communicable diseases have persisted to the present day (Frenk, 2006). Malaria, for example, has continued to pose a health threat in predominantly rural areas despite efforts at its eradication (Gueto, 2005).

In addition to improvements in health, Mexico also experienced rapid industrialization and urbanization in the first half of the 20th century. Unfortunately, the consequent improvements in living standards were largely limited to elite and upper-middle classes; and social and economic inequalities increased during this period (Bortz & Aguila, 2006). One indicator of disparities in living conditions at the time was reflected in the social-class difference in adult height, which increased substantially only among upper- and upper-middle-class individuals (Bortz, 1988; Lopez-Alonso, 2007). Thus, because of the uneven improvements in living standards and health, childhood nutritional conditions and disease burden were also likely to differ by family background among Mexicans born in the first half of the 20th century. We hypothesized that these childhood nutritional and health disparities would be reflected in variation in adult health outcomes today. Moreover, many individuals who experienced economic deprivation in early life may have continued to do so at older ages. A sizable fraction of Mexicans, 20% according to the World Bank (2004), still lived in extreme poverty in 2002.

Access to health care also varies by SES in Mexico today. As late as 2002, fewer than half of Mexican households were covered by health insurance. Compared to the poor, upper- and upper-middle-class individuals, who are covered through various health insurance programs provided by private employers or the government, have much better access to health-care services (Barraza-Llorens, Bertozzi, Gonzalez-Pier, & Gutierrez, 2002; Knaul & Frenk, 2005). Additional evidence suggests that the health status of the population varies by SES and density of residential area. For example, about 16% of Mexicans aged 50 years and above were estimated to have diabetes at the beginning of the 21st century with a higher prevalence in urban than rural areas (Sanchez-Castillo, Velasquez-Monroy, Lara-Esqueda, Berber, Sepulveda, Tapia-Conyer, et al., 2004). The prevalence of overweight and obesity

among the poor in Mexico in turn was estimated to be over 50% (Fernald, Gutierrez, Neufeld, Olaiz, Bertozzi, Mietus-Snyder, et al., 2004).

Data and Methods

Study Population

The Mexican Health and Aging Study (MHAS) is a nationally representative sample of Mexicans born prior to 1951. Researchers collected extensive information about respondents, including current health conditions, family structure, and socioeconomic status in middle and late life as well as retrospective information on early-life circumstances. The survey was conducted by well-trained, full-time interviewers (http://www.mhas.pop.upenn.edu/). The MHAS baseline interview took place in 2001 (N=9,719), and a second interview was conducted in 2003 (N=8,583). The institutional review board of the Universities of Pennsylvania, Maryland and Wisconsin approved the survey protocol, and the informed consent of study participants was obtained and the rights of the informants were guaranteed. Because retrospective information on early-life conditions was obtained only in 2003, we based our analysis on the 2003 survey wave. We excluded 1,161 individuals with proxy interviews because functional status was not collected in these interviews. We further excluded 58 respondents with missing information on functional status. Our final sample thus consisted of 7,364 respondents, including 3,230 males and 4,134 females born prior to 1951. We did not exclude cases with missing values on explanatory variables (information on missing data is reported in Table 1); instead we used Multiple Imputation (MI) to deal with missing data in the statistical analysis.

Adult lower-body functional limitations (LBFL)

The MHAS used 12 Nagi items to measure functional performance. We coded our outcome variable based on the following eight measures of LBFL: difficulty with running a mile, walking several blocks, walking one block, climbing several flights of stairs, climbing one flight of stairs, sitting for two hours, getting up from chair after sitting for long periods, and stooping, kneeling, or crouching. LBFL more accurately predicts disability than upper-body limitations across diverse populations (Guralnik, Ferrucci, Peiper, Leveille, Markides, Ostir, et al., 2000). For each of the eight items, a value of one was assigned to those who answered “having trouble,” “can’t do,” or “doesn’t do”; and zero was assigned to those who reported “no trouble.” We then summed the eight items and obtained a value ranging from zero to eight with higher values indicating more severe LBFL. Respondents who answered “don’t know” or refused to answer were excluded from the analysis as discussed above (N=58).

Early-life conditions

We measured childhood SES by the mother’s educational attainment and father’s occupation. Mother’s education was coded as no education, elementary school, and junior high school and above. Father’s occupation was categorized into five groups: (a) agricultural workers; (b) office/professional; (c) other nonagricultural workers, including workers in construction, gardening, maintenance, service, restaurant, store, and hotel; (d) other, including childcare or domestic workers for a private residence, workers in occupations not specified in the questionnaire, and those who did not work; and (e) respondents who reported having no father or a guardian.

We also included two additional indicators of childhood conditions. One was whether the respondent generally went to bed hungry before age 10. The other was whether the respondent reported any of the following illnesses or health problems before age 10: tuberculosis, rheumatic fever, polio, typhoid fever, or a serious blow to the head that made the respondent faint. A respondent who reported any of the above health conditions was

coded as "having had a serious health problem before age 10." These indicators were associated with adult diabetes in a prior study based on the MHAS (Kohler & Soldo, 2005).

