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SSM - Population Health

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Displacement due to armed conflict and violence in childhood and adulthood and its effects on older adult health: The case of the middle-income country of Colombia

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ABSTRACT

Large population displacement in developing economies due to internal armed conflict and violence is of international concern. There has been relatively little research on the long-term consequences of displacement on older adult health among populations characterized by rapid demographic, epidemiological, and nutritional transitions during the 20th century. We examine displacement in the middle-income country of Colombia, which experienced these rapid transitions and a large population displacement over the last 50-60 years due to internal armed conflict and violence. Using a nationally representative survey of adults 60 years and older, SABE-Colombia (2014-2015, n = 23,694), we estimate the degree to which displacement relative to those never displaced is associated with older adult health (self-reported health, major illness/stress, at least one chronic condition, heart disease), controlling for age, gender, SES (socioeconomic status), residence, early life conditions (infectious diseases, poor nutrition, health, SES, family violence), and adult behavior (smoking, exercise, nutrition). We found (1) strong associations between poor early life conditions and older adult health with little attenuation of effects after controlling for displacement, adult SES, and lifestyle; (2) strong associations between displacement and self-reported health; along with poor early life conditions, displacement increases the chances of poor health at older ages; (3) significant positive interaction effects between childhood infections and displacement during young adulthood for older adult stress/major illness, suggesting the importance of the timing of displacement; (4) significant interaction effects between childhood infections and being displaced during childhood, indicating lower levels of older adult stress/major illness and suggesting the possibility of resilience due to childhood adversity. We conclude that displacement compounds the effects of poor early life conditions and that timing of displacement can matter. The results raise the possibility of similar patterns in the health of aging populations in low-income countries that also experience displacement and rapid demographic and epidemiological transitions.

1. Introduction

Displacement due to armed conflict and violence in the developing world continues to be of international concern (Internal Displacement Monitoring Centre & Norwegian Refugee Council, 2018; United Nations High Commissioner for Refugees, 2017). Displacement is a traumatic event that disrupts families and affects physical and psychological health at all ages (Avogo & Agadjanian, 2010; Internal Displacement Monitoring Centre & Norwegian Refugee Council, 2018; Shultz et al., 2014b; Siriwardhana & Stewart, 2013; Verwimp & Bavel, 2005; Virgincar, Doherty, & Siriwardhana, 2016). Many displaced individuals live in adverse economic conditions (Internal Displacement Monitoring Centre & Norwegian Refugee Council, 2018; United Nations High Commissioner for Refugees, 2017). The number of new internal displacements due to conflict and violence almost doubled between 2016 and 2017, reaching a total of 40 million people (Internal Displacement Monitoring Centre & Norwegian Refugee Council, 2018) and creating a

unique cohort in the developing world. Regardless of age, exposure to conflict and displacement has long-term implications for health.

Displacement is occurring within the context of historical rapid demographic and epidemiological transitions, which also have long-term consequences for health. In particular, the rapid demographic and epidemiological transitions of the 20th century largely explain the growth of the older adult population in the developing world (Palloni & Souza, 2013). As population aging becomes a major issue facing the developing world in the coming decades (He, Goodkind, & Kowal, 2016), we do not know the degree to which displacement at a particular time during the life course (childhood or adulthood) will affect the health of a population of older adults who have also experienced rapid demographic and epidemiological transitions. Only a few studies have examined the long-term consequences of displacement on health (Daoud, Shankardass, O'Campo, Anderson, & Agbaria, 2012) and we know of no studies that have examined the long-term consequences of displacement on health within the larger context of these rapid

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<https://doi.org/10.1016/j.ssmph.2019.100369>

Received 14 June 2018; Received in revised form 25 January 2019; Accepted 28 January 2019

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transitions. An examination of the long-term consequences of displacement on the health of older adults who also are characterized largely by the rapid transitions of the 20th century is therefore relevant.

1.1. Population health of older adults in middle income countries

Middle-income countries are of particular interest in examining the impact of displacement and rapid historical transitions for older adult health because they account for much of the growth of aging populations in the developing world. The share of adults over the age of 65 from 1970–2015 was greater in upper-middle-income countries (4.5%) than other developing countries (1.5% in lower-middle-income countries and less than 1% in low-income countries). Upper-middle-income countries are projected to have the largest absolute growth (13%) (Sudharsanan & Bloom, 2018).

Increases in the aging population have also resulted in increasing prevalence of chronic diseases, such as heart disease and diabetes, and associated risk factors, such as obesity (He et al., 2016; World Health Organization, 2016), especially in urban areas (Ibrahim & Damasceno, 2012). While lifestyle is an important determinant of older adult health in high-income countries (Kuh & 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 birth and during childhood. This occurred mostly without parallel improvements in standards of living in middle-income countries but rather due to public health interventions and improved medical technology. These circumstances produced large cohorts that help explain population aging trends in middle-income countries (Sudharsanan & Bloom, 2018). They also produced unique cohorts born during the 1930s–1960s characterized by increased survivorship of poor early life conditions (poor nutrition, infectious diseases). However, they continued to be exposed to adverse economic conditions, potentially increasing the risk of poor health at older ages (McEniry, 2014; Palloni & Beltran-Sanchez, 2017; Palloni & 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. These individuals had limited access to good nutrition and proper medical care as children but then experienced rapid urbanization (Flórez, Guataquí, Mendez, & Cote, 2016; López-Alonso, 2007) and improvements and transitioned away from the traditional diet as adults (FAO, 1946, 2012). The rapid changes experienced by the unique cohorts set the stage for potentially negative long-term consequences for their health.

There are compelling theories regarding the importance of early life conditions on 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). 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 their physiology. However, a mismatch occurs when exposed to a nutritionally richer environment later in life, leading to disease (Bateson & Gluckman, 2011; Gluckman & Hanson, 2005). The increasing exposure to non-traditional foods high in saturated fats experienced in middle-income countries (Popkin, 2006; Schmidhuber & Shetty, 2005) may compound early life effects for the unique cohorts of the 20th century. Early life conditions could increase 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 (hepatitis, tuberculosis, rheumatic fever, other respiratory infections), or persistent inflammation due to infections in early life or childhood can damage organs and increase the risk of poor health at older ages (Crimmins & Finch, 2006; Elo & Preston, 1992). The synergy between type of nutrition and infections (Scrimshaw, Taylor, & Gordon, 1968) undoubtedly affects epigenetic processes important to child development, especially in very early life.

Other environmental factors that cause stress during early life and childhood, such as violence, can be detrimental to adult health. Exposure to violence has long-term effects on health, including physical and psychological problems and mortality (Guedes et al. 2016; Olofsson, 2014; Wilson, Kliewer, & Sica, 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; Elder, George, & Shanahan, 1996; Lanius, Vermetten, & Pain, 2010; Schwartz et al. 1995; Taylor, 2010; Vaiserman, 2015; Winning, Glymour, McCormick, Gilsanz, & Kubzansky, 2015).

1.2. Displacement in the unique cohort of the 1930s–1960s

How might displacement affect the health of older adults already characterized by poor early life conditions? The consequences of displacement are complex and it is difficult to discern the exact impact of displacement without information regarding the nature or severity of the displacement. Displacement due to armed conflict and violence is stressful and it can have negative economic and health consequences (Internal Displacement Monitoring Centre & Norwegian Refugee Council, 2018).

In that regard, displacement during early life or childhood could increase the severity of poor childhood conditions and compound their effects on older adult health. Displacement increases the likelihood of poor nutrition (Hart, 2010; Loschmann, 2016; Oyelere & Wharton, 2013) and infections, such as rheumatic fever (De Maio et al. 2016),—conditions known to produce a higher risk of disease at older ages (Barker, 1998). Displacement could also increase childhood stress, which can have long-term negative consequences on health (Middlebrooks & Audage, 2008). Displacement in early life and childhood can lead to lower educational attainment with negative consequences for health (Carrillo, 2009; Loschmann, 2016; Meeks & Murrell, 2001; Oyelere & Wharton, 2013; Smith, Anderson, Salinas, Horvatek, & Baker, 2015).

