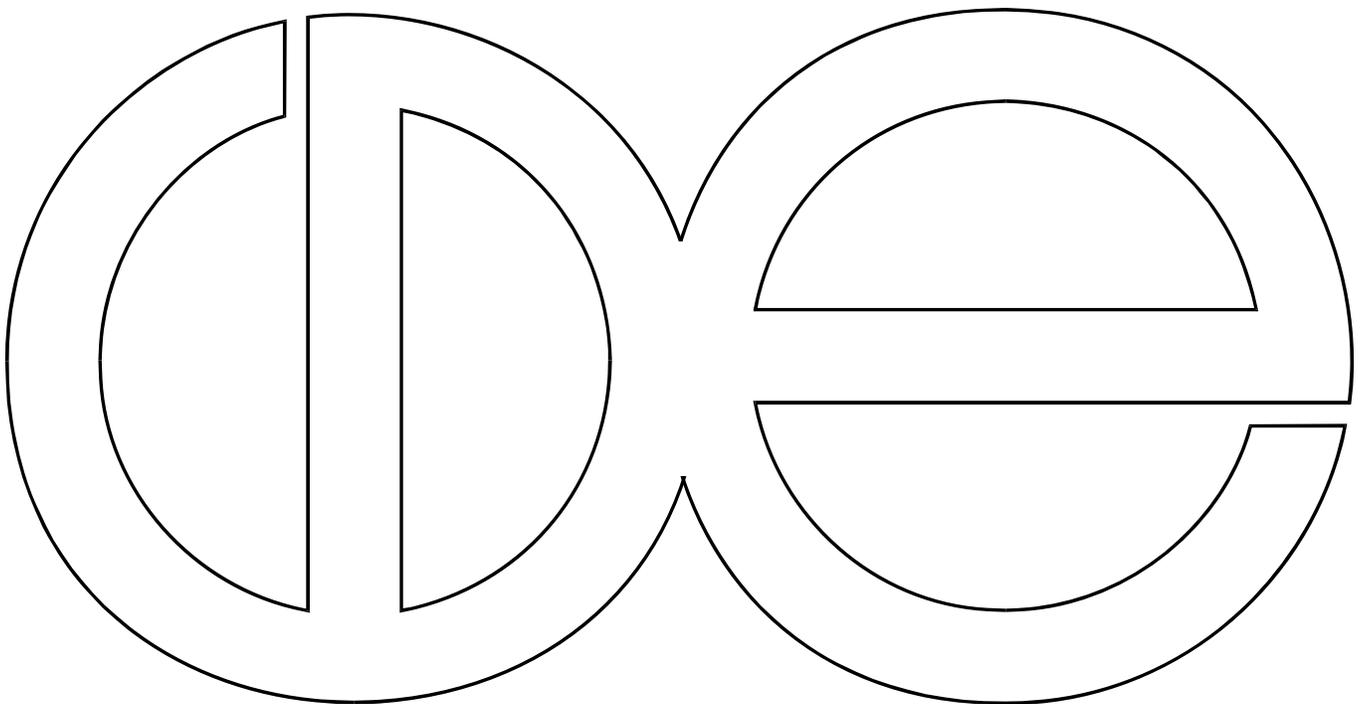


**Center for Demography and Ecology
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**Displacement due to Armed Conflict and
Violence in Childhood and Older Adult
Health: The Case of the Middle-income
Country of Colombia**

**Mary McEniry, Rafael Samper-Ternent,
and Carlo Cano Guitierrez**

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Abstract

Large displacement of populations in developing economies due to internal armed conflict and violence is of international concern but there has been relatively little research on the long-term consequences of displacement on older adult health, in particular displacement during childhood. We examine displacement in the middle-income country of Colombia which experienced a large displacement of its population over the last 50-60 years due to internal armed conflict and violence. Using a national representative survey of older adults, SABE-Colombia (2014-2015, n=23,694), we estimate the degree to which displacement during childhood and adulthood relative to those never displaced is associated with health (obesity, chronic conditions, depression, cognition, stress, functionality, frailty, self-reported health), controlling for age, gender, SES, residence, other indicators of early life conditions (infections, nutrition, health, SES, family violence), and risky adult behavior (smoking, little exercise, no prevention, poor nutrition). We find that displacement during childhood is associated with higher risk of chronic conditions and stress; being displaced and having rheumatic fever during childhood increases the risk of heart disease. Displacement in adulthood and early life infections increase the risk of poor adult health but timing of displacement may also provide resilience to the effects of poor early life conditions.

Introduction

Middle-income countries are of particular interest for older adult health because they are experiencing an increasing population of older adults along with an increasing prevalence of chronic diseases such as heart disease, diabetes, and associated risk factors such as obesity (He et al. 2016; World Health Organization 2016), in particular in urban areas (Ibrahim and Damasceno 2012). While lifestyle is an important determinant of older adult health in high-income countries (Kuh and Ben-Shlomo 2004), middle-income countries experienced different historical circumstances during the 20th century which point to other relevant factors in explaining older adult health.

The argument that early life conditions are particularly important for adult chronic conditions in middle-income countries is a compelling one. The demographic and epidemiological histories of the 20th century produced dramatically improved life expectancy at young ages but occurred mostly without parallel improvements in standards of living in middle-income countries. These circumstances produced unique cohorts born during the 1930s-1960s characterized by increased survivorship of poor early life conditions (poor nutrition, infectious diseases) but with continued exposure to adverse economic conditions, potentially increasing the risk of poor health at older ages (McEniry 2014; Palloni and Beltran-Sanchez 2016; Palloni and Souza 2013). A large portion of older adults in middle income countries were born or grew up in rural areas in the early to mid-20th century with limited access to good nutrition and proper medical care but then experienced rapid urbanization (Flórez et al. In press; Flórez and Méndez 2000; López-Alonso 2007) along with rapid improvements and changes in nutrition away from the traditional diet as adults (FAO 1946, 2010). The rapid changes experienced by the unique cohorts in early life and childhood and then as adults set the

stage for potentially negative long-term consequences for their health as they age if theories regarding the importance of early life conditions have relevance for older adult health.

Inadequate nutrition *in utero* during critical periods can lead to poor intrauterine and post-birth growth, low birth weight and stunted babies, and an increased risk of heart disease, diabetes, and obesity at older ages (Barker 1998). We now know that poor nutrition in early life can affect epigenetic mechanisms that are important to development and growth; the resulting epigenetic modifications can increase survival but negatively affect health later. Predictive adaptive responses made *in utero* as a result of cues from a nutritionally resource scarce environment prepare the individual to survive in a similar environment by altering an individual's physiology but a mismatch occurs when exposed to a nutritionally richer environment later in life, leading to disease (Bateson and Gluckman 2011; Gluckman and Hanson 2005). The increasing exposure to non-traditional foods high in saturated fats experienced in middle-income countries (Popkin 2006; Schmidhuber and Shetty 2005) may compound early life effects for the unique cohorts of the 20th century by increasing the risk of a mismatch between early life physiological changes and later life environment, thereby increasing the risk of poor health at older ages.

Early life and childhood infections are also relevant considerations for older adult health. Infectious diseases (e.g. hepatitis, tuberculosis, rheumatic fever, other respiratory infections), diseases caused by infections (e.g. kidney disease) or persistent inflammation due to infections in early life or childhood can damage organs and increase risk of poor health at older ages (Crimmins and Finch 2006; Elo and Preston 1992). The synergy between nutrition and infection (Scrimshaw et al. 1968),

undoubtedly affects epigenetic processes important to child development, especially in very early life.