In Mexico life experiences and social economic conditions of individuals may vary by the state in which a person was born (Hanson, 2007). To capture this variability, we included an indicator of whether the respondent was born in a state with a high rate of out-migration, namely Durango, Guanajuato, Jalisco, Michoacán, Nayarit, or Zacatecas. These six states were among the nine states with consistently high migration to the United States from the 1920s to the 1960s. In general, these states also had a high level of poverty and limited job opportunities (Durand, Massey, & Zenteno, 2001).

Adult characteristics

We also included several adult sociodemographic characteristics, such as marital status, educational attainment, occupation, and income or wealth. Marital status was coded as either married (including in a consensual union) or other, that is, single, divorced, separated, and widowed. The respondent's educational level was distinguished among the following: no schooling; some elementary school; completed elementary school, junior high school, high school, or above. The respondent's occupation refers to the main occupation the respondent had held throughout his or her life. Based on the *Structure of the Mexican Classification of Occupations INEGI*, we coded respondents' occupations into four categories: workers in agriculture, livestock, forestry, and fishing; professional or administrative personnel; workers in other sectors; and those who never had a paid or unpaid job in a business or on a farm or ranch.

The MHAS was the first survey that collected detailed information on assets for the Mexican population (Wong & Espinoza, 2002). We included total income and net worth from data on ownership of assets. Missing values (either complete nonresponse or information available only in a form of unfolding brackets rather than exact value) have been imputed by MHAS investigators (Wong & Espinoza, 2002).

We also included health behaviors, which may have their antecedents in childhood. We coded smoking behavior as follows: never smoked, started smoking before age 16, and started smoking at age 16 or above. In Mexico, age 16 is the minimum legal age of marriage for men; after this age individuals are likely to gain more independence and less supervision from their parents or legal guardians. Body mass index (BMI) is included as an indicator of diet and physical activity. We categorized BMI according to the World Health Organization (1998) criteria: underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (30.0+ kg/m^2). This measure of BMI is based on self-reported height and weight. In the MHAS, around 20% of the respondents were randomly selected for anthropometric measurements, including weight and height. Among these respondents, the correlation between self-reported and measured BMI was about 0.85. Previous researchers found a similar high correlation and concluded that the accuracy of self-reported BMI is sufficient in epidemiological studies (McAdams, Van Dam, & Hu, 2007).

Finally, in the MHAS, respondents were asked a series of questions about current health conditions and medical history. We included dichotomous indicators of whether the respondent often felt pain and whether the respondent had diabetes or arthritis, based on whether the respondent was ever told by a doctor or medical personnel that she or he had these conditions. Results from previous research suggest a relatively high level of agreement between self-reported and clinical diagnosis regarding the chronic diseases included here. For example, results based on the 2000 ENSA, a nationally representative cross-sectional health survey of Mexicans (N=45,294), indicated that estimates of diabetes prevalence based on self-reports and clinical measures were similar and that undiagnosed cases were

relatively rare, especially among older Mexicans (Aguilar-Salinas, Monroy, Gomez-Perez, Chavez, Esqueda, Cuevas, et al., 2003; Kohler & Soldo, 2005). Previous public health campaigns have urged Mexicans to be diagnosed and treated for diabetes, increasing awareness of the disease (Kohler & Soldo, 2005).

Analytic Strategy

To estimate the associations between early-life conditions and adult LBFL, we used a cumulative logistic model suitable for ordinal response variable; the proportional odds assumption was met by the score test (p=0.70). Specifically, P_j is the probability that the dependent variable is equal to j, where j is the number of functional limitations, ranging from zero to eight. We then defined cumulative probability $f_j = \sum_{m=0}^{j} P_m$, where f_j is the probability of being in the j^{th} category or in a lower one. For example, f_1 refers to the cumulative probability of having one functional limitation or having no limitation. Finally, the cumulative logit model can be specified as

$$\log\left(\frac{f_j}{1-f_j}\right) = \alpha + \beta X,$$

where X refers to a vector of explanatory variables. We estimated series of nested models to examine the associations between early-life conditions and adult LBFL and to determine whether these associations were mediated by various dimensions of adult characteristics. In Model 1, we assessed whether each indicator of early-life conditions predicted adult LBFL, controlling only for age and sex; whereas in Model 2 we included all early-life conditions simultaneously. In addition in Model 3, we adjusted for marital status and our indicators of adult SES. In Model 4 we included age, sex, early-life conditions, health behaviors, and BMI; whereas in Model 5 we adjusted for chronic diseases and symptoms in addition to age, sex, and early-life conditions. Model 6 included all explanatory variables. All models were estimated in SAS, version 9.1.

As noted above, we used Multiple Imputation (MI) to treat explanatory variables with missing values. MI is a Monte Carlo technique in which each missing value is replaced by multiple (*five* in this study) simulated values. Each simulated complete dataset was then analyzed, and the results were combined to produce estimates of coefficients and confidence intervals (Rubin, 1978). The MI usually produces more efficient estimates than the widely practiced listwise deletion, particularly when missing data are common (Allison, 2001).

Results

Table 1 presents sample characteristics by sex. Women reported worse functional health than men with a higher mean number of functional limitations than men. Many respondents were exposed to adverse early-life conditions. About one third of both male and female respondents reported that they went to bed hungry before age 10, and around 11% reported that they had serious health problems before age 10. In addition, about half the respondents' mothers had no schooling, and more than half the respondents' fathers worked in agriculture compared to about 3% in office/professional occupations.