Timing of displacement during adulthood could matter. Displacement during critical/sensitive periods of adulthood could affect older adult health by itself or by compounding existing early life risk factors. The life-course perspective has shown that all exposures in an individual's life are connected and have an effect. It is plausible to infer that the timing of displacement during adulthood plays an important role (Ben-Shlomo & Kuh, 2002; George, 2003). 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. Poor childhood health due to poor early life conditions could reduce resources to successfully confront disease in the future (Elo & Preston, 1992). It is thus plausible to infer that severe stress from displacement during critical periods of adulthood in combination with poor childhood health could augment the risk of stress and disease at older ages. The literature has shown that stress during adulthood can alter epigenetic programming and interact with early life developmental programming to produce disease (McEwen, Eiland, Hunter, & Miller, 2012; Vaiserman, 2015).

Stressful events, such as displacement, may be so consequential to health that they overshadow the effects of poor early life conditions

(Avogo & Agadjanian, 2010; Internal Displacement Monitoring Centre & Norwegian Refugee Council, 2018; Shultz et al., 2014b; Siriwardhana & Stewart, 2013; Verwimp & Bavel, 2005; Virgincar et al., 2016). Therefore, displacement could mediate the effects of poor early life conditions. However, 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. Favorable circumstances later in life and development of psychological defense mechanisms can offset some of the effects related to displacement during childhood (Bonanno, Brewin, Kaniasty, & Greca, 2010; Saarela & Elo, 2016). Adverse early life conditions can build resilience and produce protective effects against adverse circumstances later in life (Phillips, Auais, Belanger, Alvarado, & Zunzunegui, 2016; Santarelli et al. 2017). The degree to which individuals perceive stress due to displacement in relation to their own beliefs may also impact its influence on health. Displaced families who provide strong social support may help mitigate the negative consequences of displacement (Taylor, 2010). Despite health vulnerabilities observed among older adults, some show a high degree of resilience to stressful events (MacLeod, Musich, Hawkins, Alsgaard, & Wicker, 2016) and this may affect how they react to the stress of displacement experienced at older ages. Older adults who have developed well-established and strong social connections and psychological resources throughout their lifetimes may be better off when facing adversity such as displacement later in life (Bonanno et al., 2010).

1.3. 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 a relevant 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., 2016) (Fig. 1). Large migrations to urban areas since the 1950s 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) who then experienced rapid changes in caloric intake in later years (FAO, 2012) along with an increasingly sedentary lifestyle (Popkin, 2006). These cohorts are characterized by increased survivorship of poor early life conditions and are now living in more urban areas with higher caloric intake, decreased physical activity, and increased exposure to non-traditional food.

Colombia experienced a 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 LAC region (Internal Displacement Monitoring Centre & Norwegian Refugee Council, 2018; 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, Díaz, & Formisano, 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 guerilla groups began to form in scattered regions of the country.

The second major period of conflict and violence 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. 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-Gutierrez, 2016; Cano-Gutierrez et al. 2016; Gomez, Curcio, & Duque, 2009).

In our study, we examine the degree to which displacement is associated with older adult health in Colombia within the context of a population already at-risk due to poor early life conditions and rapid demographic and nutritional transitions (the birth cohort of the 1930s–1960s). In examining the health of this unique cohort of older adult Colombians, we are particularly interested in the degree to which (a) early life conditions and displacement are associated with adult health; (b) displacement compounds the effects of poor early life conditions or whether it mediates early life conditions; (c) timing of displacement matters; and (d) childhood adversity builds resilience. If displacement compounds the effects of poor early life conditions, we expect that displacement along with poor early life conditions will increase the risk of health conditions known to originate in early life (chronic conditions, stress) whether that be through main effects or interactions between early life conditions and displacement. If displacement mediates early life conditions (overshadowing their effects), we expect that the effects of early life conditions will be attenuated when displacement is added to model estimation. If timing matters, differences at age of displacement with adult health should be apparent. If childhood adversity builds resilience, we expect that interactions between childhood conditions and displacement will reduce the negative impact of displacement on adult health.

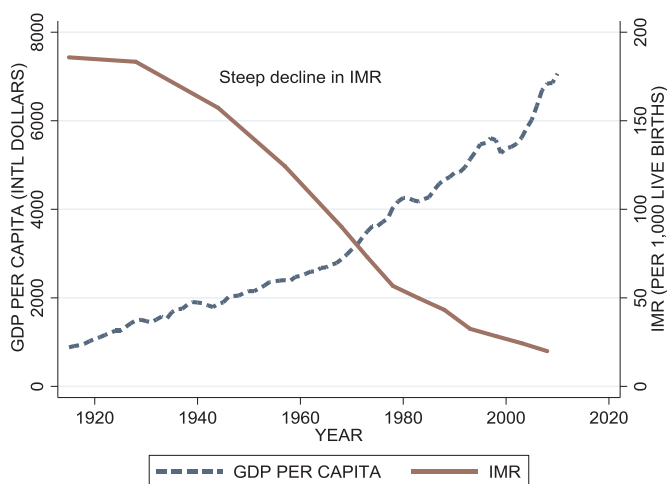


Fig. 1. Rapid reductions in infant mortality rate (IMR) in Colombia in the 20th century. Sources: (Flórez et al., 2016; Maddison Project Database version 2013, Bolt, & van Zanden, 2014); in 1990 international Geary-Khamis dollars and IMR (deaths per 1,000 live births).

2. Methods

2.1. Data

The data came from the Survey of Health, Well-Being and Aging (SABE-Colombia), which is a nationally representative sample of 23,694 adults 60 years and older living in Colombia in 2014-2015. The study is based on a multistage probability sampling design. It was modelled after the original SABE surveys administered in 2000 in seven major cities of the LAC region, but included additional comprehensive information on health. The overall response rate was 70% (62% for urban areas and 77% for rural areas) (Ministerio de Salud y Protección Social et al., 2016). All appropriate procedures were taken for IRB approval for the study. More detailed information concerning the sample selection procedure can be found in publications describing the study (Gomez, Corchuelo, Curcio, Calzada, & Mendez, 2016).

2.2. Measures

2.2.1. Overall health

We defined poor self-reported health (SRH) as reporting fair or poor health. We used a survey question to define a dichotomous variable reflecting recent stress/serious illness (“In the last three months have you had a serious illness, or stressful or anxiety-producing situation?”).

2.2.2. Chronic conditions and obesity

We defined obesity using waist circumference (greater than 88 cm for females, greater than 102 cm for males). We defined at least one chronic condition if the respondent reported having diabetes, respiratory disease, heart disease, cancer, stroke, or arthritis.

2.2.3. Displacement

We viewed displacement due to armed conflict and violence as a general indicator of exposure to stressful events which have possible negative economic and health consequences. We defined displacement from armed conflict and violence according to age at displacement (never displaced, 1-17 childhood, 18-39 young adulthood, 40-59 mid-adulthood, and 60+ older adulthood), constructed from survey questions (“Have you been displaced due to armed conflict or violence at some time in your life? How old were you when you were displaced for the first time?”). All categories of age at displacement were mutually exclusive relative to the two major periods of violence in Colombia (before and after 1976) with the exception of those displaced at ages 18-39. Thus, we also created an expanded definition for age of displacement that used separate categories to distinguish respondents displaced as young adults according to period of violence and also used this variable to estimate adult health.

2.2.4. Early life conditions

Self-reported questions regarding childhood economic situation and childhood health defined early life conditions. These are frequently used in surveys of older adults (McEniry, 2013). We used them to broadly reflect childhood adversity due to poor nutrition and infectious diseases. The SABE survey had a question regarding family violence during childhood and we included this question to reflect childhood stress (Guedes et al., 2016). We defined dichotomized variables regarding early life conditions before the age of 15: (1) poor early SES (based on three categories: good, intermediate, or poor; we used the last two categories to define poor early SES), (2) poor child health (based on three categories: good, intermediate, or poor; we used the last two categories to define poor child health), (3) hunger (yes, no), (4) at least one reported serious childhood infection (hepatitis, TB, rheumatic fever, bronchitis), (5) rheumatic fever, and (6) 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?”).