In addition to nutrition and infection, environmental factors that cause stress during early life and childhood such as exposure to violence or threats of violence can be detrimental to adult health. Exposure to violence has long-term effects on health in terms of physical and psychological problems and mortality (Guedes et al. 2016; Olofsson 2014; Wilson et al. 2004). Such early life stress can affect epigenetic processes related to development and growth, leading to adult chronic conditions, poor physical functioning, depression, cognitive impairment, and responses to stress in later life (Alastalo et al. 2013; Taylor 2010; Vaiserman 2015; Winning et al. 2015). The synergy between stress and nutrition (Vaiserman 2015) underscores the complexity of fully understanding how early life conditions affect older adult health in the unique cohorts of the 20th century. Early life stress due to violence is of particular interest in regards to characterizing some of the unique cohorts of the 1930s-1960s in middle-income countries because in some instances they experienced pervasive and widespread violence in early life and childhood.

Long-term consequences of displacement in the special cohort of the 1930s-1960s

An added component to understanding the health of older adults from the special cohorts of the 20th century is settings where there has been significant displacement of the population due to armed conflict and violence. Displacement is a traumatic event disrupting families, affecting physical and psychological health at all ages (Avogo and Agadjanian 2010; Internal Displacement Monitoring Centre 2015; Shultz et al. 2014b; Siriwardhana and Stewart 2013; Verwimp and Bavel 2005; Virgincar et al. 2016). Many

displaced individuals live in adverse economic circumstances (Internal Displacement Monitoring Centre 2015; United Nations High Commissioner for Refugees 2017).

Displacement alone could thus affect childhood health and have long-term consequences for older adult health. The increased risk of poor nutrition (Hart 2010; Loschmann 2016; Oyelere and Wharton 2013), higher risks of infections such as rheumatic fever (De Maio et al. 2016) can all have detrimental effects on childhood health. Displacement in early life and childhood can increase the risk of lower educational attainment in children (Loschmann 2016; Oyelere and Wharton 2013) with long run negative consequences for health. Stress due to displacement in childhood can also influence how people respond to stress later in life; early life stress may produce life-long stress. Given the already existing early life risk factors in the unique cohorts of the 20th century, displacement during early life or childhood could compound the effects of already existing poor early life conditions producing higher risk of disease, in particular chronic conditions and obesity.

Displacement during adulthood at critical periods could also be important for later health both by itself but also with existing early life risk factors. Being displaced during young adulthood may cause economic hardship and interrupt the building of family and livelihood. Being displaced at very old ages may place undue stress in an already more vulnerable population. However, stress during adulthood could alter epigenetic programming and interact with early life developmental programming to produce disease (Vaiserman 2015). Displacement during critical periods of adulthood could thus be a trigger event that combines with poor early life conditions to later affect health at older ages.

An important caveat to note is that while there are long-term negative consequences of displacement for adult health in some settings (Daoud et al. 2012), this is not true for all settings. Being displaced during childhood may not seriously affect adult health because of favorable circumstances later in life (Saarela and Elo 2016). The degree to which individuals perceive stress due to displacement in relation to their own positive beliefs may impact its influence on health; displaced families may also be able to offer the type of social support that mitigates the negative consequences of adversity on health that displaced individuals may not have (Taylor 2010). Paradoxically, even though older adults may be more vulnerable in terms of health, older adults may also show a high degree of resilience to stressful events (MacLeod et al. 2016) and this may affect how they react to the stress of displacement experienced at older ages. Older adults who have well-established and strong social connections developed throughout a lifetime may be at an advantage when facing adversity such as displacement later in life.

Adverse early life conditions may facilitate resilience in the face of adversity later in life because of matched early life and adult adverse environments (Santarelli et al. 2017). Thus, for some older adults poor early life conditions may have protective effects on their health. As a result, even though they are displaced during adulthood, the combination of the protective effects of early life with strong social connections may result in less negative consequences on their health.

Our Study

To-date there has been little research in middle-income countries regarding the long-term consequences of displacement due to armed conflict and violence during childhood on older adult health. The middle-income country of Colombia is an

interesting case study. In regards to rapid demographic and nutritional transitions, Colombia is similar to many other middle income countries in the Latin American and Caribbean (LAC) region. Colombia experienced rapid mortality decline starting at the end of the 1930s through the 1980s as a result of reduced infant mortality and access to medical technology; improvements in standard of living were not as rapid (Flórez et al. In press; Flórez and Méndez 2000) (Figure 1). Large migrations to urban areas since the 1950s-1960s transformed Colombia from a predominantly rural to an urban country; urban areas, for the most part, benefited from modernization, urbanization, and education but also exposed individuals to less traditional diets (Popkin 2006). These historical circumstances produced cohorts of older adults (60 years and older) who were born mostly in less populated areas with low levels of caloric intake (Food and Agriculture Organization of the United Nations 1946; United Nations Statistical Office & the Department of Economic and Social Affairs 1958) and who then experienced rapid changes in caloric intake in later years (FAO 2010). They are characterized by increased survivorship of poor early life conditions, and are now living in more urban areas with higher caloric intake and increased exposure to non-traditional food.

[Insert Figure 1 about here]

Yet, what makes Colombia unique is the very large displacement of its population over the last 50-60 years due to armed conflict and violence—one of the largest displacements in the entire Latin American region (Internal Displacement Monitoring Centre 2015; United Nations High Commissioner for Refugees 2017). Displacement due to armed conflict and violence in Colombia can be roughly characterized in terms of two broad periods which affected different segments of the population (Sánchez et al. 2003; Shultz et al. 2014a). The first period began in the late 1940s and lasted until the early

1960s—a period when most of the Colombian population lived in rural or smaller urban areas and where political violence affected much of the Colombian population although mortality was highest for local farmers (*campesinos*) in rural areas. By the 1960s, Colombia experienced rapid urbanization (partly due to the violence of the 1950s) and small guerrilla groups began to form in scattered regions of the country.

The second major period of conflict and violence roughly began in the mid-1970s with a modest increase in membership in guerilla groups; the 1980s showed a notable increase in membership in guerilla groups, drug cartels, and illegal paramilitary groups. Guerilla groups increasingly became financed by criminal drug activities, extortion, and kidnapping. The conflict and violence happened mostly in urban areas and much higher homicide rates appeared during the second period especially during the 1990s—suggesting a greater intensity of conflict and violence (Figure 2). During the second period of conflict and violence those directly affected by it tended to be the less educated and poor. Most displaced do not return to their communities. Regardless of period, the social and political situation resulting from armed conflict in Colombia during the last decades of the 20th century had profound effects on population aging; the population as a whole was exposed to an environment of conflict and violence; many personally experienced its consequences in their own communities and some were displaced from their homes (Cano In press; Gomez et al. 2009). The question remains as to the degree to which the overall exposure to conflict and violence in Colombia equalizes its effects reducing differences in age at displacement while maintaining the effects on health due to a population largely characterized by poor early life conditions given that Colombian society has lived with so much conflict and violence for so long.

[Insert Figure 2 about here]

In our study, we examine the degree to which displacement from armed conflict and violence is associated with older adult health across multiple aspects of health in Colombia within the context of a population already at risk due to poor early life conditions (the birth cohort of the 1930s-1960s), that experienced rapid demographic and nutritional transitions affecting health at older ages. In particular, we examine:

- (1) Effects of early life conditions on adult health regardless of displacement
- (2) Displacement in childhood and interaction with other poor early life conditions
- (3) Displacement during adulthood and its interaction with early life conditions
- (4) Possibilities of resilience at older ages in spite of poor early life conditions

We expect to find that poor early life conditions are important determinants of older adult health in Colombia regardless of displacement; displacement at younger ages is important in terms of chronic conditions and obesity later in life but also for other aspects of health. Furthermore, we expect to observe that timing of displacement during adulthood combined with poor early life conditions matters in terms of health. Finally, we suspect that resilience may mitigate the effects of poor early life conditions on older adult health for some older adults displaced during adulthood.