The sample also varied regarding adult SES, health behaviors, and chronic conditions. Men had higher levels of schooling than women with about 24% of the men compared to about 20% of the women having completed at least junior high school. Nearly all male

respondents (99.4%) had worked, whereas around 30% of the women reported never having held a job. Men also reported higher levels of income and assets than women. These income differences may be related to the fact that women (40.1%) were less likely to be married or in a consensual union than men (75.5%) in part because of a higher rate of widowhood among women than men (Cattell, 1997).

In contrast, women (74.8%) were far more likely than men (33.4%) to have never smoked, and if they smoked, women were more likely than men to have started after age 16. At the same time, women were somewhat more likely to be obese, to have diabetes and arthritis, or to suffer from pain.

Early-life conditions and adult LBFL

Each early-life condition exhibited a significant association with adult LBFL, controlling for age and sex (Model 1). Both indicators of childhood health and nutritional deprivation exhibited a significant association with adult LBFL such that having gone to bed hungry (OR: 1.55; CI: 1.42–1.69) and having had serious health problems before age 10 (OR: 1.27; CI: 1.12–1.45) increased the risk of LBFL. In contrast, having been born in a high-migration state and having a mother with a higher level of education significantly lowered the risk of adult LBFL. In addition, higher childhood SES, measured by father's occupation was associated with a significantly lower risk of LBFL such that having a father with an office or a professional occupation (OR: 0.63, CI: 0.51–0.82) or with another nonagricultural occupation (OR: 0.84, CI: 0.77–0.93) reduced the risk compared to those whose fathers worked in agriculture. When all early-life conditions were included in the model simultaneously (Model 2), each indicator continued to exhibit some significant associations with adult LBFL.

Adjustment for adult sociodemographic characteristics, that is, educational attainment, occupation, income, assets, and marital status (Model 3), attenuated the association between mother's education and adult LBFL; and it was no longer statistically significant. In contrast, adjustment for adult SES resulted in only small changes in the associations between early-life health problems, nutritional status, and residence in a high-migration state. The inclusion of smoking and BMI in the model had little effect on the risks associated with early-life conditions (Model 2 versus Model 4), whereas adjustment for diabetes, arthritis, and frequent pain attenuated the risk associated with childhood health problems and nutritional status before age 10 by 41–44% (Model 2 versus Model 5). This latter finding is consistent with the hypothesis that the influence of early-life nutritional and health status is associated with adult chronic disease. In the final model (Model 6), all indicators of early-life conditions, except for mother's educational attainment, continued to predict adult LBFL; but in the case of father's occupation, an elevated risk was present only for the relatively small occupational category consisting of unspecified occupations.

We also tested whether the associations between early-life conditions and adult LBFL varied between men and women by adding interaction terms between sex and each indicator of early-life conditions (results not shown). No interaction was statistically significant at the 0.05 level, suggesting that the relationship between early childhood conditions and adult LBFL did not vary between men and women.

Adult characteristics and LBFL

Several adult characteristics were also significant predictors of adult LBFL, controlling for early-life environment. Among indicators of adult SES, greater assets but not income lowered the risk of adult LBFL as did higher level of education. In addition, respondents

who worked in nonagricultural occupations were significantly less likely to report LBFL than respondents who worked in agriculture (Model 6).

We also found that both smoking and BMI were significant predictors of adult LBFL (Model 4), and these associations remained significant in the fully adjusted model (Model 6). Specifically, smoking predicted greater adult LBFL, especially among those who started smoking before age 16 (Model 6; OR: 1.34; CI: 1.18–1.53). Overweight or obesity also placed the respondent at an increased risk of LBFL. In particular, those who were obese (BMI >30.0 kg/m^2) were at a significantly higher risk of LBFL (OR: 1.78; CI: 1.57–2.01) compared to individuals of normal weight (Model 6). Not surprisingly, individuals who suffered from pain were about three times more likely to report adult LBFL. In addition, diabetes and arthritis were also significant predictors of adult LBFL (Model 5), associations that remained essentially unchanged in the fully adjusted model (Model 6).

Robustness of Results

We excluded 2,355 respondents who were lost to follow up between the 2001 and 2003 waves of MHAS (N=1,136), received a proxy interview (N=1,161) in 2003, or for whom information on functional status (N=58) was missing in 2003. To investigate whether these exclusions biased our results, we used an Inverse Probability Weighting (IPW) estimator to assess this possibility. IPW, which can address a variety of sample selection issues (Hogan, Roy, & Korkontzelou, 2004), is based on the idea that each individual has some probability (p) of being included in the sample, and an inverse of this probability ($w=1/p$) can be used to weight the sample to account for loss resulting from sample selection. To apply this procedure, we first estimated a logistic regression model, predicting the probability of being included in the analytic sample based on all respondents in the baseline MHAS (N=9,719), where explanatory variables included age, sex, mother's education, father's occupation, marital status, own educational attainment, own occupation, income and assets, and state and urban or rural residence in 2001 (variables that were available for all respondents in the 2001 wave of the MHAS). We then assigned each respondent in our analytic sample (N=7,364) a weight that was equal to the inverse of the predicted probability of being included. The weighted sample based on the IPW estimator yielded similar results to those reported here, suggesting that sample attrition was unlikely to bias our results (see Appendix Table 3).