2.2.5. Adult risk factors

Adult risk factors (or adult lifestyle) included dichotomous variables for current smoking, no rigorous exercise, and poor nutrition (less than two daily servings of fruits or vegetables).

2.2.6. Other variables

Other variables included age, gender, education (incomplete primary, incomplete secondary, completed secondary, and completed more than secondary), and current residence (four large metro cities, other urban, rural). Wealth was defined using a modified version of wealth measures found in the literature (Rutstein & Johnson, 2004). We created dichotomous variables for 17 domestic assets (radio, television, DVD, computer, refrigerator, cable TV, internet access, air conditioning/heating, vacuum cleaner, electric/gas stove, microwave, cell phone, blender, refrigerator, washer, electric fan, sound equipment). We then summed across variables to obtain a total wealth score, and created a categorical wealth variable based as close as possible on the lowest and highest quintiles of wealth with the remaining quintiles in the middle category.

2.3. Subsample for estimation and missingness

Early life questions were only asked of respondents without proxies so we excluded respondents with proxies from analysis. The final sample included 19,004 respondents, 3478 of whom indicated that they were displaced at some point during their lives. Missing values for variables were all under 5% with the exception of poor early SES (16%), obesity (6%), and stress/serious illness (18%). We compared those with/without missing values and found that missing values appeared more likely for (a) females with more education for stress, (b) younger males with less education for poor child SES, and (c) older females with more education for waist circumference obesity. To better ascertain the consequences of missing values, we used multiple imputation procedures (Raghunathan, Reiter, & Rubin, 2003) using Stata 15 to impute the data. Imputation ensured that all cases were included for model estimation. We then estimated separate models for non-imputed and imputed data.

2.4. Analyses

We first examined associations between displacement groups across demographic factors, childhood conditions, adult health, and lifestyle using chi-square to ascertain the uniqueness of the displaced population. We then estimated a series of logistic models to examine the total and net effects of poor childhood conditions on adult health in relation to displacement and adult SES and lifestyle. Examining the attenuation of effects and interaction effects helps discern the relation between poor childhood conditions and displacement in terms of compounding effects, mediation, and resilience. We began with baseline models that controlled for age and gender and then expanded these models to include displacement, adult SES, and lifestyle. The models used never displaced as the reference group, and controlled for age, gender, early life conditions, education, wealth, current residence, and adult risk factors. We tested for interactions between displacement and each of the early life variables by including suitable interaction terms in our final models. The interactions that had the most consistent patterns across all health outcomes were with early life infections. These were shown as part of the main results although we produced a summary of all relevant statistically significant interactions (see [Supplementary Table S1](#)). The models using the expanded definition for age at displacement produced similar results (available upon request).

We compared non-imputed and imputed models and found no major discrepancies, except for some interactions that were no longer significant when imputed data were used. Thus, we showed non-imputed results in the current study and interpreted interactions for models that were consistent in both models with imputed and non-imputed data

(imputed results available upon request). Differences with imputed results are indicated in results. We identified best models using Bayesian Information Criterion (BIC) and used Stata 15 for all analyses.

To assess the actual magnitude of effects from logistic regression models, we calculated predicted probabilities either by holding constant the values of covariates for a typical respondent (age 70–74, incomplete primary school, living in smaller urban setting) or by taking the average value of covariates. For full main effect models, we calculated the predicted probability of adult health for the typical respondent with no exposure to childhood conditions or adult risk factors for those never displaced and across different ages at displacement. We then added poor childhood conditions and adult risk factors. For interaction models, we calculated the predicted probability of adult health for those with/without exposure to early life infections for those never displaced and across different ages at displacement.

3. Results

3.1. Displacement

About 15% of the sampled population of older adults were displaced at least once during their lifetimes (3,478 respondents). About 17% (601 respondents) of those displaced were displaced more than once (Table 1). Of those displaced, about 20% were displaced during childhood and 74% were displaced with their families. Most of those displaced were displaced after the late 1970s and, on average, adults were displaced only once in their lifetimes. Those displaced in childhood were all displaced before 1976, those displaced at older ages were displaced in or after 1976, and those displaced in young adulthood were displaced in both periods. The distribution of age at displacement (Fig. 2) aligned closely with historical descriptions of the two recent major periods of armed conflict and violence in Colombia (Sánchez et al., 2003).

3.2. Sample characteristics

The selected sample showed large differences between groups by

Table 1

Displacement of older adults.

Sources: SABE-Colombia, no proxies, n = 19,004, and 3478 displaced.

	Percent/Average
Displaced anytime during life (%)	15
Age of first displacement (%)	
Childhood (17 and younger)	22
Young adults (18–39)	19
Middle aged (40–59)	46
Older adults (60+)	13
Average years since first displacement	29 (20)
Period of first displacement ^a	
Before 1976	29
1976 and after	71
Average # of displacements ^b	1.26 (0.71)
Last displacement (%)	
Individual	19
Family	74
Community	7

Notes: Weighted averages. Some missing values in variables describing displacement. Standard deviations in parentheses followed by mean for average number of displacements.

^a Age of displacement and period of displacement:

- 100% of displacement at ages 1–17 occurred before 1976.
- 36%/64% of displacement at ages 18–39 occurred before/1976 or after.
- 1%/99% of displacement at ages 40–59 occurred before/1976 or after.
- 100% of displacement at ages 60+ occurred 1976 or after.

^b 17% of displaced respondents reported more than 1 displacement (601 older adults).

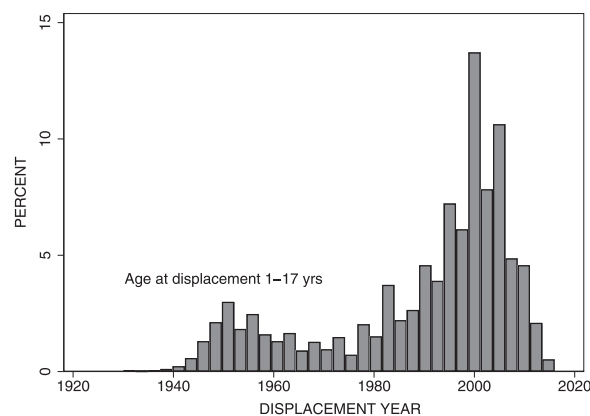


Fig. 2. Year of first displacement among SABE-Colombia respondents. Notes: Graph depicts the distribution of displaced respondents according to the year of displacement. The two peaks correspond to the two major periods of violence and armed conflict in Colombia. All respondents displaced in childhood were displaced during the first major period of violence. Source: SABE-Colombia, no proxies (n = 19,004).

age at displacement (Table 2). More males were displaced during adulthood (53–60%). Those displaced (especially at older ages) have not completed primary school compared to those never displaced (58–72% versus 44%). The distribution of wealth was particularly less favorable for those displaced at older ages (40+ years). A higher percent of those displaced in childhood currently live in large metropolitan areas (50%) compared with those who were never displaced (40%). Most respondents were born after 1930, the period during which Colombia’s rapid mortality decline began.

3.3. Prevalence of health outcomes and risk factors

Differences between displacement groups appeared in health outcomes, adult risk factors, and early life conditions (Table 3). Those displaced in childhood differed from those never displaced in stress/serious illness (32% displaced, 27% never displaced), chronic conditions (at least one chronic condition: 68% displaced, 52% never displaced), family violence (27% displaced, 18% never displaced), hunger (38% displaced, 27% never displaced), obesity (52% displaced, 47% never displaced), and less than recommended fruits/vegetables (36% displaced, 30% never displaced). Those displaced during childhood were similar to those displaced in young adulthood. Other ages of displacement were similar to those displaced in childhood in health characteristics such as stress/serious illness, and childhood conditions, but different in terms of adult risk factors like exercise and nutrition. Almost twice as many individuals displaced at older ages reported poor health (12–13% displaced, 7 % never displaced).