Methods

Data

The data come from the recent **SABE-Colombia** study, which is a nationally representative sample of 23,694 older adults 60 years and older living in Colombia in 2014-2015. The study was modelled after the original SABE surveys administered in 2000 in seven major cities of the Latin American and Caribbean region, but included additional information on health that were collected on subsamples for biomarkers and physical performance measures. The overall response rate was 66% (66% for urban

areas and 75-77% for rural areas) (Ministerio de Salud y Protección Social et al. 2016).

The response rates for the biomarker subsample was 79% for diabetes, 84% for hypertension and 41% for grip strength.

Measures

Overall health. We define poor self-reported health (SRH) as reporting fair or poor health. Frailty is measured through a physical performance test: (1) the highest quartile of minutes using a timed walk, and (2) less than or equal to 20 Kg for grip strength.

Difficulty with functionality is measured using the ADLS (at least one difficulty).

Cognitive impairment was defined using the immediate word recall questions from the mini-mental. We defined depression using the Yesavage depression scale (GE 10 defined major depression). Respondents were asked if they had had a serious illness or stressful/distressful situation and we used this question to reflect recent adult stress.

Chronic conditions and obesity. We identified hypertension (HTN) using systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHG, or taking medication for HTN; diabetes (fasting glucose ≥ 126 mg/dL) or taking medication for diabetes; other chronic conditions (heart disease, respiratory disease, cancer, arthritis, stroke) using self-reported information; waist circumference for obesity (greater than 88 cm for females, greater than 102 cm for males) and body mass index (BMI) for obesity (BMI greater than or equal to 30). We also defined a dichotomous variable for at least one chronic condition (diabetes, respiratory, heart, cancer, stroke, arthritis).

Early life conditions included displacement according to age at displacement (1-17, 18-39, 40-59 and 60+), first quartile of knee height, and dichotomized responses to questions (yes/no) regarding the following before the age of 15: poor early SES (regular

or poor), poor child health (regular or poor), at least one reported childhood infection (kidney disease, hepatitis, TB, rheumatic fever, asthma, bronchitis), rheumatic fever, respiratory disease, and family violence (Were you present or did you witness physical violence among close relatives, for example between your parents or between your parents and siblings?).

Adult risk factors included dichotomous variables for current smoking, no rigorous exercise, no preventive health activities in the last two years (for females, pap or mammogram exam; for males, prostate exam), poor nutrition (less than two daily servings of fruits or vegetables and mid upper arm circumference of less than 31 cm).

Controlling variables included age, gender, education (incomplete primary, incomplete secondary, secondary complete, and above), wealth (distribution of 17 assets—bottom 20%, top 26%, and everyone else in middle category), strata (defined by electric company with 1=lowest SES and 5-6 the highest SES), current residence (four large metro cities, other urban, rural). Proxies (about 20%) did not answer questions about early life conditions (hunger, child SES and health, violence, infections), overall self reported health, depression, consumption of fruits and vegetables. Missing values for these variables were all under 5% with the exception of poor early SES (16%). Other variables with missing values greater than 5% included obesity measured by BMI (13%), obesity as measured by waist circumference (9%), trouble walking (8%), stress/serious illness (17%). From the subsamples, missing values were grip strength (6%), diabetes based on biomarkers (23%), and measured hypertension (16%).

Analyses

We first show differences among demographic factors and health across displacement groups (never displaced, displaced in childhood, young adulthood, mid-

adulthood, and older adulthood). We then estimate logistic regression models for each health outcome, adult risk factor, and early child condition using age at displacement relative to never displaced and controlling for age, gender, education, wealth, and current residence. Selecting those aspects of health where we observe differences between displacement groups, we then estimate fully adjusted models for selected health outcomes in addition controlling for adult risk factors and early life conditions. Because those displaced at age 18-49 were exposed to two different cycles of violence, we also estimate models where we distinguished these respondents by cycle of violence. We calculate predicted probabilities for selected health outcomes in relation to age at displacement by gender for typical (average) respondent (age group 70-74, incomplete primary school, and current residence urban but not large cities). We estimate models with interactions for displacement and early life and also calculate predicted probabilities for the average respondent. Models including early life conditions as predictors of health exclude respondents with proxies. We do not include a control for cycle of violence in our models because cycle of violence was so closely correlated with age at displacement.

Results

Displacement

About 15% of the sampled population of older adults were displaced at least once during their lifetimes and, of those displaced, about 20% were displaced during childhood (Table 1). Most of those displaced were displaced after the late 1970s and, on average, adults were displaced once in their lifetimes with 75% of those displaced with their families. Those displaced in childhood were all displaced prior to the mid 1970s and those displaced at older ages were displaced after the late 1970s. Those displaced in

young adulthood were displaced in both periods. The distribution of age at displacement suggests two distinct periods of displacement—prior to and after the mid 1970s (Figure 3). The distribution of age at displacement aligns closely with historical descriptions of the armed conflict and violence in Colombia. In particular, the peaks during both periods at age at displacement roughly coincides with the highest peak of homicide rates (Sánchez et al. 2003).

[Insert Table 1 and Figure 3 about here]

Sample characteristics

The selected sample shows large differences between groups by age at displacement, although those never displaced and those displaced in childhood are more similar than respondents displaced at older ages (Table 2). More males were displaced during adulthood (44-49%); those displaced (especially at older ages) have not completed primary school than those never displaced (60-78% versus 50%); less assets in those displaced at older ages (25-34% in lowest SES group versus 14% in never displaced group); current residence where a higher percent of those displaced in childhood live in large metropolitan areas (49%) whereas those displaced at older ages (18%) as compared with never displaced (38%). Fifty-nine (59) percent of those displaced in childhood were born in the 1930-1945 period as compared with never displaced (41%) and others displaced at young-mid adulthood (27-28%) and at 60+ (49%).

[Insert Table 2 about here]

Prevalence of health outcomes and risk factors

Group differences also appear in health outcomes, adult risk factors, and early life conditions (Table 3). Those displaced in childhood show similar patterns of health for

those never displaced with the exception of weak grip (37% displaced versus 49% never displaced), stress/serious illness (33% displaced versus 27%), chronic conditions (at least one chronic condition: 67% displaced, 54% never displaced; arthritis: 38% displaced, 27% never displaced; cancer: 8% displaced, 5% never displaced; diabetes: 37% displaced, 16% never displaced; hypertension: 70% displaced, 66% never displaced), family violence (38% displaced, 27% never displaced), obesity (52% displaced, 46% never displaced), no prevention (47% displaced, 42% never displaced), less than required fruits/vegetables (36% displaced, 30% never displaced). Those displaced during childhood are similar to those displaced in young adulthood in some chronic conditions. However, other ages of displacement are similar to those displaced in childhood in certain characteristics such as grip strength, stress, and childhood conditions, but different in terms of adult risk factors like exercise, prevention, and nutrition. A higher percent of respondents displaced at older ages report poor health (12-13%) compared to never displaced (7%).

[Insert Table 3 about here]

Logistic models

Models show that stress and chronic conditions are more likely for those displaced at younger ages as compared with those never displaced; there is an increased likelihood of reporting poor SRH across all displacement groups (Table 4). Poor early life conditions are more likely in those displaced at younger ages while adult risk factors are more likely for those displaced at older ages. Adult risk factors are more likely in those displaced at older ages. In fully adjusted models for selected health outcomes, the same patterns continue (Table 5). Those displaced during childhood have an increased likelihood of reporting at least one chronic condition and stress. Across all displacement groups

there is an increased likelihood of reporting poor SRH although it is highest among those displaced as young adults; those displaced as young adults also have an increased likelihood of heart disease and stress. Both poor early life and adult risk factors are important across these aspects of health. Estimated models separating out the 18-39 age group according to period of violence produced no large differences and are not reported here.

