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ORIGINAL ARTICLE

The association of parental and offspring educational attainment with systolic blood pressure, fasting blood glucose and waist circumference in Latino adults

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Summary

Objective

The objective of the study is to evaluate the association of intergenerational educational attainment with cardiovascular disease (CVD) risk factors among US Latinos.

Methods

We used cross-sectional data from the Niños Lifestyle and Diabetes Study, an offspring cohort of middle-aged Mexican-Americans whose parents participated in the Sacramento Latino Study on Aging. We collected educational attainment, demographic and health behaviours and measured systolic blood pressure (SBP), fasting glucose and waist circumference. We evaluated the association of parental, offspring and a combined parent–offspring education variable with each CVD risk factor using multivariable regression.

Results

Higher parental education was associated only with smaller offspring waist circumference. In contrast, higher offspring education was associated with lower SBP, fasting glucose and smaller waist circumference. Adjustment for parental health behaviours modestly attenuated these offspring associations, whereas adjustment for offspring health behaviours and income attenuated the associations of offspring education with offspring SBP and fasting glucose but not smaller waist circumference, even among offspring with low parental education.

Conclusions

Higher offspring education is associated with lower levels of CVD risk factors in adulthood, despite intergenerational exposure to low parental education.

Keywords: Cardiovascular disease, cardiovascular risk factors, educational attainment, health disparities.

Introduction

Latino communities in the USA have a high burden of cardiovascular disease (CVD) and CVD risk factors, including obesity, diabetes and lower rates of adequate blood pressure control (1–3). Latinos are also more likely to have lower socioeconomic position (SEP) compared with non-Hispanic Whites in the USA (2). Low SEP and educational attainment have been associated with increased CVD morbidity and mortality and with higher prevalence of CVD risk factors among Whites and African-Americans (1,4–10). Less is known about the association of educational attainment with CVD risk factors among Latinos (2,11,12). Low educational attainment is associated with poor future health outcomes through several pathways including higher rates of detrimental behaviours such as smoking, alcohol use, low physical activity, unhealthy dietary habits and residence in neighbourhoods with poor

conditions with little access to medical care or nutritious and affordable food options (13–16). Low SEP has been shown to have biological effects not only in parents, especially based on when they were born, but also in offspring, suggesting an intergenerational transmission of negative health effects (17–21). There are few intergenerational cohort studies of Latinos. The degree to which parental educational attainment impacts offspring CVD risk factors and health behaviours in Latinos is not well established.

A limitation of prior research is that the majority of studies examining the importance of SEP on CVD risk factors have focused on SEP markers at a single point in the life course, specifically adulthood. However, childhood experience of socioeconomic disadvantage is also associated with increased incidence of CVD risk factors in adulthood (5,22–27). The life course framework in epidemiology demonstrates that health is impacted by social exposures (i.e. socioeconomic status) throughout life and that there are certain time points (i.e. in utero and early childhood) that may be critical for health later in life (28–30). Additionally, social mobility in life may play a role in health with upward mobility being beneficial to improved health later in life compared with downward mobility or stable socioeconomic over the same time period (6,8). Parental educational attainment can serve as a proxy for childhood SEP and has been associated with health outcomes of offspring in childhood, adolescence and adulthood (31,32). The associations of parental educational attainment on offspring health may be mediated by lower education and income attained by offspring, which in turn affect health (4,33). In addition, lower parental education may affect offspring health through cumulative exposure to 'unhealthy behaviours', such as parental smoking, alcohol use, low physical activity or poor dietary habits maintained by the next generation (15,19,34,35). The importance of parental educational attainment on offspring health among Latinos is less well studied (12). Moreover, the importance of factors such as parental smoking, alcohol, physical activity and parental CVD risk factors on offspring health is not well established. Prior work suggests that low parent and offspring education or socioeconomic status are associated with worse health indicators, including metabolic risk factors, dementia, infection, depression and cognitive decline (12,36–42).

Although educational attainment has increased over time for all race groups including Hispanics in the USA, Hispanics continue to have the lowest rates of adults with at least a high school education compared with non-Hispanic Whites (43). Understanding the association of intergenerational educational attainment with cardiovascular risk factors is important in designing CVD prevention strategies for Latinos. We analysed intergenerational data from the Niños Lifestyle and Diabetes Study (NLDS) to evaluate the relative contributions of parental and offspring education on systolic blood pressure (SBP), fasting glucose and waist circumference (WC) among contemporary middle-aged Latinos. We also evaluated whether these associations were explained by differences in parental versus adult offspring health behaviours.