3.4. Logistic models

Poor early life conditions were strongly associated with poor SRH, and their effects were only slightly attenuated after adding displacement, adult SES, and lifestyle (Table 4, Panel A, Models 1–4). Early life infections produced the strongest effects on poor SRH in the full model (Model 4). Compared with those never exposed, exposure to childhood infections increased the likelihood of reporting poor health at older ages by about 50% (OR 1.51, 95% CI 1.25–1.81). The odds of poor health also increased for those with a history of family violence (OR 1.35, 95% CI 1.14–1.60) and hunger during childhood (OR 1.24, 95% CI 1.07–1.45).

The effects of displacement were also only slightly attenuated after adding adult SES and lifestyle (Models 3–4) but nevertheless showed strong associations with SRH. The odds of reporting poor health were 50–79% higher for those displaced at some time during their life time

Table 2
Sample characteristics (total and by displacement).
Source: SABE-Colombia, no proxies, n = 19,004.

	Total	Never displaced and age at displacement					p-value
		Never	1-17	18-39	40-59	60+	
Female (%)	54	55	56	40	47	43	0.000
Age group							
60-64	36	36	20	53	50	9	0.000
65-69	27	27	30	25	29	14	
70-74	18	18	25	8	13	32	
75-79	12	12	19	9	6	22	
80+	7	7	3	2	2	6	
Education (%)							
0-4	47	44	58	71	65	72	0.000
5-10	33	34	26	22	25	21	
11+	20	22	16	7	10	5	
Wealth assets (%)							
Low	13	12	14	17	22	29	0.000
Middle	46	45	46	37	60	55	
High	41	43	41	46	17	16	
Residence (%)							
Large metro	39	40	50	44	20	19	0.000
Other urban	42	41	38	41	47	51	
Rural	20	19	12	15	33	30	
Birth cohort (%)							
Before 1930	2	2	1	2	0.29	5	0.000
1930-1945	38	38	57	25	24	75	
After 1945	60	60	42	73	76	20	

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

compared with those never displaced in the full model (Model 4). Adult lifestyle showed strong associations with poor health (Model 4) as little exercise, obesity, and poor diet increased the odds of reporting poor health by about 31-51% compared with those who had a better lifestyle.

An examination of predicted probabilities using Model 4 reinforced these results (Fig. 3A). Poor early life conditions more than doubled the predicted probability for SRH across all displacement ages compared with those with no exposure to poor early life conditions (+Early life bars in Fig. 3A), but adding adult risk factors accounted for a much higher increase in the probability of poor health (+Obesity, +Adult risks in Fig. 3A). Those displaced as young adults had the highest predicted probability of poor SRH (0.36, which represents a 50%

increase in probability compared with those never displaced for the average respondent, 0.24) (+ Adult risks bars in Fig. 3A).

Including interaction terms (Model 5) produced significant interactions between displacement in mid-adulthood and early life infections. However, these results were more fragile since the interaction effects disappeared in models using imputed data (results not shown); thus, they were not interpreted further.

Similar patterns emerged for stress/major illness in that there was a strong association between poor early life conditions and adult stress/major illness (Table 4, Panel B, Models 1-4). The effects of poor childhood conditions were not attenuated with the addition of displacement, adult SES, or lifestyle (Table 4, Panel B, Models 2-4). The likelihood of reporting stress/major illness compared with those not

Table 3
Health and lifestyle.
Source: SABE-Colombia, no proxies, n = 19,004.

	ALL	Never displaced and age at displacement					p-value
		Never	1-17	18-39	40-59	60+	
Health (%)							
Poor health	7	7	7	12	13	12	0.000
Stress/serious illness	27	27	32	36	32	26	0.000
At least 1 chronic	53	52	68	71	46	55	0.000
Heart disease	14	14	12	18	14	15	0.000
Early life risks (%)							
Child infections	12	12	9	8	13	14	0.002
Rheumatic fever	3	3	3	4	5	8	0.000
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
Adult risks (%)							
Little exercise	75	74	78	73	83	81	0.000
Obese (waist)	47	47	52	51	46	34	0.000
Poor nutrition							
LT req fr/veg	31	30	36	40	36	45	0.000
Smoker	11	11	14	6	18	14	0.000

Weighted averages, showing significant differences. LT req fr/veg = Less than the required serving of daily fruits/vegetables (defined as less than 2 servings).

Table 4
Age at displacement and overall health.
Source: SABE-Colombia, no proxies.

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)
Panel A: Poor SRH					
Early life					
Family violence	1.32 (1.12–1.56)	1.30 (1.10–1.54)	1.36 (1.15–1.61)	1.35 (1.14–1.60)	1.35 (1.14–1.60)
Infections	1.48 (1.23–1.77)	1.47 (1.22–1.76)	1.49 (1.24–1.79)	1.51 (1.25–1.81)	1.37 (1.10–1.71)
Poor SES	0.94 (0.82–1.07)	0.96 (0.84–1.09)	0.97 (0.86–1.11)	0.95 (0.83–1.08)	0.95 (0.83–1.08)
Poor health	1.25 (1.03–1.57)	1.24 (1.02–1.51)	1.19 (0.97–1.45)	1.18 (0.97–1.44)	1.18 (0.98–1.44)
Hunger	1.36 (1.17–1.58)	1.31 (1.13–1.53)	1.24 (1.06–1.44)	1.24 (1.07–1.45)	1.25 (1.07–1.45)
Displacement					
Never (ref)		1.00	1.00	1.00	1.00
1–17		1.58 (1.11–2.24)	1.60 (1.12–2.28)	1.59 (1.12–2.27)	1.65 (1.12–2.44)
18–39		1.98 (1.46–2.68)	1.81 (1.33–2.46)	1.79 (1.31–2.43)	1.74 (1.24–2.45)
40–59		1.80 (1.49–2.18)	1.55 (1.28–1.88)	1.50 (1.24–1.82)	1.37 (1.11–1.69)
60+		1.85 (1.39–2.45)	1.60 (1.20–2.12)	1.60 (1.20–2.13)	1.60 (1.17–2.18)
Adult behaviors					
Little exercise				1.51 (1.25–1.81)	1.51 (1.25–1.82)
Obese (waist)				1.31 (1.14–1.51)	1.32 (1.14–1.51)
LT req fr/veg				1.47 (1.29–1.68)	1.47 (1.29–1.68)
Smoker				1.03 (0.83–1.26)	1.02 (0.83–1.26)
Interactions					
Not displaced (ref)					1.00
(1–17) X infections					0.82 (0.31–2.18)
(18–39) X infections					1.17 (0.52–2.63)
(40–59) X infections					1.82 (1.11–3.00)
(60+) X infections					1.04 (0.48–2.26)
Panel B: Stress/major illness					
Early life					
Family violence	1.63 (1.45–1.83)	1.62 (1.44–1.82)	1.57 (1.40–1.77)	1.57 (1.40–1.77)	1.57 (1.40–1.77)
Infections	1.51 (1.32–1.73)	1.50 (1.31–1.71)	1.49 (1.30–1.71)	1.49 (1.30–1.71)	1.39 (1.19–1.63)
Poor SES	1.12 (1.02–1.22)	1.12 (1.03–1.23)	1.12 (1.02–1.23)	1.11 (1.01–1.21)	1.11 (1.01–1.22)
Poor health	1.16 (1.00–1.34)	1.16 (1.00–1.33)	1.17 (1.01–1.35)	1.17 (1.01–1.35)	1.16 (1.00–1.34)
Hunger	1.56 (1.41–1.73)	1.55 (1.29–1.72)	1.55 (1.40–1.73)	1.56 (1.40–1.73)	1.56 (1.41–1.74)
Displacement					
Never (ref)		1.00	1.00	1.00	1.00
1–17		1.65 (1.25–2.18)	1.62 (1.22–2.14)	1.61 (1.22–2.13)	1.83 (1.36–2.48)
18–39		1.42 (1.12–1.79)	1.40 (1.10–1.77)	1.39 (1.09–1.76)	1.20 (0.92–1.56)
40–59		1.15 (1.00–1.32)	1.16 (1.01–1.34)	1.15 (1.00–1.33)	1.11 (0.96–1.29)
60+		1.09 (0.86–1.39)	1.14 (0.89–1.45)	1.14 (0.89–1.45)	1.06 (0.81–1.39)
Adult behaviors					
Little exercise				1.18 (1.05–1.32)	1.18 (1.05–1.32)
Obese (waist)				1.07 (0.97–1.17)	1.07 (0.97–1.18)
LT req fr/veg				1.18 (1.08–1.30)	1.19 (1.08–1.30)
Smoker				0.93 (0.80–1.07)	0.92 (0.80–1.18)
Interactions					
Not displaced (ref)					1.00
(1–17) X infections					0.45 (0.20–1.00)
(18–39) X infections					2.64 (1.35–5.19)
(40–59) X infections					1.34 (0.87–2.05)
(60+) X infections					1.58 (0.83–2.98)