Predicted probabilities for selected health conditions (Appendix, Figures 4-6) from models in Table 5 confirm the general impression that the health of this population of older adults is strongly influenced by early life conditions. Across all groups the predicted probability of poor SRH, stress, heart disease, and chronic conditions greatly increases when adding poor early life conditions (#2, Table A1) (it more than doubles the probability for SRH, stress, and heart disease and about 50% more for those reporting at least one chronic condition); these increases are greater in magnitude than when we add adult risk factors (#4, Table A1) except for poor SRH where the probability doubles when we add adult risk factors.

The predicted probabilities also suggest strong magnitude of effects for poor SRH between never displaced and displaced regardless of age at displacement; those displaced as young adults have the highest predicted probability of reporting poor SRH (from #4 in Table A1, a 49-53% increase in probability compared with those never displaced for the average respondent). Those displaced during childhood and as young adults have the highest probabilities of stress (from #4 in Table A1, a 14-27% increase for stress compared with those never displaced; about a 16-21% increase for heart disease compared with those never displaced). Although those displaced during childhood showed the highest probabilities of reporting at least one chronic condition,

the magnitude of differences are small when compared with those never displaced (from #4 in Table A1, about a 1-4% increase in probability compared with those never displaced).

Interaction models based on models shown in Table 5 are displayed in Table 6 and show instances where there were significant interactions between early life conditions, age at displacement, and health. The effects of early life infections and displacement are the strongest and most consistent across adult health, although the timing of those effects appears differently according to age of displacement: displacement during childhood for adult heart disease; displacement in young adulthood for adult stress; displacement in mid-life for poor SRH; and displacement in late life for adult chronic conditions. Curiously, experiencing hunger and poor health in childhood have protective effects on adult health, especially for those displaced during mid-life.

Predicted probabilities for interactions between displacement and exposure to early life infections show that exposure increases the probability of poor health across all groups for the average respondent but that the probability of poor health is generally higher for those displaced and exposed than for those never displaced and exposed/never exposed; there are particularly strong differences between age of displacement and exposure for heart disease and stress in that being displaced at younger ages greatly increases the predicted probability for these aspects of health (Table A2). A comparison between those never displaced/exposed to early life infection versus those displaced/exposed shows that the predicted probability increases from: (1) 14 to 45 (2.2 times increase) for heart disease for those displaced during childhood; (2) 26 to 48 (an 85% increase) for stress for those displaced as young adults; (3) 8 to 15 (an

88% increase) for poor SRH for those displaced during mid-adult life; (4) 60 to 74 (a 23% increase) for at least one chronic condition for those displaced during old age.

[Insert Tables 4-6, Figures 4-6 about here]

Discussion

Our study examined the effects of age at displacement due to armed conflict and violence across a wide spectrum of health dimensions in a population of 60+ years old in the middle-income country of Colombia that experienced rapid demographic and nutritional changes in the 20th century. We found strong associations between (1) poor early life conditions and adult health regardless of age at displacement; (2) those displaced at younger ages and adult stress, chronic conditions, and poor SRH but, notably between displacement and rheumatic fever during childhood and adult heart disease; (3) age at displacement during adulthood and poor SRH, heart disease, stroke and stress; but notably in interactions between early life infections and displacement: in young adulthood for adult stress; in mid-life for poor SRH; and in late life for adult chronic conditions; (4) being displaced during mid-life and some aspects of poor early life conditions which were protective suggesting resilience to adverse early life conditions in the face of adult stress.

The particular nature of the Colombian birth cohorts of the 20th century is a relevant framework to explain the impact of displacement due to armed conflict and violence on health. We highlight four main aspects of our results. **First**, our results show the importance of poor early life conditions across all groups, particularly for poor SRH, chronic conditions, and stress. The importance of poor early life conditions by itself in relation to health for this population of older adults is not surprising given that they were mostly born during a period of rapid demographic and epidemiological changes in

Colombia which produced rapid improvements in mortality at younger ages but were not accompanied by parallel improvements in standard of living, thus continuing exposure to poor early life conditions. These cohorts, characterized by increasing survivorship of poor early life conditions, then experienced dramatic improvement in nutritional environment as adults. These circumstances increase the likelihood of mismatches between their poor early life and later life nutritional environment—mismatches leading to potentially higher risk of adult diseases such as chronic conditions (Bateson and Gluckman 2011; Gluckman and Hanson 2005).

Second, that those displaced during childhood are most likely to report at least one chronic condition, even after controlling for other early life and adult risk factors, suggests in particular the relevance of displacement in childhood as a relevant early life determinant of older adult health. Displacement in childhood leading to economic instability and difficult access to quality health care are known to affect child health (Hart 2010; Loschmann 2016; Oyelere and Wharton 2013) and poor child health can have negative consequences for older adult health. The synergistic relationship between infections and nutrition (Scrimshaw et al. 1968) suggests the importance of poor early life nutrition and raises the risk of disease at older ages as a result of epigenetic changes in key aspects of development and growth (Bateson and Gluckman 2011; Gluckman and Hanson 2005). The strong interaction between displacement during childhood and rheumatic fever in predicting adult heart disease further strengthens the relevance of displacement. Rheumatic fever in childhood increases the risk of adult heart disease and displaced children are at increased risk of rheumatic fever due to poverty and lack of health care (De Maio et al. 2016). Displacement during childhood could also reflect early life stress which has been shown to have long-term consequences (Alastalo et al.

2013; Taylor 2010; Vaiserman 2015; Winning et al. 2015). Poor nutrition/infection in early life and the stress of displacement in childhood could result in stress later in life.

A **third aspect** is that displacement during certain periods of adulthood can influence health at older ages differently. Our results show that timing of displacement during adulthood in combination with poor early life conditions in a population already susceptible to the effects of poor early life conditions clearly has differing effects on health. Stress during adulthood can interact with poor early life conditions to produce disease (Vaiserman 2015). Displacement during critical/sensitive periods during adulthood may be a trigger event that exacerbates the long-term effects of childhood poor nutrition and infection leading to disease later in life. Stress caused by displacement may be more difficult at younger than older ages. Young adults are vulnerable because they are starting out in life and may not yet have the coping mechanisms by which to handle stressful events. Older adults may be more vulnerable because they are experiencing major transitions such as a decline in their health or children leaving the household. Those in mid-life may be less impacted by displacement because they are more established in their communities. That we find early life or childhood infections in conjunction with timing of displacement to be consistently associated with different aspects of older adult health suggests the complexity of different pathways affecting health.

A **fourth** aspect to understanding our results is the possibility of resilience in relation to the negative consequences of adverse childhood conditions during adulthood stressful events. The particular nature of the violence in the 1950s which affected all levels of the Colombia population could mitigate the negative effects of displacement at the population level but we found little evidence of this. However, although the

intensity of the armed conflict and violence was higher during the second period (1980s-present) as measured by homicide rates (Sánchez et al. 2003), it is worthwhile to point out that, across most chronic conditions, those displaced at older ages were no different from those never displaced, leading us to believe those displaced at older ages may be more resilient than those displaced at younger ages even though the intensity of the violence was greater during the period when they experienced displacement.

It may be that those who experience adversity in early life are better prepared to face adversity later in life (Santarelli et al. 2017), especially if one has supportive social connections (Taylor 2010). In that regards, a high percentage of those displaced in Colombia were displaced as a family. Being displaced at mid-age may provide protective effects against the negative impact of poor early life conditions not only because early life adversity produces resilience but also because people in mid-life are more likely to have have established lives and grown children with established coping mechanisms to deal with stress thus making them less vulnerable and more resilient. Nevertheless, morbidity may not tell the complete story as those displaced at older ages also show higher likelihood of adult risk factors (smoking, poor diet, no prevention) and ultimately there will be health consequences for those displaced at older ages—whether it be on life expectancy or health life expectancy.

There are other aspects of our results that are important to mention. That we observe strong differences between those displaced and not displaced for chronic conditions but mixed results for obesity (an important risk factor for chronic conditions) and low knee height is puzzling. The obesity results could be partially explained by the uneven nature of the nutritional transition in Colombia that is affecting urban areas more than rural areas and resulting on average in fewer differences between groups.