Methods

Participants

The participants in our study were from the Niños cohort designed to study life course and intergenerational sociocultural and biological factors associated with diabetes incidence, obesity and metabolic syndrome in middle-aged Latinos of Mexican descent. Niños included persons who had at least one parent or grandparent participating in the Sacramento Latino Study on Aging (SALSA) cohort, self-identified as Latino and were ≥18 years old. Briefly, SALSA was designed to examine physical and cognitive impairment and CVD in older Latino adults and included 1,789 Latinos aged 60 years and older in 1998–1999 residing in California's Sacramento metropolitan statistical area. A full description of SALSA participants and recruitment has been previously published (36). Niños was approved by the Institutional Review Board at the University of Michigan and the University of California at San Francisco and Davis.

Niños participants were recruited from the Sacramento area in two waves: from March 2013 to November 2014 and from May 2014 to November 2014. A telephone interview was followed by an in-home visit during which trained field staff collected further medical history, performed a physical and anthropometric examination and took a venous blood sample. A total of 410 participants completed an in-home visit in Niños. For these analyses, we excluded persons who were missing education data (N = 35). Additionally, because we were interested in the effects of parental educational attainment on participants, we excluded those who had only a grandparent and not a parent in SALSA (N = 27). Among the 348 Niños participants included for analysis, 95 have both parents in the SALSA study. There are 253 unique SALSA parents included in this study.

Predictors

Our predictors of interest were offspring and parent educational attainment. Individual offspring educational attainment was obtained from the Niños participant by

questionnaire and measured by self-reported maximum years of education completed. Based on the distribution of the data, individual years of education were dichotomized into low (<16 years of education) and high (≥16 years of education). Parental educational attainment was obtained directly from the parent (SALSA participant) via questionnaire and measured by self-reported years of education completed. Based on the distribution of the data and our prior work, parental years of education were dichotomized into low (<12 years of education) and high (≥12 years of education). Because a Niños participant could have more than one parent in the SALSA study, it was decided *a priori* to use data from the parent with the maximum years of education.

To evaluate the relative contribution of offspring and parental educational attainment, we created a combination variable of parent and individual educational attainment with the following four mutually exclusive categories: 1, parent low/individual low; 2, parent low/individual high; 3, parent high/individual low; 4, parent high/individual high. This is a similar approach to what has been performed in previous papers (12).

Outcomes

Our primary outcomes of interest were the CVD risk factors of SBP, fasting blood glucose and standardized WC. These measures were collected during in-home examination. Venous blood samples were obtained by trained phlebotomists and were kept refrigerated and delivered to the University of California Davis laboratory within 4 h of collection for processing. Sitting SBP was measured twice using automated blood pressure cuffs. For these analyses, the average of two blood pressure measurements was used. WC was measured by field staff. This measurement was normalized in this analysis by dividing WC by height squared, with summaries back transformed to 64 in of height. This adjustment has the effect of normalizing WC to a standard height, analogous to body mass index (BMI), which is useful in comparing subjects in populations with differing heights (36).

Covariates

Offspring age, gender, income, nativity, smoking status, alcohol use and physical activity were obtained via self-report. Income was categorized as follows: <$30,000; $30,001–$75,000; and >$75,000 per year. Nativity was measured as born in the USA, Mexico or Other. Nativity was then dichotomized as foreign born and US born with foreign born encompassing Mexico and Other. Smoking status was assessed by asking the participant to describe their smoking status as never smoked, former smoker or current smoker. Alcohol use was defined as having answered yes or no to any alcohol consumption ever. Adult participants were asked how many days a week and how much time they spent performing vigorous and moderate physical activity. The measure of physical activity used in these analyses was obtained by totalling the number of hours per week spent performing any physical activity. Height and WC variables were obtained by averaging two separate measurements taken at in-home visits.

Parental characteristics were obtained directly from the parent (SALSA participant) at the time of their enrolment in SALSA. Nativity, smoking status, alcohol use and physical activity were obtained via self-report and were categorized as noted previously. For parental physical activity, parents were asked how many hours per week they spent performing different specific physical activities and measured in hours per week. Physical activity tertiles and other covariates were defined as above. Parental obesity was defined as BMI $\geq$ 30 kg m^{-2}. Parental diabetes mellitus was defined as either self-report of diabetes or a fasting glucose $\geq$ 126 mg dL^{-1}. Parental hypertension was defined based on average sitting blood pressure measurements and categorized by meeting at least one of the following three criteria: average SBP $\geq$ 140 mmHg, average diastolic blood pressure $\geq$ 90 mmHg or self-report of taking at least one anti-hypertensive medication.