Notes: Model 1 controls for age and gender; Model 2 adds early life conditions; Model 3 adds education, wealth, current residence; Model 4 adds adult risk factors; Model 5 adds interactions between displacement and childhood infections. SRH n = 14,606; stress n = 12,003. All models were different from the null model ($p < 0.001$). Best model according to BIC (Bayesian Information Criterion) is Model 4, except with stress (Model 2).

reporting these conditions was higher for those reporting poor early life conditions (Model 4) such as family violence (OR 1.57, 95% CI 1.40–1.77), hunger (OR 1.56, 95% CI 1.40–1.73), infections (OR 1.49, 95% 1.30–1.71), poor health (OR 1.17, 95% 1.01–1.35), and poor SES (OR 1.11, 95% 1.01–1.21).

Displacement also showed a strong association with adult stress/major illness, especially for those displaced at younger ages (Models 1–4). Being displaced during childhood and young adulthood increased the likelihood of reporting stress/major illness by about 61% and 39% respectively (Model 4). The effects of displacement were not greatly attenuated by the addition of adult SES and lifestyle (Models 3 and 4). The effects of adult lifestyle were weaker (Model 4) as the odds of reporting stress/major illness increased by only about 18% for those with little exercise or poor diet compared with those with a better lifestyle.

The predicted probability for stress/major illness using Model 4

greatly increased between those with and without exposure to poor early life conditions across all categories of displacement (Fig. 3B, + Early life bars). The predicted probability of being displaced during childhood (0.47) and young adulthood (0.44) was about three times that of displaced children (0.16) or young adults (0.14) with no early life exposures. In contrast, adding adult risk factors (Fig. 3B, + Obesity, + Adult risk) did not increase the probability as much. Those displaced during childhood and as young adults had the highest probability of reporting stress (+ Adult risks bar: 0.55 and 0.52, which represents a 25% and an 18% increase in probability respectively compared with those never displaced, 0.44).

Including interaction terms (Model 5) produced significant positive interactions between displacement in young adulthood and early life infections (OR 2.64, 95% CI 1.35–5.19), suggesting that the effects of early life infections were higher among those displaced in young

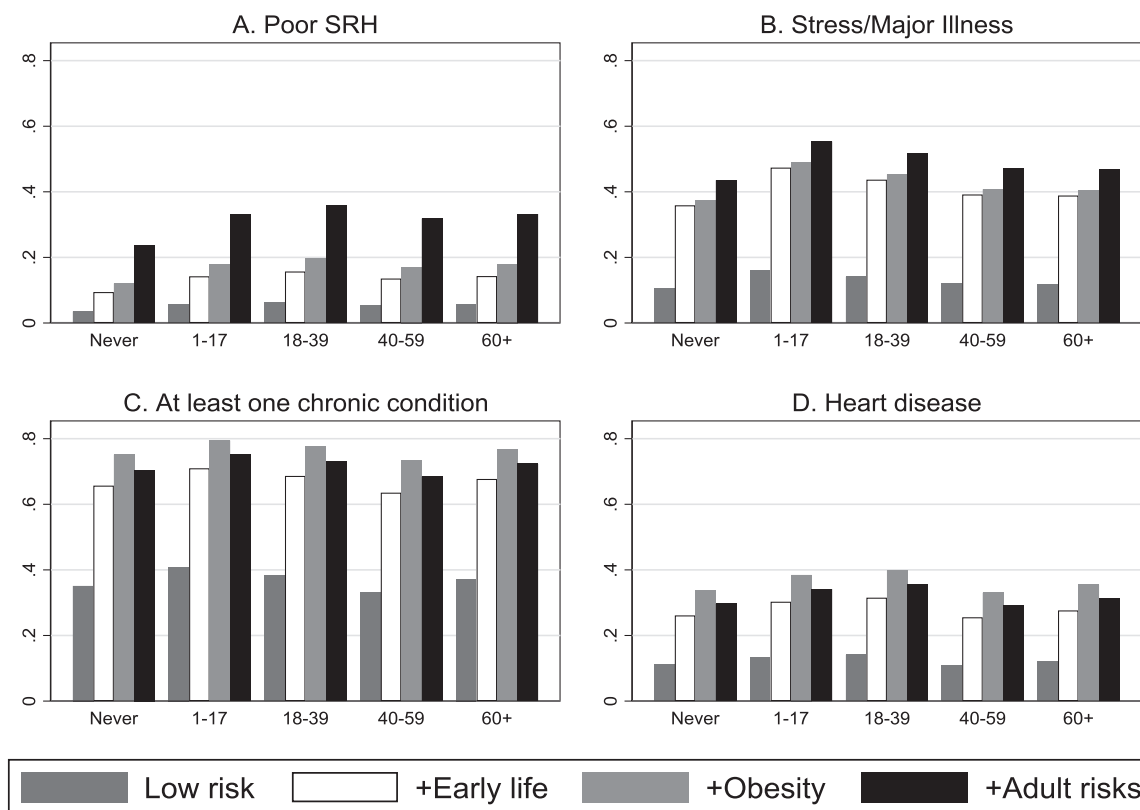


Fig. 3. Predicted probabilities for older Colombian male adults. *Notes:* Predicted probabilities for males for typical respondent. Similar results for females. X-axis shows never displaced and age at displacement (1–17 = childhood, 18–39 = young adulthood, 40–59 = mid adulthood, 60+ = older adulthood). Values for the y-axis ranges from 0–0.80. Low risk = no early life or adult risk factors (exercise, diet, smoking). Probabilities below are ordered from left to right (Low risk, +Early life, +Obesity, +Adult risks). *Poor SRH:* never displaced (0.04, 0.09, 0.12, 0.24), 1–17 (0.06, 0.14, 0.18, 0.33), 18–39 (0.06, 0.16, 0.20, 0.36), 40–59 (0.05, 0.14, 0.17, 0.32), 60+ (0.06, 0.14, 0.18, 0.33). *Stress:* never displaced (0.11, 0.36, 0.37, 0.44), 1–17 (0.16, 0.47, 0.49, 0.55), 18–39 (0.14, 0.44, 0.45, 0.52), 40–59 (0.12, 0.39, 0.41, 0.47), 60+ (0.12, 0.39, 0.40, 0.47). *At least one chronic condition:* never displaced (0.35, 0.66, 0.75, 0.70), 1–17 (0.41, 0.71, 0.79, 0.75), 18–39 (0.38, 0.69, 0.78, 0.73), 40–59 (0.33, 0.64, 0.73, 0.68), 60+ (0.37, 0.68, 0.77, 0.72). *Heart disease:* never displaced (0.11, 0.26, 0.34, 0.30), 1–17 (0.13, 0.30, 0.38, 0.34), 18–39 (0.14, 0.32, 0.40, 0.35), 40–59 (0.11, 0.26, 0.33, 0.29), 60+ (0.12, 0.28, 0.35, 0.31). *Source:* Based on Model 4, Tables 4 and 5.

adulthood. Protective effects appeared for the interaction between childhood infections and displacement during childhood on health (OR 0.45, 95% CI 0.20–1.00, $p < 0.049$), suggesting that the effects of early life infections were lower among those displaced during childhood. Overall, these results were consistent with imputed results although the interaction between childhood infections and displacement during childhood became insignificant in imputed models (available upon request).