Average knee height reflects that this group of older adults for the most part experienced poor nutritional environments with little improvement in nutrition. However, low knee height and infections in childhood are related (results available upon request) and so it may be the case that our measurement of low knee height does not adequately capture differences between groups as does infections.

The study has limitations. First, we defined childhood from ages 1-17 because of small sample sizes making it difficult to separate out different age groups. There are sensitive periods in early life and childhood which are more vulnerable to the effects of being displaced (Hart 2010; Wald 2014) but we cannot examine these. Second, while the psychological aspect of displacement is important, we do not have enough information from the survey that we could use to reflect this aspect such as functioning of family and relationships, community involvement, or multidimensional measures of mental health. Because a high percentage of older Colombian adults were displaced with their families, this may be an important consideration. Third, we do not have information regarding birthplace which may have helped better understand exposure to armed conflict and violence. Fourth, differences in the nature of displacement across times (1950s-present) mean different exposures and perhaps different impacts on health—however, we do not have data to distinguish the severity of violence. The data do not allow us to separate out people with varying degrees of exposure to conflict and violence. The Colombian population as a whole has experienced violence for the last 50-60 years; it is hard to find a group of older adults who have not—some have been more directly exposed to it than others. Thus, never displaced does not mean never exposed to armed conflict and violence. Furthermore, the general level of exposure to armed conflict and violence in Colombian society could play a role in equalizing the effects of

displacement but we are not able to ascertain the degree to which this is true from available data. Fifth, it is hard to fully capture the complexity and impact of displacement because of the changing nature of the violence and importance of regional differences and time differences. Sixth, measurement issues could be problematic. Cognitive impairment is based on three immediate recall words. Wording of the displacement question (“armed conflict and violence”) and the stress variables (sharp illness or stress/anxiety) may produce ambiguity resulting in different interpretations. Finally, the data we use is cross-sectional; stronger conclusions are possible with longitudinal data.

In spite of these limitations, our study has produced one of the few studies available regarding the long-term consequences of displacement during childhood and older adult health in the Latin American and Caribbean region and in a country which has experienced a long history of displacement of its population. We know of no other study which has examined the consequences for older adult health according to age at displacement throughout the life course in conjunction with poor early life conditions. Our study suggests that both are important considerations for older adult health in a population of older adults that experienced rapid demographic and nutritional transitions in the 20th century. We conclude that poor early life conditions and age of displacement show strong associations with older adult health; timing of displacement and poor early life conditions have differing effects on health.

Appendix

Table A1. Predicted probabilities according to displacement

Health/age at displacement	#1	#2	#3	#4
	Low risk Females, Males	+ Early life Females, Males	+ Obesity Females, Males	+ Other risks Females, Males
Poor SRH				
Never	4.6, 3.9	11.5, 9.7	14.4, 12.2	28.6, 24.9
1-17	7.3, 6.1	17.3, 14.7	21.3, 18.3	39.2, 34.7
18-39	8.3, 7.0	19.5, 16.7	23.8, 20.5	42.7, 38.1
40-59	6.8, 5.7	16.3, 13.9	20.1, 17.3	37.5, 33.2
60+	7.2, 6.0	17.2, 14.7	21.2, 18.2	39.1, 34.6
At least 1 chronic condition				
Never	49.0, 39.6	76.9, 68.6	83.7, 77.1	81.4, 74.1
1-17	55.6, 45.0	81.3, 74.0	87.0, 81.4	85.0, 78.8
18-39	53.0, 42.4	79.6, 71.9	85.8, 79.8	83.6, 77.0
40-59	46.7, 36.5	75.2, 66.5	82.4, 75.4	79.9, 72.3
60+	51.1, 40.6	78.4, 70.3	84.8, 78.6	82.6, 75.7
Heart disease				
Never	11.1, 12.3	25.2, 27.5	32.3, 35.0	29.4, 31.9
1-17	13.4, 14.8	29.5, 32.0	37.2, 40.0	34.1, 36.8
18-39	14.2, 15.7	30.9, 33.5	38.9, 41.7	35.6, 38.4
40-59	10.9, 12.1	24.9, 27.1	31.9, 34.6	29.0, 31.5
60+	11.9, 13.2	26.8, 29.2	34.2, 36.9	31.1, 33.7
Stress/serious illness				
Never	19.0, 11.6	50.6, 36.4	51.8, 37.6	59.3, 45.0
1-17	27.6, 17.6	62.5, 48.3	63.6, 49.5	70.4, 57.1
18-39	24.9, 15.7	59.1, 44.8	60.4, 46.0	67.4, 53.6
40-59	21.3, 13.2	54.2, 39.9	55.5, 41.1	62.8, 48.6
60+	20.8, 12.9	53.5, 39.2	54.7, 40.4	62.1, 47.9

Notes: The first number in each column is for females, second number for males. Probabilities calculated using models from Table 5.

Table A2: Predicted probabilities for interactions models between displacement and exposure to early life infections

Displacement/ exposure	Poor SRH	Chronic conditions	Heart disease	Stress
Never displaced				
Never exposed	6	47	12	21
Exposed	8	60	14	26
Displaced				
1-17, never exposed	9	53	13	32
1-17, exposed	11	69	45	26
18-39, never exposed	10	50	15	24
18-39, exposed	16	67	11	48
40-59, never exposed	8	45	11	22
40-59, exposed	15	57	14	32
60+, never exposed	9	46	12	22
60+, exposed	11	74	24	30

Source: Predicted probabilities calculated from models shown in Table 6.

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Table 1: Displacement of older adults

Displaced anytime during life (%)	15
Age of first displacement (%)	
Childhood (LE 17)	20
Young adults (18-39)	19
Middle aged (40-59)	45
Older adults (60+)	16
Average (median) years since first displacement	29 (22)
Period of first displacement ^a	
Before 1976	29
After 1976	71
Average # of displacements	1.26
Last displacement (%)	
Individual	18
Family	75
Community	7

Sources: SABE-Colombia, n=23,689 and 4413 displaced. Weighted averages appear in table.

Notes:

^a Age of displacement and period of displacement:

- 100% of displacement at ages 1-17 occurred before 1976
- 43%/57% of displacement at ages 18-39 occurred before/after 1976
- 1%/99% of displacement at ages 40-59 occurred before/after 1976
- 100% of displacement at ages 60+ occurred after 1976

Table 2: Sample characteristics (total and by displacement)

	Never displaced and age at displacement						p-value
	Total	Never	1-17	18-39	40-59	60+	
Age (avg, sd)	70 (8)	70 (8)	71 (6)	68 (8)	66 (6)	76 (7)	0.000
Age group							
60-64	32	32	19	50	48	6	0.000
65-69	25	25	29	23	27	12	
70-74	17	17	25	9	16	26	
75-79	13	13	19	9	7	26	
80+	13	13	9	9	3	30	
Female (%)	55	55	56	44	49	47	0.000
Education (%)							
0-4	53	50	60	70	70	78	0.000
5-10	30	32	25	24	22	17	
11+	17	19	15	6	8	5	
Wealth assets (%)							
Low	15	14	15	17	25	34	0.000
Middle	46	45	46	42	59	53	
High	38	41	39	41	16	13	
Strata (%)							
One (Low)	28	26	26	35	55	47	0.000
Two	40	41	36	34	31	41	
Three	25	27	33	16	11	11	
Four	5	5	4	11	2	1	
Five and six (High)	2	2	2	4	1	0	
Residence (%)							
Large metro	37	38	49	41	18	18	0.000
Other urban	41	41	38	41	46	49	
Rural	22	21	12	18	36	33	
Birth cohort							
Before 1930	5	6	2	4	1	11	0.000
1930-1945	41	41	59	28	27	73	
After 1945	54	54	40	68	72	16	

Notes: Weighted averages, showing significant differences. Differences in age uses multivariate test of means; all other variables use chi square.