Analyses

We first examined characteristics of the Niños participants by parental educational attainment using χ^2 or *t*-tests, as appropriate (Table 1). In a second step, we evaluated the association of parental and offspring educational attainment on each outcome, separately, using multivariate linear regression (Table 2). We used sequential models in order to examine the degree to which either parental health behaviours or Niños health behaviours and income attenuated any observed associations. These variables were chosen *a priori* and based on previously hypothesized confounders or explanatory factors for the association of educational attainment with cardiovascular risk. Specifically, model 1 adjusted for Niños age and gender. Model 2 added adjustment for parental (SALSA) characteristics: smoking status, alcohol use, physical activity and parental obesity. We included parental diabetes and hypertension as additional adjustment to model 2 in sensitivity analyses to account for potentially genetic contributions to each outcome. Model 3 adjusted for age and gender plus Niños characteristics: smoking status, alcohol use, physical activity and income. Finally, we evaluated the association of our combined education predictor (parent

Table 1 Summary characteristics for Niños participants from Sacramento in 2014, stratified by low or high parental education*

Individual characteristics	All participants (n = 348)	Low parent education (n = 220)	High parent education (n = 128)	p-value§
Age (SD)	56.1 (9.4)	56.8 (10.6)	55.0 (6.7)	0.09
Male	125 (36%)	69 (31%)	56 (44%)	0.02
Married	183 (53%)	106 (48%)	77 (60%)	0.08
US born	257 (74%)	136 (62%)	121 (95%)	<0.001
Income				<0.001
<30,000	79 (23%)	58 (26%)	21 (16%)	
30,000–75,000	118 (34%)	75 (34%)	43 (34%)	
>75,000	107 (31%)	51 (23%)	56 (44%)	
Education				<0.001
Low	251 (72%)	177 (81%)	74 (58%)	
High	97 (28%)	43 (20%)	54 (42%)	
Average systolic BP (mmHg)	130.0 (19.6)	131.0 (19.7)	128.4 (19.4)	0.23
Average diastolic BP (mmHg)	79.3 (11.7)	78.7 (11.3)	80.4 (12.5)	0.2
Fasting glucose (mg dL^{-1})	107.1 (39.8)	108.7 (44.8)	104.6 (29.7)	0.37
BMI (kg m^{-2})	31.2 (7.1)	31.5 (7.3)	30.6 (6.7)	0.27
Waist circumference (in)	40.0 (7.5)	41.0 (7.5)	38.1 (7.1)	<0.001
LDL (mg dL^{-1})	110.4 (32.4)	109.5 (32.0)	112 (33.0)	0.5
HDL (mg dL^{-1})	47.9 (13.5)	48.2 (13.1)	47.5 (14.2)	0.66
Smoking				0.7
Never	224 (64%)	138 (63%)	86 (67%)	
Former	79 (23%)	54 (25%)	25 (20%)	
Current	44 (13%)	27 (12%)	17 (13%)	
Alcohol use	100 (29%)	70 (32%)	30 (23%)	0.1
Physical activity				0.97
Least activity	119 (34%)	76 (35%)	43 (34%)	
Moderate activity	115 (33%)	73 (33%)	42 (33%)	
Most activity	114 (33%)	71 (32%)	43 (34%)	

BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SD, standard deviation.
A p-value < 0.05 is statistically significant.
*Low parental education defined by <12 years of education; high parental education defined by ≥12 years of education.
§p-values were obtained with t-test and χ^2 tests.

low/offspring low [referent], parent low/offspring high, parent high/offspring low and parent high/offspring high) with each outcome separately and adjusted in sequential models as above (Table 3). We also tested for effect modification of associations by parent nativity because prior literature demonstrates that associations of social factors with health indicators may vary in foreign-born versus US-born Latinos, using the likelihood ratio test (37,39,43,44). Two-tailed p-values were used with a significance level of <0.05 for all analyses. Statistical analysis was performed using STATA, version 12.1 (StataCorp. 2011. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP.).