Conclusions and Discussion

This study contributes to the literature on early-life antecedents of functional limitations in adulthood, a topic that has been less frequently studied in the context of a developing than developed country. Based on a nationally representative sample of Mexicans born prior to 1951, we found that childhood nutritional deprivation and poor health as well as low SES of the family of origin were significant predictors of adult LBFL. These findings were robust for adjustment of adult characteristics, including adult SES, smoking, BMI, diabetes, arthritis, and chronic pain.

That childhood hunger may have an adverse impact on children's physical health is well known (Weinreb, Wehler, Perloff, Scott, Hosmer, Sagor, et al., 2002). Our results suggest that the influence of childhood nutritional deprivation may extend to adulthood and increase the risk of physical disability at older ages. Our results further suggest that adult chronic disease may be a key mediator of this association. Other factors, not investigated here may, however, also play a role, such as reduced muscle fiber associated with muscle weakness (Kuh et al., 2006). Furthermore, malnutrition in early life may also increase the risk of

osteoporotic fracture, leading to LBFL in later life (Cooper, Javaid, Taylor, Walker-Bone, Dennison, & Arden, 2002).

That maternal education improves child health and development is widely believed (Heckman & Hotz, 1986; Schultz, 1993). In a series of health campaigns to eliminate infectious diseases in the early 20th century in Mexcio, maternal education was found to play a key role in improved child health (Laveaga, 2007). We also found evidence for the beneficial effect of mothers' education: Children of mothers with elementary school or higher level of education reported significantly lower levels of LBFL in adulthood. This association, however, was mediated by the respondent's own adult SES, including educational attainment. At the same time, we also documented significant associations between fathers' occupation and adult LBFL, and some occupational associations remained significant with controls for adult sociodemographic characteristics, health behaviors, and self-reported chronic conditions.

In addition, birth in a high-migration state in Mexico was associated with a significantly lower burden of adult LBFL. We speculate that heads of households in high-migration states were more likely to migrate to the United States than their counterparts in low-migration states. The migration experience may improve the health outcomes of children in these families, mainly through remittances sent back home and health knowledge acquired in the United States (Hildebrandt & McKenzie, 2005). In addition, the diffusion of health knowledge among residents in these states may also benefit the respondents whose parents did not migrate.

The measures of early-life conditions were based on retrospective reports. A critical question is whether significant recall errors occurred, biasing our estimates. In particular, given that the mean age of the respondents in the MHAS was about 61, the question remains whether the respondents were able to recall correctly health events before age 10. Prior studies have provided supportive evidence regarding one's ability to recall early-life events and childhood health conditions (Smith, 2009). Krall, Valadian, Dwyer, and Gardner (1988) found that self-reports of childhood illness were highly accurate when compared to historical clinical records among German adults older than age 50. Haas (2007) investigated whether current health conditions impacted retrospective reports of childhood health and found that such "anchoring" was not evident among participants in the Health and Retirement Study (HRS) in the United States. We know of no researchers who have investigated the reliability and validity of self-reports of childhood health and SES among MHAS participants. Objective measures of early-life conditions would, of course, be preferred; but in their absence, researchers have relied on retrospective reports similar to those used here (Huang & Elo, 2009; Kohler & Soldo, 2005; Monteverde, Noronha, & Palloni 2009; Zeng, Gu, & Land, 2007). Furthermore, our results are quite consistent with prior research from diverse settings and provide additional evidence supporting the hypothesis that adult health is shaped by early-life circumstances (Barker, 1993; Barker & Clark, 1997; Blackwell et al., 2001; Haas, 2008; Kuh et al., 2003; Preston, Hill, & Drevenstedt, 1998).

Our results have important implications for policy. For example, we found that children who experienced hunger and suffered from serious illness before age 10 were more likely to develop functional limitations in adulthood than their better nourished and healthier peers. Based on this finding, programs that subsidize food and medical care may help children born into low-income families avoid excessive risk of physical disability in adulthood. Unfortunately, over 50% of children in developing countries are estimated to be deprived of access to food, water, and sanitation and lack access to education and medical services

(Gordon, Nandy, Pantazis, Pemberton, & Townsend, 2003). Childhood poverty may translate into poor health in adulthood.

References

Adair L, Prentice A. A critical evaluation of the fetal origins hypothesis and its implications for developing countries. Journal of Nutrition 2004;134:191–193. [PubMed: 14704317]

Aguilar-Salinas C, Monroy OV, Gomez-Perez FJ, Chavez AG, Esqueda AL, Cuevas VM, et al. Characteristics of patients with type 2 diabetes in Mexico. Diabetes Care 2003;26:2021–2026. [PubMed: 12832306]

Aletaha D, Ward M. Duration of rheumatoid arthritis influences the degree of functional improvement in clinical trials. Annals of the Rheumatic Diseases 2006;65:227–233. [PubMed: 15975967]

Allison, PD. Missing data. Thousand Oaks, CA: Sage; 2001.

Armus, D. Avatares de la Medicalizacion en America Latina 1870–1970. Buenos Aires, Argentina: Lugar Editorial; 2005.