Table 3: Health and lifestyle

	ALL	Never displaced and age at displacement					p-value
		Never	1-17	18-39	40-59	60+	
Overall health (%)							
Poor health	7	7	7	12	13	12	0.000
At least 1 ADL	6	7	4	4	2	9	0.000
Weak grip	50	51	48	39	36	56	0.000
Trouble walking	23	23	22	18	20	36	0.000
Depression	6	6	4	13	5	5	0.508
Cognitive impairmnt	3	3	4	1	1	2	0.000
Stress/serious illness	28	27	33	36	31	23	0.000
Chronic conditions							
At least 1 chronic	54	54	67	71	47	55	0.000
Arthritis	27	27	38	24	20	27	0.000
Cancer	5	5	8	3	3	5	0.024
Diabetes (bio)	18	16	37	33	24	5	0.085
Heart disease	15	14	14	21	13	15	0.000
Hypertension	65	66	70	40	66	72	0.200
Respiratory	11	12	13	11	7	14	0.000
Stroke	5	5	7	4	5	8	0.000
Early life risks (%)							
Child infections	16	15	12	13	19	20	0.000
Rheumatic fever	3	3	3	4	5	8	0.000
Respiratory	9	9	9	9	9	9	0.107
Poor child SES	54	54	56	61	50	49	0.002
Poor child health	10	10	12	9	11	9	0.025
Family violence	18	18	27	25	20	12	0.000
Hunger	28	27	38	38	32	31	0.000
Short knee height	28	29	28	29	22	24	0.000
Adult risks (%)							
Little exercise	78	77	80	77	85	86	0.000
Obese (waist)	46	46	52	47	45	35	0.000
Obesity (BMI)	24	23	33	22	23	17	0.000
No prevention	43	42	47	47	50	60	0.000
Poor nutrition							
MUAC	14	14	14	10	11	26	0.000
LT req fr/veg	31	30	36	40	36	45	0.000
Smoker	11	11	15	7	18	15	0.000

Notes: Weighted averages, showing significant differences.

Table 4: Likelihood of health outcomes and lifestyle according to age at displacement

Outcome	Period displaced	Prior to 1976	Mixed	After 1976
		Age at displacement		
	1-17	18-39	40-59	60+
Overall health				
Poor SRH	1.46**	1.85***	1.49***	1.62***
At least 1 ADL	1.10	0.99	0.68**	0.82
Weak grip	0.87	1.06	0.77	0.82
Trouble walking	0.95	1.02	1.01	1.00
Depression	0.94	0.94	0.84	0.88
Cognitive impairmnt	1.03	0.79	0.70	0.58**
Stress/serious illness	1.58***	1.45***	1.22***	1.20*
Chronic disease				
At least 1 chronic	1.36***	1.22*	0.94	0.99
Arthritis	1.24*	1.11	0.94	0.97
Cancer	1.22	0.85	0.88	1.19
Diabetes (bio)	1.50	1.27	1.26	0.73
Heart	1.34*	1.52***	1.02	1.03
Hypertension	1.12	0.83	1.10	0.79
Respiratory	1.38*	1.07	0.90	1.00
Stroke	1.18	1.00	1.14	1.41**
Early life risks				
Child infections	1.38**	1.37**	1.14	1.37**
Rheumatic fever	1.61*	1.94***	1.35*	1.47*
Respiratory	1.28	1.26	1.03	1.27
Poor child SES	1.30*	0.77**	0.84**	0.90
Poor child health	1.43**	1.13	1.04	0.97
Family violence	1.80***	1.27*	1.19**	1.20
Hunger	1.50***	1.31**	1.18**	1.26**
Short knee height	1.01	0.98	0.65***	0.78**
Adult risks				
No rig exercise	0.81	0.93	1.27***	1.08
Obesity (waist)	1.16	1.22*	1.11	0.83*
Obesity (BMI)	1.04	1.06	1.03	0.83
No prevention	0.94	1.13	1.19***	1.02*
Poor MUAC	0.92	0.92	0.95	1.08
LT req fr/veg	1.11	1.18	1.15**	1.23*
Smoker	0.98	0.86	1.31***	1.43***

Notes: Each row of health outcomes/risks indicates a separate logistic regression model. Shown are odds ratios; reference group is never displaced; models control for age, gender, current residence, wealth assets, and education. Models with childhood conditions exclude proxies. *p<0.05, **p<0.01, ***p<0.001

Table 5: Age at displacement and early life conditions predicting health

	Poor SRH	At least 1 chron	Respiratory disease	Heart disease	Stress/Illness	Stroke
Displacement						
Never	1.00	1.00	1.00	1.00	1.00	1.00
1-17	1.61**	1.30*	1.36	1.24	1.63***	1.35
18-39	1.86***	1.17	0.97	1.33*	1.42**	1.05
40-59	1.50***	0.91	0.88	0.98	1.16*	1.14
60+	1.60***	1.09	1.02	1.09	1.12	1.36
Early life risks						
Family violence	1.34***	1.34***	1.27**	1.36***	1.56***	1.59***
Infections	1.44***	1.75***			1.39***	1.06
Rheumatic				1.34*		
Respiratory			4.44***			
Poor SES	0.95	1.07	0.98	1.00	1.10*	0.79*
Poor health	1.16	1.18**	1.38***	1.28**	1.16*	1.38*
Hunger	1.25**	1.17***	1.14	1.16*	1.57***	1.25
Adult risks						
Obesity	1.29***	1.54***	1.20**	1.42***	1.05	1.09
No exercise	1.52***	1.09*	1.19*	1.03	1.20**	1.06
No prevention	0.80***	0.71***	0.91	0.81***	0.80***	0.85
LT req fr/veg	1.49***	1.13***	1.13	1.13*	1.20***	1.05
Smoker	1.05	0.68***	0.70**	0.74**	0.94	0.87

Notes: We estimated models based on those instances in Table 4 where there were notable significant differences between displacement groups and older adult health. The models in this table expand upon the models in Table 4 in that for each health outcome they not only control for age, gender, education, wealth assets, and current residence but also for early life and adult risks. Reference group for age at displacement is never displaced. Proxies did not answer questions regarding early life conditions and thus the models in the table exclude respondents with proxies.

Table 6. Odds ratios for interactions between early life infections, age at displacement and older adult health

Health/early life	Childhood	Young adult	Mid-adult	Older adult
Poor SRH				
Infections	0.94	1.34	1.58*	0.89
Hunger	0.36*	0.61	0.56**	1.30
Poor health	0.98	1.17	0.47*	1.04
At least one chronic condition				
Infections	1.17	1.22	0.98	2.00**
Violence	0.92	1.08	1.40*	0.88
Poor health	0.89	0.70	0.67*	0.99
Heart disease				
Rheumatic fever	4.79**	0.56	1.07	1.97
Stress				
Infections	0.55	2.20**	1.22	1.15
Hunger	0.88	1.23	0.73*	1.78*

Notes: Interaction models estimated from Table 5 models controlling for age, gender, education, current residence, wealth assets, obesity, childhood conditions, and adult risk factors. Each row is a different model; shown are models with significant interactions. Reference group is never displaced and no exposure to poor early life conditions.