Results

Participant characteristics

Among 348 Niños participants, the mean age was 56.1 ± 9.4 years, 36% were male and approximately 74% were US born. The mean education level for the parents in the SALSA cohort was 7.8 (standard deviation ±5.2) and 13.6 (standard deviation ±3.3) for the Niños cohort. There was a high prevalence of obesity in this cohort, with 52% having BMI ≥ 30 kg m^{-2}. The mean fasting glucose was 107.1 ± 39.8 mg dL^{-1}, mean SBP 130 ± 19.6 mmHg and mean standardized WC 40 ± 7.5 in. Overall, 63% of Niños had parents with low educational attainment. Those who had parents with high parental educational attainment were more likely to be married, be born in the USA and have higher income levels (Table 1). Overall, 51% of participants had both individual and parental low educational attainment (low/low), while only 15% had high parental and individual educational attainment (high/high). Approximately 12% had a high educational attainment while the parent had low educational attainment (high/low), and 21% had low individual educational attainment while the parent's educational attainment was high (low/high) (Table 1). There were no significant interactions between parental

Table 2 Multivariable linear regression of the association of parental and offspring education with offspring systolic blood pressure, fasting blood glucose and waist circumference for Niños participants from Sacramento in 2014

	N	Age–Gender adjust	+ Parental factors	+ Offspring factors
Offspring systolic blood pressure				
Parent education				
Low parent education	218	Ref	Ref	Ref
High parent education	127	−2.9 mmHg (−7.0, 1.3)	−2.0 mmHg (−6.3, 2.3)	−2.5 mmHg (−7.0, 2.0)
Offspring education				
Low offspring education	249	Ref	Ref	Ref
High offspring education	96	−6.3 mmHg (−10.7, −2.0)§	−5.0 mmHg (−9.5, −0.4)§	−5.0 mmHg (−10.2, 0.3)
Offspring fasting blood glucose				
Parent education				
Low parent education	218	Ref	Ref	Ref
High parent education	127	−5.0 mg dL^{-1} (−14.1, 4.0)	−1.6 mg dL^{-1} (−10.3, 7.1)	0.0 mg dL^{-1} (−8.5, 8.5)
Offspring education				
Low offspring education	231	Ref	Ref	Ref
High offspring education	94	−13.3 mg dL^{-1} (−22.8, −3.9)§	−10.8 mg dL^{-1} (−19.9, −1.8)§	−9.2 mg dL^{-1} (−18.8, 0.5)
Offspring waist circumference				
Parent education				
Low parent education	209	Ref	Ref	Ref
High parent education	120	−2.3 in (−3.9, −0.6)§	−2.3 in (−4.0, −0.5)§	−1.3 in (−3.0, 0.4)
Offspring education				
Low offspring education	236	Ref	Ref	Ref
High offspring education	93	−4.9 in (−6.6, −3.3)	−4.6 in (−6.4, −2.9)§	−3.6 in (−5.5, −1.7)§

Parental factors model is adjusted for offspring age and gender plus parental health behaviours (smoking, obesity, alcohol use and physical activity).
Offspring factors model is adjusted for offspring age and gender and offspring health behaviours (smoking status, alcohol use and physical activity) + offspring income.
§p-value < 0.05.

nativity, parental education and outcomes in our preliminary analyses (all p-values > 0.05), and thus, we did not pursue their inclusion in our multivariable regression modelling.

Multivariable results of parental and offspring educational attainment with offspring systolic blood pressure, fasting blood glucose and waist circumference

Educational attainment and systolic blood pressure

Compared with low parental educational attainment, high parental educational attainment was associated with 2.9 mmHg lower SBP in the offspring, but the association was not statically significant in any of the multivariable models. In contrast, high offspring educational attainment was associated with 6.3 mmHg lower SBP in adulthood, compared with low offspring educational attainment. Adjustment for parental income and health behaviours only modestly attenuated the association to 5 mmHg lower SBP for high compared with low offspring educational attainment, although this association became non-statistically significant with adjustment for offspring behaviours and income (Table 2).

Educational attainment and fasting glucose

High parental education was not significantly associated with fasting glucose levels in the offspring compared with low parental education level. NLDS offspring with high educational attainment had 13.3 mg dL^{-1} lower fasting glucose levels compared with offspring with low education level. The difference estimate was only moderately attenuated to −10.8 mg dL^{-1} by adjustment for parental income and health behaviours. The association became non-statistically significant when adjusted for the offspring health behaviours and income (Table 2).