Balfour J, Kaplan G. Neighborhood environment and loss of physical function in older adults: Evidence from the Alameda County Study. American Journal of Epidemiology 2002;155:507–515. [PubMed: 11882524]

Barker D. The intrauterine origins of cardiovascular disease. Acta Paediatrica Supplement 1993;391:93–99. [PubMed: 8219485]

Barker D, Clark P. Fetal undernutrition and disease in later life. Reviews of Reproduction 1997;2:105–112. [PubMed: 9414472]

Barraza-Llorens M, Bertozzi S, Gonzalez-Pier E, Gutierrez J. Addressing inequality in health and health care in Mexico. Health Affairs 2002;21:47–56. [PubMed: 12026003]

Berkman C, Gurland B. The relationship among income, other socioeconomic indicators, and functional level in older persons. Journal of Aging and Health 1998;10:81–98. [PubMed: 10182419]

Blackwell DL, Hayward MD, Crimmins EM. Does childhood health affect chronic morbidity in later life? Social Science and Medicine 2001;52(8):1269–1284. [PubMed: 11281409]

Bortz, J. Los salaries industrials en la Ciudad de Mexico, 1939–1975. Mexico City, Mexico: 1988.

Bortz J, Aguila M. Earning a living: A history of real wage studies in twentieth- century Mexico. Latin American Research Review 2006;41:112–138.

Carolina SM, Gustavo FL. Epidemiological transition: Model or illusion? A look at the problem in Mexico. Social Science and Medicine 2003;57:539–550. [PubMed: 12791495]

Case A, Fertig A, Paxson C. The lasting impact of childhood health and circumstance. Journal of Health Economics 2005;24(2):365–389. [PubMed: 15721050]

Cattell, M. African widows, culture and social changes: Case studies from Kenya. In: Sokolovsky, J., editor. The cultural context of aging. 2. Westport, CT: Bergin & Garvey; 1997. p. 71-98.

Cawthon P, Fink H, Barrett-Connor E, Cauley J, Dam T, Lewis C, et al. Alcohol use, physical performance, and functional limitations in older men. JAGS 2007;55:212–220.

Cooper C, Javaid M, Taylor P, Walker-Bone K, Dennison E, Arden N. The fetal origins of osteoporotic fracture. Calcified Tissue International 2002;70:391–434. [PubMed: 11960204]

Dunlop D, Semanik P, Song J, Manheim L, Shih V, Chang R. Risk factors for functional decline in older adults with arthritis. Arthritis & Rheumatism 2005;52:1274–1282. [PubMed: 15818691]

Durand J, Massey D, Zenteno R. Mexican immigration to the United States: Continuities and changes. Latin American Research Review 2001;36(1):107–127. [PubMed: 17595734]

Fernald L, Gutierrez J, Neufeld L, Olaiz G, Bertozzi S, Mietus-Snyder M, et al. High prevalence of obesity among the poor in Mexico. JAMA 2004;291:2544–2545. [PubMed: 15173143]

Figaro M, Simonsick E, Kritchevsky S, Goodpaster B, Resnick H, Newman A, et al. Diabetes, inflammation, and functional decline in older adults: Findings from the Health, Aging and Body Composition (ABC) Study. Diabetes Care 2006;29:2039–2045. [PubMed: 16936150]

Frenk J. Bridging the divide: Global lessons from evidence-based health policy in Mexico. Lancet 2006;368:954–961. [PubMed: 16962886]

Gillen M, Faucett J, Beaumont J, McLoughlin E. Injury severity associated with nonfatal construction falls. American Journal of Industrial Medicine 1997;32:647–655. [PubMed: 9358922]

Gordon, D.; Nandy, S.; Pantazis, C.; Pemberton, S.; Townsend, P. Child poverty in the developing world. Bristol, England: Policy Press; 2003.

Gueto M. Appropriation and resistance: Local responses to malaria eradication in Mexico, 1955–1970. Journal of Latin American Studies 2005;37:533–559.

Guralnik J, Butterworth S, Wadsworth M, Kuh D. Childhood socioeconomic status predicts physical functioning a half century later. Journal of Gerontology Series B: Psychology Sciences and Social Sciences 2006;61:694–701.

Guralnik J, Ferrucci L, Peiper C, Leveille G, Markides K, Ostir G, et al. Lower extremity function and subsequent disability: Consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. Journal of Gerontology Series A: Biological Sciences & Medicine Sciences 2000;55:M221–M231.

Haas S. The long-term effects of poor childhood health: An assessment and application of retrospective reports. Demography 2007;44:113–135. [PubMed: 17461339]

Haas S. Trajectories of functional health: The 'long arm' of childhood health and socioeconomic factors. Social Science & Medicine 2008;66:849–861. [PubMed: 18158208]

Hanson, G. Emigration, labor supply, and earnings in Mexico. In: Borjas, GJ., editor. Mexican immigration to the United States. Chicago, IL: University of Chicago Press; 2007.

Heckman J, Hotz V. An investigation of the labor market earnings of Panamanian males: Evaluating the sources of inequality. Journal of Human Resources 1986;21:507–542.

Hildebrandt N, McKenzie D. The impact of immigration on child health in Mexico. Economia 2005;6:257–289.

Hogan JW, Roy J, Korkontzelou C. Handling drop-out in longitudinal studies. Statistics in Medicine 2004;23:1455–1497. [PubMed: 15116353]

House J, Lantz P, Herd P. Continuity and change in the social stratification of aging and health over the life course: Evidence from a nationally representative longitudinal study from 1986 to 2001/2002 (Americans Changing Lives Study). Journal of Gerontology Series B: Psychology Sciences and Social Sciences 2005;60B:15–26.