The predicted probability of stress/major illness for those displaced during young adulthood was nearly (or more than) double compared with those not exposed to infection but displaced (Fig. 4A, ages 18–39, no exposure 0.24, exposure 0.54), and compared with those never displaced (no exposure 0.21, exposure 0.27). However, being exposed to early life infections and displaced in childhood (0.23) produced a lower probability of stress compared with being displaced during childhood but not exposed (0.32), with those never displaced and exposed (0.27). This probability was very similar to being never displaced and not exposed (0.21).

Similar patterns persisted as both poor early life conditions and displacement were associated with reporting at least one chronic condition with little attenuation in the nested models (Table 5, Panel A, Models 1–4). The likelihood of chronic conditions was particularly strong for early life infections (Model 4, OR 1.73, 95% CI 1.54–1.94), family violence (OR 1.36, 95% CI 1.23–1.50), and poor childhood health (OR 1.21, 95% CI 1.07–1.37). Strong associations also appeared for those displaced during childhood (Model 4, OR 1.28, 95% CI 1.02–1.60). Obesity was very strongly associated with chronic

conditions (Model 4, OR 1.58, 95% CI 1.47–1.70).

Predicted probabilities using Model 4 showed a large increase in risk for those exposed to poor early life conditions compared with those not exposed to poor early life conditions (Fig. 3c, Low risk and +Early life bars). In particular, those displaced in childhood with no poor early life conditions went from 0.41 probability to 0.71 probability if exposed to poor early life conditions—an increase of about 73%. Adding obesity and adult risk factors increased the probability slightly (Fig. 3c, +Obesity and +Adult risks bars). With all risk factors (+Adult risks bar), those displaced during childhood showed the highest probabilities of reporting at least one chronic condition (0.75), but the differences were small when compared with those never displaced (0.70) (about a 7% increase).

Including interaction terms (Model 5) produced significant interactions between displacement in older adulthood and early life infections (OR 2.00, 95% CI 1.07–3.74), consistent with imputed results (available upon request). The predicted probability for reporting chronic conditions increased by 56% for those displaced at old age and exposed to early life infections versus displaced at older ages but not exposed (no exposure 0.48, exposure 0.75) (Fig. 4B). It also increased by 56% when compared with those never displaced with no exposure (0.48), and by 25% for those never displaced but with exposure (0.60).

Similar patterns appeared for heart disease in terms of the strength of association between early life conditions, displacement, and heart disease and the little attenuation in effects after controlling for adult SES and risk factors (Table 5, Panel B, Models 1–4). The likelihood of adult heart disease increased with family violence (OR 1.38, 95% CI

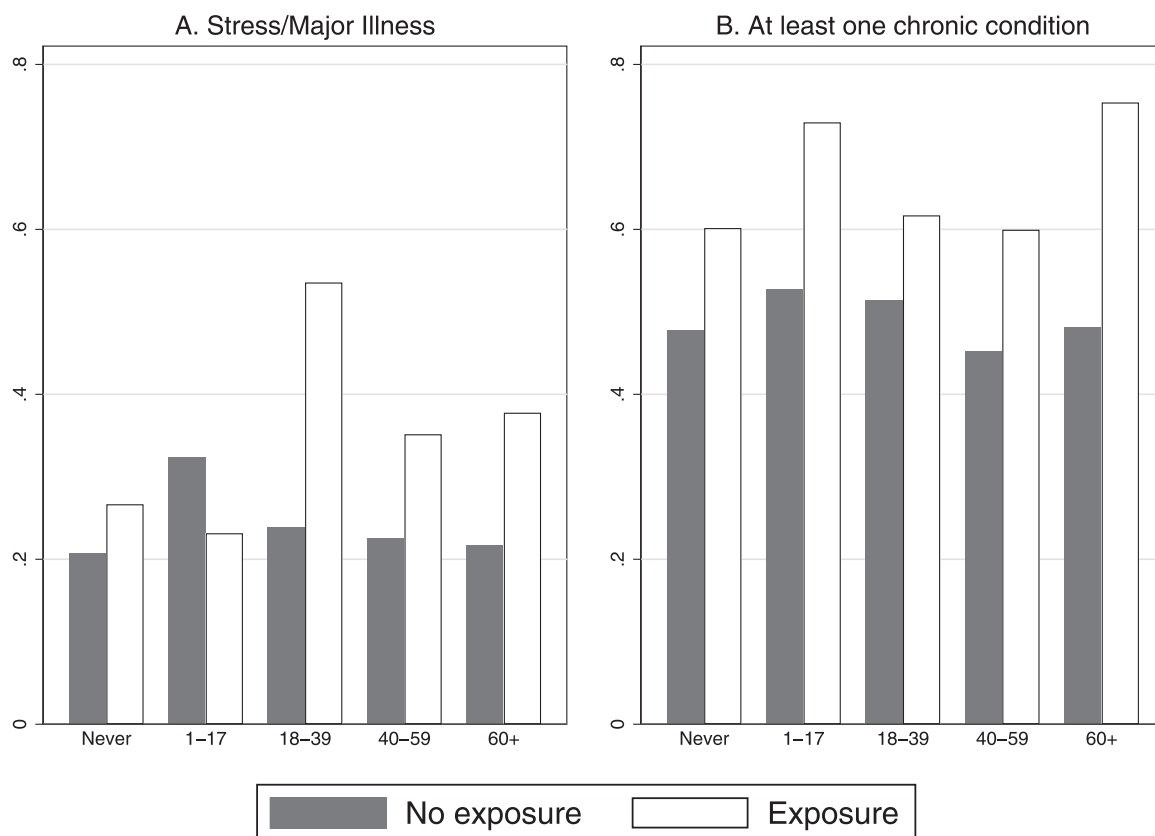


Fig. 4. Predicted probabilities for interactions between early life infections and older adult health. *Notes:* Predicted probabilities for typical respondent. X-axis shows never displaced and age at displacement (1-17 = childhood, 18-39 = young adulthood, 40-59 = mid adulthood, 60+ = older adulthood). Values for the y-axis ranges from 0-0.80. Probabilities below are ordered from left to right (never displaced, displaced at ages 1-17, 18-39, 40-59, 60+). *Stress:* no exposure (0.21, 0.32, 0.24, 0.23, 0.22), exposure (0.27, 0.23, 0.54, 0.35, 0.38). *At least one chronic condition:* no exposure (0.48, 0.53, 0.51, 0.45, 0.48), exposure (0.60, 0.73, 0.62, 0.60, 0.75).

Source: Based on Model 5, Tables 4 and 5 for stress/major illness and at least one chronic condition.

1.21-1.57), rheumatic fever (OR 1.36, 95% CI 1.06-1.74), poor childhood health (OR 1.29, 95% CI 1.10-1.51), and hunger (OR 1.17, 95% CI 1.03-1.32) (Model 4). Although there were significant effects of displacement during young adulthood on heart disease (Model 3, OR 1.34, 95% CI 1.01-1.76), these effects disappeared when adding adult lifestyle (Model 4).

Predicted probabilities for those exposed to poor childhood conditions and displaced during childhood or young adulthood (Fig. 3D, + Early life bars, 0.30-0.32) were about double that of those with no risk factors (Low risk bars, 0.13, 0.14). However, there was only a small increase for those never displaced but exposed (+ Early life bar, 0.26). With all risk factors (+ Adult risks bar), there were only small differences between displacement during childhood, young adulthood, and never displaced (0.34, 0.35, 0.30).

Including interaction terms (Model 5) produced significant and strong interactions between displacement in childhood and early life rheumatic fever. However, these interaction effects disappeared in models using imputed data (available upon request), suggesting the fragileness of results and were not interpreted further. Estimated models separating out the 18-39 age group according to period of violence and using an alternative definition of displacement produced similar results and are not reported here.