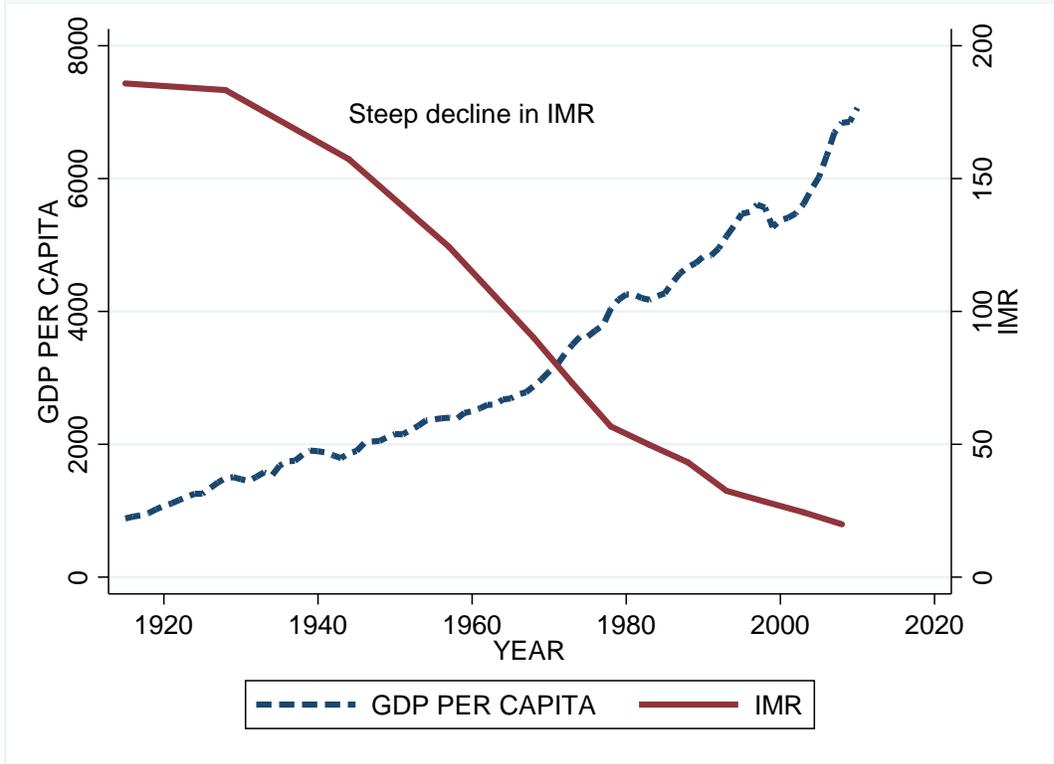


Figure 1: Rapid reductions in IMR in Colombia in the 20th century

Sources: (Flórez et al. In press; The Maddison Project 2013); in 1990 international Geary-Khamis dollars

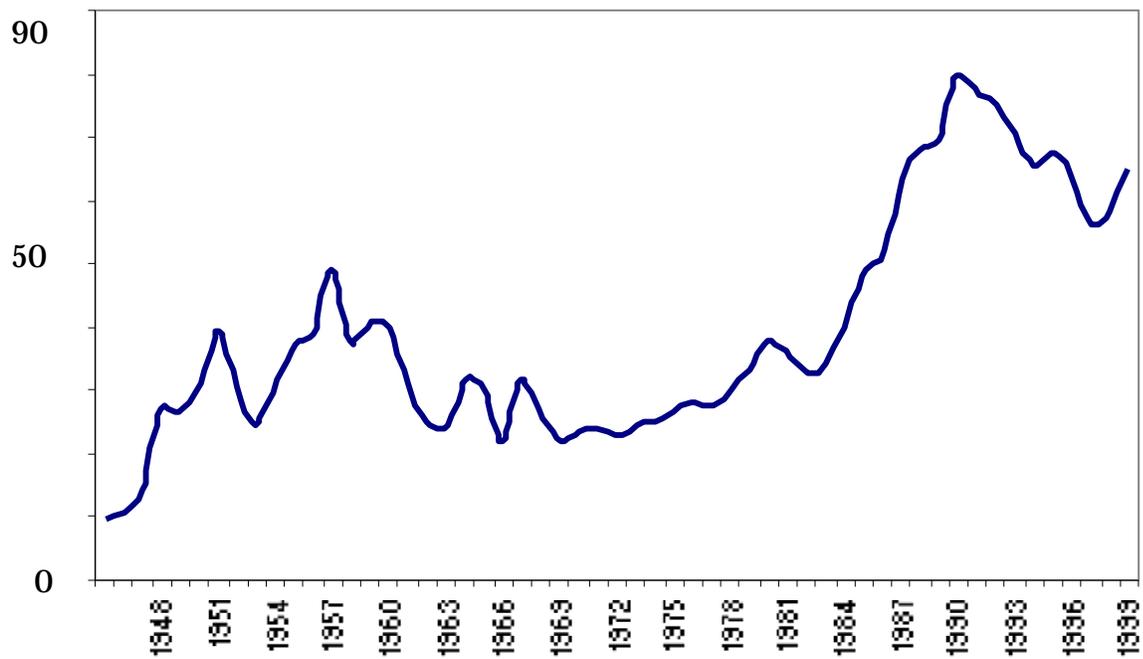


Figure 2: Homicide rates in Colombia (1946-1999)

Source: (Sánchez et al. 2003). Homicides per 100,000, page 15. About 81 at highest peak in 1992 and 50 in the 1950s.

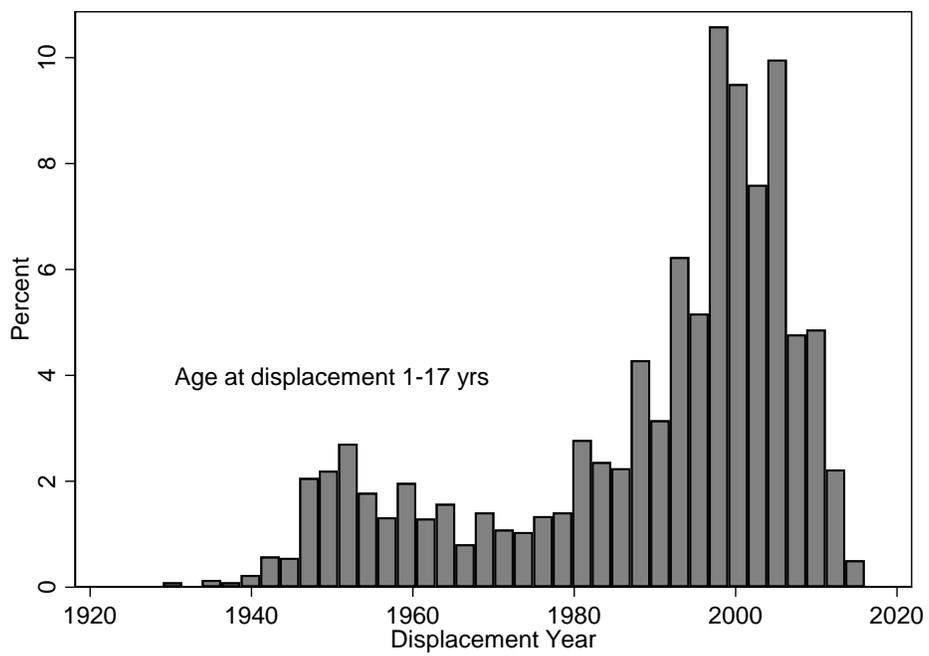


Figure 3: Displacement year reported by older adults

Source: SABE-Colombia for year of first displacement.