Huang C, Elo I. Mortality of the oldest old Chinese: The role of early-life nutritional status, socio-economic conditions, and sibling sex-composition. Population Studies 2009;63(1):7–20. [PubMed: 19184718]

Kapoor S, Anand K. Nutritional transition: A public health challenge in developing countries. Journal of Epidemiology & Community Health 2002;56:804–805. [PubMed: 12388563]

Kim S, Symons M, Popkin B. Contrasting socioeconomic profiles related to healthier lifestyles in China and the United States. American Journal of Epidemiology 2004;159:184–191. [PubMed: 14718221]

Knaul F, Frenk J. Health insurance in Mexico: Achieving universal coverage through structural reform. Health Affairs 2005;24:1467–1476. [PubMed: 16284018]

Kohler I, Soldo B. Childhood predictors of late-life diabetes: The case of Mexico. Social Biology 2005;52:113–131.

Kondo K, Tanaka T, Hirota Y, Kawamura H, Miura H, Sugioka Y, et al. Factors associated with functional limitation in stair climbing in female Japanese patients with knee osteoarthritis. Journal of Epidemiology 2006;16:21–29. [PubMed: 16369105]

Krall EA, Valadian I, Dwyer JT, Gardner J. Recall of childhood illness. Journal of Clinical Epidemiology 1988;41:1059–1064. [PubMed: 3204416]

Kuh D, Ben-Shlomo Y, Lynch J, Hallqvist J, Power C. Life course epidemiology. Journal of Epidemiology & Community Health 2003;57:778–783. [PubMed: 14573579]

Kuh D, Hardy R, Butterworth S, Okell L, Richards M, Wadsworth M, et al. Developmental origins of midlife physical performance: Evidence from a British birth cohort. American Journal of Epidemiology 2006;164:110–121. [PubMed: 16757569]

Laveaga G. Avatares de la medicalizacion en America Latina 1870–1970. Book review. Social History of Medicine 2007;20:175–176.

Lopez-Alonso M. Growth with inequality: Living standards in Mexico, 1850–1950. Journal of Latin American Studies 2007;39:81–105.

Luo Y, Waite L. The impact of childhood and adult SES on physical, mental, and cognitive well-being in later life. Journal of Gerontology Series B: Psychological Science & Social Science 2005;60:S93–S101.

Lynch J, Kaplan G, Salonen J. Why do poor people behave poorly? Variation in adult health behaviors and psychosocial characteristics by stages of the socioeconomic lifecourse. Social Science & Medicine 1997;44:809–819. [PubMed: 9080564]

Mazza J, Lee B, Gunderson P, Stueland D. Rural health care providers' educational needs related to agricultural exposures. Journal of Agricultural Health and Safety 1997;3:207–215.

McAdams M, Van Dam R, Hu B. Comparison of self-reported and measured BMI as correlates of disease markers in U.S. adults. Obesity 2007;15:188–196. [PubMed: 17228047]

Minh H, Ng N, Wall S, Stenlund H, Bonita R, Weinehall L, et al. Smoking epidemics and social-economic predictors of regular use and cessation: Findings from WHO STEPS Risk Factor Survey in Vietnam and Indonesia. Internet Journal of Epidemiology 2006;3:1.

Monteverde M, Noronha K, Palloni A. Effect of early conditions on disability among the elderly in Latin America and the Caribbean. Population Studies 2009;63:21–35. [PubMed: 19184719]

Partida-Bush, V. Demographic transition, demographic bonus and aging in Mexico. UN meeting proceedings. 2005. Retrieved from http://www.un.org/esa/population/meetings/Proceedings_EGM_Mex_2005/partida.pdf

Power C, Graham H, Due P, Hallqvist J, Joung I, Kuh D, et al. The contribution of childhood and adult socioeconomic position to adult obesity and smoking behaviour: An international comparison. International Journal of Epidemiology 2005;34:335–344. [PubMed: 15659473]

Power C, Hertzman C. Social and biological pathways linking early life and adult disease. British Medical Bulletin 1997;53:210–221. [PubMed: 9158295]

Preston S, Hill M, Drevenstedt G. Childhood conditions that predict survival to advanced ages among African-Americans. Social Science & Medicine 1998;47:1231–1246. [PubMed: 9783866]

Rubin DB. Multiple imputation in sample surveys: A phenomenological Bayesian approach to nonresponse. Proceedings of the survey research methods section of the American Statistical Association 1978:20–34.

Sanchez-Castillo C, Velasquez-Monroy O, Lara-Esqueda A, Berber A, Sepulveda J, Tapia-Conyer R, et al. Diabetes and hypertension increase in a society with abdominal obesity: Results of the Mexican National Health Survey 2000. Public Health Nutrition 2004;8(1):53–60. [PubMed: 15707539]

Schultz, T. Returns to women's education. In: King, E.; Hill, M., editors. Women's education in developing countries: Barriers, benefits, and policies. Baltimore, MD: Johns Hopkins University Press; 1993. p. 51-99.