4. Discussion

Our study examined the effects of age at displacement due to armed conflict and violence in a population of 60+ year olds in the middle-income country of Colombia that experienced rapid demographic and

nutritional changes in the 20th century. Older adults in Colombia are a unique cohort characterized not only by their displacement history but also by their survivorship of poor early life conditions. Controlling for an extensive group of variables reflecting adult SES and lifestyle, we found strong associations between (1) poor early life conditions and older adult health (poor SRH, stress/major illness, at least one chronic condition, heart disease); these results were not greatly attenuated controlling for displacement, adult SES, and lifestyle. The strong associations were particularly notable for childhood infections, family violence, hunger, and child health; (2) displacement and older adult health (except for heart disease), the results of which were not greatly attenuated by adult SES and lifestyle; this was particularly notable in displacement at younger ages and older adult stress/major illness and at least one chronic condition. In terms of interactions, we found (3) significant positive interaction effects between childhood infections and being displaced during young adulthood for older adult stress/major illness, and between childhood infections and being displaced at older ages for reporting at least one chronic condition; (4) significant negative interaction effects between childhood infections and being displaced during childhood for older adult stress/major illness.

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 five main aspects of our results. First, our results confirm the general impression that the health of older adults exposed to a rapid demographic transition during the 20th century is strongly influenced by early life conditions. Poor nutrition, infectious diseases, childhood health, and family violence, are all relevant in explaining how early life conditions impact

Table 5
Age at displacement and chronic conditions.
Source: SABE-Colombia, no proxies.

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)
Panel A: At least 1 chronic condition					
Early life					
Family violence	1.40 (1.27–1.54)	1.40 (1.27–1.54)	1.35 (1.22–1.49)	1.36 (1.23–1.50)	1.36 (1.23–1.50)
Infections	1.72 (1.53–1.93)	1.71 (1.52–1.92)	1.70 (1.51–1.91)	1.73 (1.54–1.94)	1.65 (1.45–1.88)
Poor SES	1.12 (1.04–1.20)	1.11 (1.04–1.19)	1.10 (1.02–1.17)	1.07 (1.00–1.15)	1.07 (1.00–1.15)
Poor health	1.17 (1.04–1.31)	1.17 (1.04–1.31)	1.21 (1.08–1.37)	1.21 (1.07–1.37)	1.21 (1.08–1.37)
Hunger	1.10 (1.01–1.20)	1.11 (1.02–1.21)	1.15 (1.06–1.26)	1.16 (1.07–1.27)	1.16 (1.07–1.27)
Displacement					
Never (ref)		1.00	1.00	1.00	1.00
1–17		1.30 (1.04–1.62)	1.28 (1.02–1.60)	1.28 (1.02–1.60)	1.22 (0.96–1.56)
18–39		1.12 (0.91–1.37)	1.18 (0.96–1.44)	1.14 (0.93–1.40)	1.16 (0.93–1.44)
40–59		0.83 (0.74–0.93)	0.92 (0.82–1.04)	0.91 (0.81–1.03)	0.90 (0.80–1.02)
60+		0.94 (0.78–1.14)	1.06 (0.88–1.28)	1.10 (0.91–1.32)	1.02 (0.83–1.24)
Adult behaviors					
Little exercise				1.07 (0.98–1.16)	1.07 (0.98–1.16)
Obese (waist)				1.58 (1.47–1.70)	1.58 (1.46–1.70)
LT req fr/veg				1.11 (1.03–1.20)	1.11 (1.03–1.20)
Smoker				0.66 (0.59–0.74)	0.66 (0.59–0.75)
Interactions					
Not displaced (ref)					1.00
(1–17) X infections					1.47 (0.71–3.02)
(18–39) X infections					0.92 (0.49–1.72)
(40–59) X infections					1.10 (0.75–1.62)
(60+) X infections					2.00 (1.07–3.74)
Panel B: Heart disease					
Early life					
Family violence	1.43 (1.25–1.63)	1.42 (1.25–1.63)	1.38 (1.21–1.58)	1.38 (1.21–1.57)	1.39 (1.21–1.58)
Rheumatic fever	1.32 (1.04–1.69)	1.32 (1.03–1.69)	1.36 (1.06–1.73)	1.36 (1.06–1.74)	1.22 (0.90–1.64)
Poor SES	1.03 (0.93–1.14)	1.03 (0.93–1.14)	1.02 (0.92–1.13)	1.00 (0.90–1.11)	1.00 (0.90–1.11)
Poor health	1.27 (1.08–1.48)	1.26 (1.08–1.48)	1.29 (1.10–1.52)	1.29 (1.10–1.51)	1.30 (1.11–1.52)
Hunger	1.13 (1.00–1.28)	1.13 (1.00–1.28)	1.16 (1.02–1.31)	1.17 (1.03–1.32)	1.16 (1.03–1.32)
Displacement					
Never (ref)		1.00	1.00	1.00	1.00
1–17		1.27 (0.95–1.69)	1.24 (0.92–1.66)	1.23 (0.92–1.65)	1.10 (0.80–1.50)
18–39		1.30 (0.99–1.71)	1.34 (1.01–1.76)	1.30 (0.99–1.72)	1.35 (1.02–1.80)
40–59		0.91 (0.76–1.09)	0.98 (0.82–1.18)	0.97 (0.81–1.17)	0.97 (0.80–1.17)
60+		0.96 (0.74–1.25)	1.05 (0.81–1.37)	1.08 (0.83–1.41)	1.02 (0.77–1.35)
Adult behaviors					
Little exercise				1.02 (0.90–1.16)	1.02 (0.90–1.16)
Obese (waist)				1.44 (1.29–1.61)	1.44 (1.29–1.61)
LT req fr/veg				1.12 (1.00–1.25)	1.12 (1.00–1.25)
Smoker				0.73 (0.60–0.88)	0.73 (0.61–0.88)
Interactions					
Not displaced (ref)					1.00
(1–17) X rheumatic					4.71 (1.59–14.01)
(18–39) X rheumatic					0.55 (0.15–2.00)
(40–59) X rheumatic					1.08 (0.49–2.37)
(60+) X rheumatic					1.99 (0.80–4.93)

Notes: Model 1 controls for age; Model 2 adds early life conditions; Model 3 adds education, wealth, current residence; Model 4 adds adult risk factors; Model 5 adds interactions between displacement and childhood infections. At least one chronic n = 14,531; heart disease n = 14,657. All models were different from the null model ($p < 0.001$). Best model according to BIC (Bayesian Information Criterion) is Model 4.

older adult health (Bateson & Gluckman, 2011; Crimmins & Finch, 2006; Elo & Preston, 1992; Gluckman & Hanson, 2005; Guedes et al., 2016). The older adults in our study were mostly born during a period of rapid demographic and epidemiological changes in Colombia. These changes 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 a dramatic improvement in the 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 disease (Bateson & Gluckman, 2011; Gluckman & Hanson, 2005).

Second, our results confirmed the overall importance of displacement on general aspects of health for older adults. Displacement during

both childhood and adulthood had comparable effects on poor SRH. Other displacement studies have also demonstrated the association between displacement and SRH (Daoud et al., 2012). SRH is a general measure of overall health that is strongly associated with mortality in some developing countries (Zhao et al. 2014).

Our results are contrary to expectations for heart disease. Our results show weaker and inconclusive evidence of associations between displacement and heart disease. Rheumatic fever in childhood increases the risk of adult heart disease (and our results showed this). However, displaced children are at an increased risk of rheumatic fever due to poverty and lack of health care (De Maio et al., 2016). We thus expected to observe a strong association. It may be that self-reported heart disease fails to adequately capture the association between displacement and heart disease, or that the small number of cases reporting rheumatic fever are not sufficient to produce more robust interactions

between rheumatic fever and displacement.

A third aspect of our results has to do with the timing of displacement. In that regard, we found positive interactions between displacement at younger ages and childhood infections for adult stress/major illness, and between displacement at older ages and childhood infections for reporting at least one chronic condition. The most intriguing (and strongest) result was the positive interaction between childhood infections and displacement during young adulthood. The temporal order of these events is clear despite the cross-sectional nature of our data—from exposure to childhood infections, to displacement during young adulthood and to older adult health.