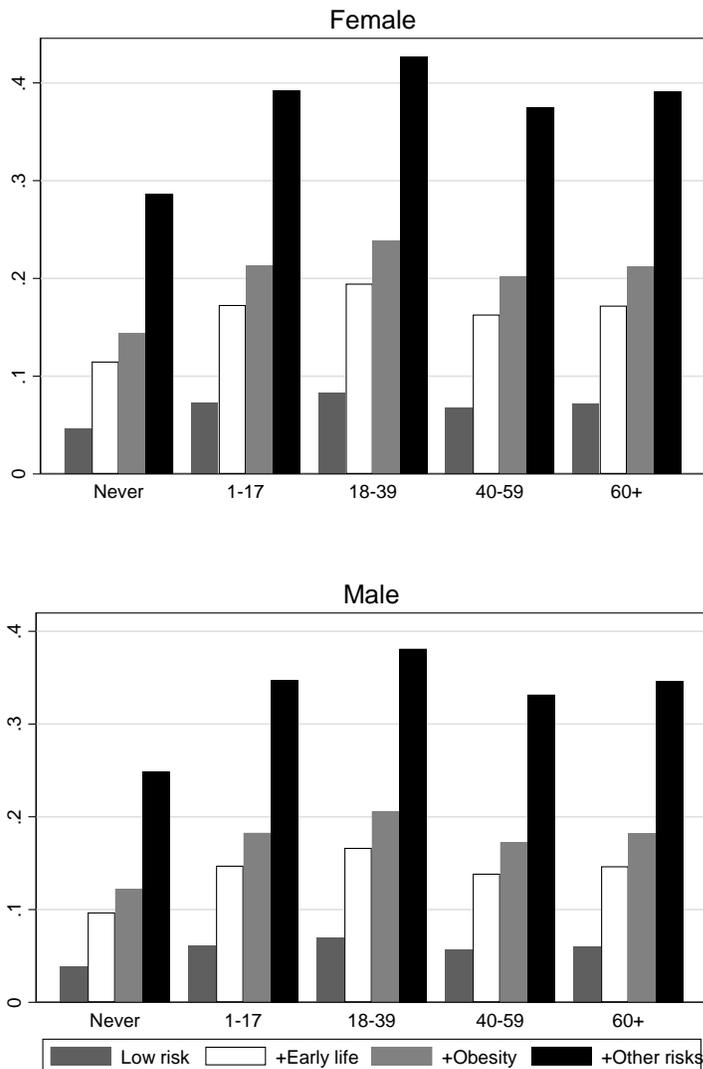


Figure 4: Predicted probabilities for poor SRH

Source: Model for stress shown in Table 5.

Notes: Predicted probabilities by gender for typical respondent (age group 70-74, incomplete primary school, and current residence urban but not large cities). See Appendix for table of predicted probabilities.

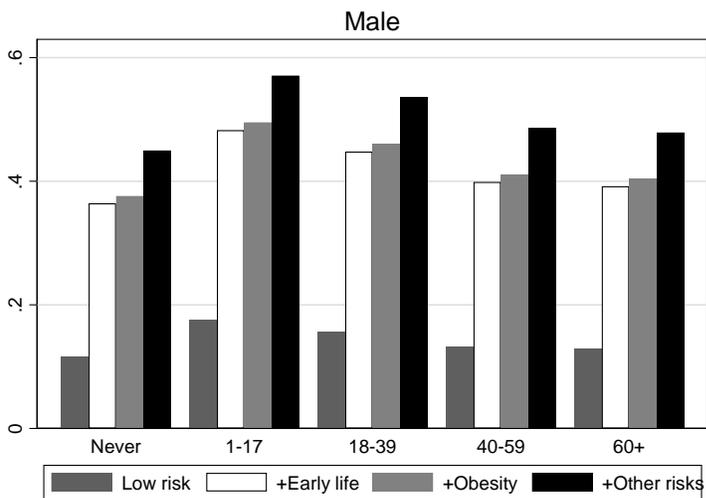
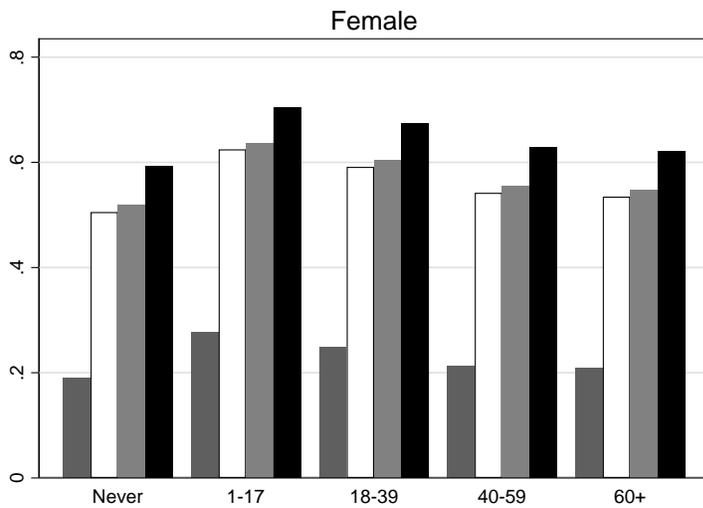


Figure 5: Predicted probabilities for stress/serious illness.

Source: Model for stress, serious illness shown in Table 5.

Notes: Predicted probabilities by gender for typical respondent (age group 70-74, incomplete primary school, and current residence urban but not large cities). See Appendix for table of predicted probabilities.

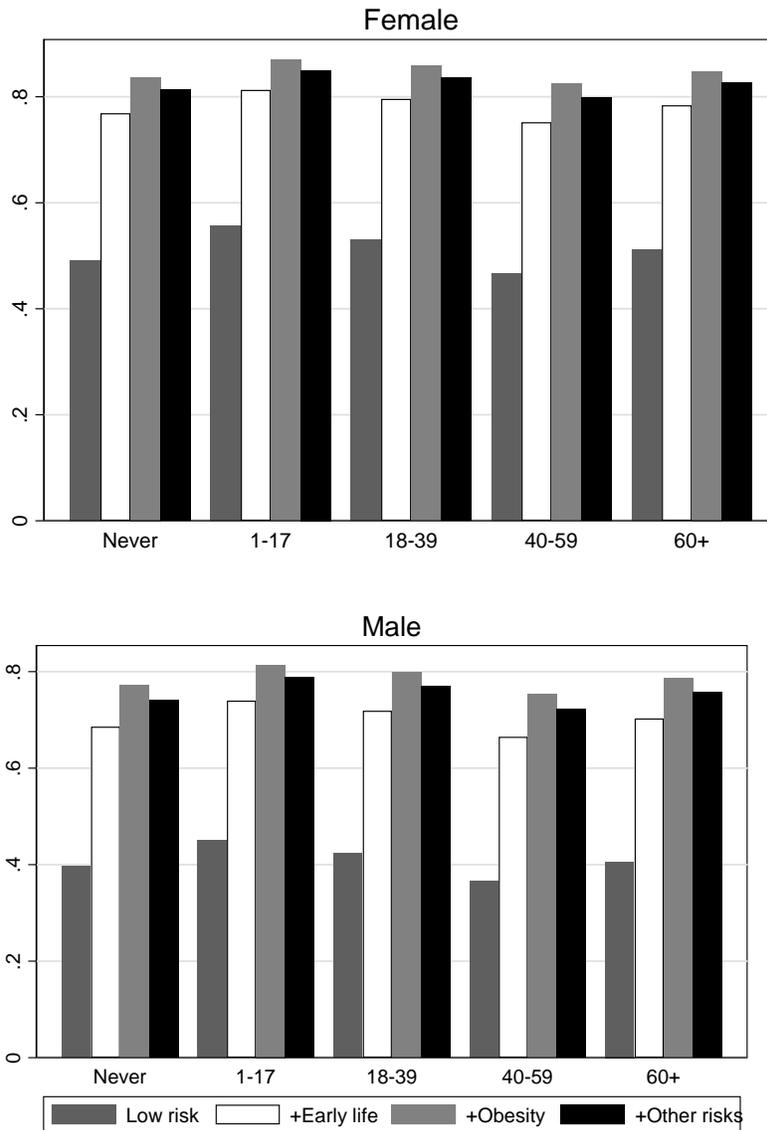


Figure 6: Predicted probabilities for at least one chronic condition.

Source: Model for at least one chronic condition shown in Table 5.

Notes: Predicted probabilities by gender for typical respondent (age group 70-74, incomplete primary school, and current residence urban but not large cities). See Appendix for table of predicted probabilities.

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