Sekine M, Chandola T, Martikainen P, Marmot M, Kagamimori S. Socioeconomic inequalities in physical and mental functioning of Japanese civil servants: Explanations from work and family characteristics. Social Science and Medicine 2006;63:430–445. [PubMed: 16529852]

Smith, James P. Reconstructing childhood health histories. Demography 2009;46:387–403.

van de Mheen H, Stronks K, Looman C, Mackenbach J. Does childhood socioeconomic status influence adult health through behavioral factors? International Journal of Epidemiology 1998;27:431–437. [PubMed: 9698131]

Verbrugge LM, Jette A. The disablement process. Social Science and Medicine 1994;38:1–14. [PubMed: 8146699]

Volpato S, Ferrucci L, Blaum C, Ostir G, Cappola A, Fried L, et al. Progression of lower-extremity disability in older women with diabetes: The Women's Health and Aging Study. Diabetes Care 2003;26:70–75. [PubMed: 12502660]

Weinreb L, Wehler C, Perloff J, Scott R, Hosmer D, Sagor L, et al. Hunger: Its impact on children's health and mental health. Pediatrics 2002;110:816–817.

Wong R, Espinoza M. Economic status of middle and old age population in Mexico: Preliminary results from the Mexican Health and Aging Study. MHAS Working Paper. 2002

World Bank. Poverty in Mexico: An assessment of conditions, trends and government strategy: Summary and key messages. Report No 28612. 2004

World Health Organization. Obesity: Preventing and managing the global epidemic. Geneva, Switzerland: Author; 1998. Report of a WHO consultation on obesity.

Zeng Y, Gu D, Land KC. The association of childhood socioeconomic conditions with healthy longevity at the oldest-old ages in China. Demography 2007;44(3):497–518. [PubMed: 17913008]

APPENDIX

Table 3

Odds Ratios From Cumulative Logistic Regression for Lower-Body Functional Limitations, Ages 50 and Above (Model 2), Mexican Health and Aging Study (MHAS) With and Without Inverse Probability Weighting (IPW)

	Without IPW[1]	With IPW[2]
Early-life conditions		
Born in a high-migration state	0.87** (0.80–0.95)	0.86** (0.79–0.94)
Often went to bed hungry before age 10	1.46** (1.34–1.60)	1.46** (1.35–1.59)
Serious health problems before age 10	1.27** (1.11–1.45)	1.27** (1.11–1.44)
Father's occupation *(Agriculture)*		
In an office/professional	0.82 (0.63–1.07)	0.78† (0.60–1.01)
Other nonagricultural	0.92† (0.84–1.01)	0.90* (0.82–0.99)
Other	1.23* (1.03–1.47)	1.21* (1.01–1.45)
No father/guardian	0.92 (0.72–1.18)	0.90 (0.69–1.16)
Mother's education *(None)*		
Elementary School	0.90* (0.82–0.98)	0.91* (0.83–0.99)
Junior high school and above	0.68** (0.54–0.85)	0.69** (0.56–0.86)

[1] Results shown in Table 2 (Model 2), including controls for age and sex

[2] Results from Model 2, including controls for age and sex, based on sample using inverse probability weighting

† p<0.1;

* p<0.05;

** p<0.01

Table 1

Sample Characteristics, Ages 50 and Above, Mexican Health and Aging Study (MHAS)[1] (percent unless otherwise noted)

Characteristics	Male	Female
Adult Lower Body Functional Limitations (LBFL)		
Mean LBFL (Std. Dev)	2.0 (2.3)	3.0 (2.5)
Age, *mean (Std. Dev.)*	61.5 (9.3)	62.3 (9.3)
Early life conditions		
Born in a high migration state		
Yes	33.0	33.1
No	67.0	66.9
Often went to bed hungry before age 10		
Yes	35.6	30.8
No	63.6	68.1
Missing	0.8	1.1
Serious health problems before age 10		
Yes	10.6	11.5
No	87.7	87.2
Missing	1.8	1.3
Father's occupation		
Agriculture	58.3	54.7
Office/Professional	3.0	3.0
Other nonagricultural	29.1	30.7
Other[2]	5.5	6.0
Had no father/guardian	2.5	3.1
Missing	1.7	2.5
Mother's education	50.9	50.1
None	34.8	35.7
Elementary school	3.9	4.3
Junior high school or above	10.4	9.8
Missing		
Adult sociodemographic characteristics		
Respondent's education		
None	21.4	27.9
Some elementary school	35.0	34.5
Completed elementary school	19.5	17.6
Junior high school	8.0	5.4
High school or above	16.0	14.6
Missing	0.1	0.0
Respondent's occupation		
Professional/ administrative	15.1	8.7
Agriculture/forestry	26.9	6.6

Characteristics	Male	Female
Other industries	57.3	54.7
Never had a job	0.3	29.9
Missing	0.3	0.2
Individual income		
No income or negative income (%)	10.1	19.3
Mean (Std. Dev.) of positive income (US $)	769.0 (4,454.6)	603.2 (4,499.1)
Household assets		
No assets or negative assets (%)	5.6	9.7
Mean (Std. Dev.) of positive assets(US $)	56,189.0 (107,691.2)	47430.5 (76,428.4)
Married or in consensual union		
Yes	75.5	40.1
No	24.6	59.9
Health behaviors & indicators		
Smoking behavior		
Never	33.4	74.8
Started smoking before age 16	27.4	5.9
Started smoking at age 16 or older	38.4	18.9
Missing	0.8	0.4
Body mass index (BMI)		
Underweight	1.4	1.9
Normal weight	31.9	22.8
Overweight	36.9	29.4
Obese	17.2	20.1
Missing	12.6	25.7
Chronic diseases & symptoms		
Have diabetes		
Yes	13.6	18.1
No	85.9	81.6
Missing	0.5	0.3
Have arthritis		
Yes	13.8	23.5
No	85.9	76.3
Missing	0.3	0.2
Often suffer from pain		
Yes	32.9	45.5
No	67.1	54.5
Missing	0.1	0

[1] Respondents with a proxy interview and those with missing data for functional status have been excluded.