While we cannot identify all the mechanisms related to this interaction, a life-course perspective suggests that all exposures in an individual's life are connected and have an effect (Ben-Shlomo & Kuh, 2002; George, 2003). Displacement is a stressful event and stressful events can have long-term consequences for adult health (Elder et al., 1996). Consequences of poor early life conditions can interact with stress during adulthood with serious consequences for health (Vaiserman, 2015). Young adulthood is a stage of life where individuals establish family and livelihood. Serious childhood infections, possibly also reflecting poor nutrition given the synergistic relationship between infection and nutrition (Scrimshaw et al., 1968), could reduce resources needed to fight future exposures threatening health, especially for those with continued exposure to poor socio-economic conditions. The number of adverse events or exposures over time can also produce cumulative negative effects on health and these effects can be much stronger than experiencing adversity at one particular moment in time (Bush, Obradović, Adler, & Boyce, 2011). Neurobiological changes vary by the type, timing, and severity of adversity that is experienced and will determine the lasting effects for health later in life (McEwen, 2007). Thus, for those displaced in young adulthood with a history of poor childhood health and childhood infections, the effects of stress due to displacement could be greatly increased creating an even larger impact on health at older ages.

The fourth aspect of understanding our results has to do with resilience reducing the risk of poor health at older ages. In contrast to what we found with displacement in young adulthood, a significant negative interaction between childhood infections and displacement during childhood for older adult stress/major illness points to resilience. The life-course literature and resilience-in-aging literature has shown that similar exposures in childhood can result in differing outcomes. Individuals experience a variety of events and develop and accumulate resources that determine resilience, both in childhood and older age (Fry & Keyes, 2010; Phillips et al., 2016; Resnick, Gwyther, & Roberto, 2011; Windle, 2012). In that sense, older adults can bring with them a variety of protective traits from early exposures that can modify how adverse conditions are experienced in later life, and that allow them to recover from these events with fewer effects on health. Parenting styles and other social and historical characteristics can contribute to or limit resilience in childhood. For children with limited resources to develop resilience, displacement could negatively impact their health (Hart, 2010; Loschmann, 2016; Oyeler & Wharton, 2013) and increase the risk of poor health at older ages (Alastalo et al., 2013; Taylor, 2010; Vaiserman, 2015; Winning et al., 2015).

Those who experience adversity in early life may be better prepared to face adversity later in life (Santarelli et al., 2017), especially if they have supportive social connections (Taylor, 2010). Both childhood infections and displacement during childhood occur during the growth and development stage. For some individuals, exposure to adversity during this early stage versus experiencing multiple adverse exposures from childhood to adulthood may have less severe consequences for health and lead to resilience to poor health at older ages (Bush et al., 2011; McEwen, 2007).

The topic of resilience in older adults in countries such as Colombia merits further attention (Cano-Gutierrez et al., 2016). Evidence of resilience for other aspects of poor childhood conditions and

displacement at older ages were apparent but were not as consistent as were early life infections (see Supplementary Material). The possibility of resilience also arises for those displaced as older adults during the more recent high intensity period of armed conflict and violence in Colombia (Sánchez et al., 2003). That their health was similar in some aspects of health to those never displaced but yet showed a higher likelihood of adult risk factors (smoking, poor diet) suggests resilience.

A fifth aspect to our results is the notion that historical context affects many of the interactions and relationships observed in our study. Displacement during childhood occurred during the period of violence that peaked during the 1950s when Colombia was a much more traditional society and when the violence affected all segments of Colombian society to some degree (Sánchez et al., 2003). Colombia was in the midst of rapid demographic and epidemiological changes but most of the population was rural with traditional large and cohesive families and close social ties. The rapid urbanization of the 1960s had yet to occur (Flórez et al., 2016). Given that a high percentage of those displaced in Colombia in our study were displaced as a family, it could be that the unique nature of the violence during the 1950s combined with the strength of the traditional family produced resilience and protective effects of poor early life conditions and displacement on adult health.

In contrast, displacement during young adulthood in our study mostly occurred during the beginning of rapid urbanization and major changes to the traditional Colombian family that placed value on close social connections (Flórez et al., 2016). Most of those displaced migrated to more urban areas. While urban areas had better access to health care, exposure to serious childhood infections for these young adults occurred before being displaced and migrating to more urban areas. While supportive social connections can help mitigate stressful events (Taylor, 2010), displacement in the context of these major changes may have reduced the close proximity of family and social connections and increased the level of stress and uncertainty for young adults establishing themselves. Exposure to serious childhood infections could have then augmented the effects of stress during young adulthood.

Many of our results are relevant for low-income countries experiencing large population displacement. Individual countries differ in terms of country history, characteristics, and health patterns. However, the argument for the importance of poor early life conditions for older adult health given the rapid historical demographic and epidemiological transitions includes low-income countries (McEniry, 2014; Palloni & Souza, 2013). Differences in the timing of these transitions and in the rate of population growth (Sudharsanan & Bloom, 2018) means that many of these populations will also eventually experience increases in chronic conditions as their population of older adults increases. Thus, older adults in low-income countries also bear the burden of their historical circumstances but with the added element that they will face even greater challenges because low-income countries tend to have fewer resources. If displacement either during childhood or adulthood adds to the risk of poor health at older ages from these historical circumstances, as it does in Colombia, then the forecast for health for those displaced in low-income countries suggests a precarious future unless there is meaningful policy and planned interventions.

The study has limitations. First, while surveys of older adults offer comprehensive information on a wide variety of topics, they also limit our ability to more precisely measure the items of interest. Self-reported early life conditions among older adults (childhood exposure, social and health conditions) raise the possibility of recall bias. We cannot clearly distinguish displacement experiences in terms of their severity and psychological impact. The wording of the displacement and stress/major illness questions also introduces ambiguity in its meaning, possibly resulting in different interpretations for respondents. Ambiguity might lead to overestimating effects. However, asking questions about these topics could also lead to underestimating effects if individuals decline to respond. Topics such as displacement or admitting stress can

be very sensitive in Colombia (Cano-Gutierrez et al., 2016). We also cannot examine sensitive periods in early life and childhood which are more vulnerable to the effects of being displaced (Hart, 2010; Wald, 2014) due to sample size, nor do we have information regarding birthplace, which may have helped better understand exposure to armed conflict and violence.

A second major limitation is that cross-sectional data limits our ability to establish a clear temporal order for variables reported in the same period (e.g. childhood displacement and childhood health/social conditions; older adult health and older adult displacement). This results in a more ambiguous interpretation of the meaning of the results for these groups. A final limitation is that we do not have information on those who have died and thus survivorship bias exists, underestimating the full impact of poor early life conditions and displacement.

In spite of these limitations, our study is one of the few studies available regarding the long-term consequences of early life conditions and displacement for older adult health in the LAC region. Colombia has experienced a long history of displacement of its population; rapid demographic, epidemiological, and nutritional transitions; and a steady increase in its older adult population. Both displacement and early life conditions are relevant considerations for older adult health in such a setting.

Acknowledgements

This work was supported by the Fulbright Commission in Colombia, the Colombian Department of Science, Technology, and Innovation (Colciencias), and the Aging Institute at the Pontificia Universidad Javeriana, Bogotá, within the framework of the Fulbright U.S. Scholar program, Cohort 2016-17. University of Wisconsin- Madison researchers are supported by core National Institute of Health grants to the Center for Demography and Ecology, University of Wisconsin [P2C HD047873] and the Center for Demography of Health and Aging, University of Wisconsin [P30 AG017266]. Dr. Samper-Ternent was supported by the Sealy Center on Aging at the University of Texas Medical Branch in Galveston, Claude D. Pepper OAIC [P30-AG024832] and The Mexican Health and Aging Study [R01AG018016] from grants of the National Institutes of Health/National Institute on Aging. We are particularly grateful to Robert M. Hauser, Alberto Palloni and Emily Agree without whom this project would not have been possible. Many thanks to Sarah Moen for editing the paper and to the anonymous reviewers for their helpful comments.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.ssmph.2019.100369>

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