[2] *Other* refers to childcare and occupations not specified in the questionnaire. It also includes those who did not work.

Table 2

Odds Ratios From Cumulative Logistic Regression for Lower-Body Functional Limitations, Ages 50 and Above, Mexican Health and Aging Study (MHAS)[1]

Characteristics	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Early life conditions						
Born in a high-migration state *(No)*	0.88** (0.80–0.95)	0.87** (0.80–0.95)	0.85** (0.78–0.93)	0.83** (0.76–0.91)	0.85** (0.78–0.93)	0.82** (0.75–0.89)
Went to bed hungry before age 10 *(No)*	1.55** (1.42–1.69)	1.46** (1.34–1.60)	1.36** (1.24–1.49)	1.45** (1.33–1.59)	1.27* (1.16–1.39)	1.19** (1.09–1.31)
Health problems before age 10 *(No)*	1.27** (1.12–1.45)	1.27** (1.11–1.45)	1.30** (1.14–1.48)	1.28** (1.12–1.47)	1.15* (1.01–1.32)	1.18* (1.03–1.35)
Father's occupation *(Agriculture)*						
Office/professional	0.63** (0.51–0.82)	0.82 (0.63–1.07)	1.10 (0.84–1.43)	0.82 (0.63–1.07)	0.84 (0.65–1.09)	1.05 (0.81–1.37)
Other nonagricultural	0.84** (0.77–0.93)	0.92† (0.84–1.01)	1.06 (0.95–1.17)	0.90 (0.81–0.99)	0.94 (0.86–1.04)	1.02 (0.92–1.13)
Other[2]	1.16 (0.97–1.38)	1.23* (1.03–1.47)	1.41** (1.18–1.70)	1.21* (1.00–1.45)	1.24* (1.04–1.49)	1.36** (1.13–1.64)
Had no father/guardian	0.91 (0.71–1.16)	0.92 (0.72–1.18)	0.98 (0.76–1.25)	0.90 (0.71–1.16)	0.96 (0.75–1.23)	0.98 (0.77–1.26)
Mother's education *(None)*						
Elementary school	0.83** (0.76–0.91)	0.90* (0.82–0.98)	1.04 (0.94–1.15)	0.89* (0.81–0.97)	0.94 (0.86–1.03)	1.04 (0.94–1.15)
Junior high school or above	0.58** (0.47–0.71)	0.68** (0.54–0.85)	0.96 (0.76–1.22)	0.69* (0.55–0.87)	0.83 (0.66–1.05)	0.99 (0.78–1.26)
Adult sociodemographic characteristics						
Respondent's education *(None)*						
Some elementary school			0.99 (0.89–1.11)			0.98 (0.88–1.10)
Completed elementary school			0.84* (0.73–0.96)			0.88† (0.77–1.01)
Junior high school			0.71** (0.58–0.87)			0.80* (0.65–0.98)
High school or above			0.56** (0.46–0.68)			0.66** (0.55–0.80)
Respondent's occupation *(Agriculture/forestry)*						
Professional/administrative			0.77** (0.63–0.93)			0.76** (0.62–0.93)
Industrial worker			0.88* (0.78–1.00)			0.86* (0.76–0.98)
Never had a job			0.81* (0.69–0.96)			0.87† (0.74–1.02)
Logged individual income			1.27 (0.86–1.88)			1.18 (0.79–1.75)
Logged household assets			0.76** (0.65–0.89)			0.78** (0.67–0.91)
Married or in consensual union *(No)*			1.12* (1.02–1.23)			1.07 (0.97–1.17)

Characteristics	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Health behaviors & indicators						
Smoking behaviors *(Never)*						
Started smoking before age 16				1.45** (1.28–1.65)		1.34** (1.18–1.53)
Started smoking at age 16 or older				1.12* (1.01–1.23)		1.08 (0.97–1.19)
Body Mass Index *(Normal)*						
Underweight				1.20 (0.90–1.61)		1.26† (0.98–1.63)
Overweight				1.19** (1.06–1.35)		1.20** (1.07–1.35)
Obese				1.87** (1.66–2.10)		1.78** (1.57–2.01)
Chronic diseases/symptoms						
Had diabetes *(No)*					1.73** (1.54–1.93)	1.69** (1.51–1.89)
Had arthritis *(No)*					2.13** (1.91–2.37)	2.08** (1.87–2.32)
Often suffer from pain *(No)*					3.23** (2.96–3.54)	3.13** (2.86–3.43)

[1] All models control for age and sex. Model 1 assesses whether each indicator of early-life conditions individually predicts adult LBFL. Model 2 controls for all early-life conditions simultaneously.

[2] *Other* refers to childcare and occupations not specified in the questionnaire. It also includes those who did not work.

† p<0.1;

* p<0.05;

** p<0.01