Educational attainment and waist circumference

Among NLDS participants, both higher parental and higher individual offspring educational attainment were negatively associated with WC. NLDS participants whose parents had a high educational attainment had 2.3-in smaller WC compared with those with parents with low educational attainment. Differences were not attenuated

Table 3 Multivariable linear regression of the association of combined parent/offspring education with offspring systolic blood pressure, fasting blood glucose and waist circumference for Niños participants from Sacramento in 2014

	N	Age–Gender adjust	+ Parental factors	+ Offspring factors
Offspring systolic blood pressure				
Parent low/offspring low	175	Ref	Ref	Ref
Parent high/offspring low	74	0.3 mmHg (−4.8, 5.4)	0.5 mmHg (−4.8, 5.8)	0.7 mmHg (−4.9, 6.3)
Parent low/offspring high	43	−3.2 mmHg (−9.4, 3.0)	−3.4 mmHg (−8.8, 4.0)	−0.9 mmHg (−8.0, 6.1)
Parent high/offspring high	53	−8.7 mmHg (−14.5, −3.0)[§]	−6.9 mmHg (−12.9, −0.9)	−8.0 mmHg (−14.7, −1.3)[§]
Offspring fasting blood glucose				
Parent low/offspring low	162	Ref	Ref	Ref
Parent high/offspring low	69	−3.8 mg dL^{-1} (−15.1, 7.5)	−0.6 mg dL^{-1} (−11.3, 10.2)	0.6 mg dL^{-1} (−10.2, 11.4)
Parent low/offspring high	41	−15.3 mg dL^{-1} (−28.8, −1.7)[§]	−12.5 mg dL^{-1} (−25.5, 0.4)	−10.1 mg dL^{-1} (−23.4, 3.2)
Parent high/offspring high	53	−13.9 mg dL^{-1} (−26.2, −1.6)[§]	−9.8 mg dL^{-1} (−21.7, 2.1)	−8.0 mg dL^{-1} (−20.3, 4.4)
Offspring waist circumference				
Parent low/offspring low	168	Ref	Ref	Ref
Parent high/offspring low	68	−1.8 in (−3.8, 0.1)	−2.1 in (−4.1, 0.0)	−1.3 in (−3.4, 0.8)
Parent low/offspring high	41	−5.6 in (−7.9, −3.2)[§]	−5.3 in (−7.8, −2.8)[§]	−4.1 in (−6.7, −1.5)[§]
Parent high/offspring high	52	−5.4 in (−7.5, −3.2)[§]	−5.4 in (−7.7, −3.1)[§]	−4.1 in (−6.5, −1.6)[§]

Parental factors model is adjusted for offspring age and gender plus parental health behaviours (smoking, obesity, alcohol use and physical activity).
Offspring factors model is adjusted for offspring age and gender and offspring health behaviours (smoking status, alcohol use and physical activity) + offspring income.
[§]p-value < 0.05.

by adjustment for parental behaviours and income but rather were attenuated after adjustment for offspring income and health behaviours. Offspring with a high education level had a 4.9-in smaller WC, compared with offspring with low educational attainment. This association was only slightly attenuated by parental characteristics and remained significant even after adjustment for offspring income and health behaviours (Table 2).

Multivariable results of combined parent/offspring educational attainment with offspring systolic blood pressure, fasting blood glucose and waist circumference

Only a high parental and high offspring education level was associated with a significant 8.7 mmHg lower SBP level adjusting for age and gender, and this association remained significant after accounting for offspring health behaviours and income (Table 3). However, this association was attenuated by adjustment for parental characteristics. High offspring education level was associated with lower offspring fasting blood glucose in the age and gender models regardless of parental education levels. However, this association was attenuated with adjustment for parental and offspring health behaviours and income. Finally, high offspring education level was associated with a smaller WC even after adjustment for parental and offspring characteristics regardless of parental educational attainment.

Discussion

In this contemporary intergenerational study of middle-aged Latinos, we found that higher offspring educational attainment was associated with lower levels of SBP, lower fasting glucose and smaller WC. Adjustment for both parental and offspring income and health behaviours only modestly attenuated associations, although only the association of high offspring education with WC remained statistically significant. A high level of parental educational attainment was associated with smaller WC in the offspring, and this association was attenuated after adjustment for offspring income and health behaviours. In contrast, high parental educational attainment was not significantly associated with offspring SBP or fasting glucose.

Compared with the dyad of low parent/low offspring education, the group with high offspring education had statistically significant lower SBP and fasting glucose and a smaller WC. Except for fasting glucose, these findings were not fully accounted for by neither parental nor offspring health behaviours or income. Importantly, high offspring education was associated with smaller WC in spite of low parental education. Taken together, our findings suggest that, in this contemporary cohort of Latinos living in the Sacramento area, a higher educational attainment by the offspring is associated with lower levels of CVD risk factors in adulthood in spite of the parental level of education.

Our findings that higher educational attainment was associated with lower levels of CVD risk factors in this population are in accordance with prior literature on the importance of SEP to long-term CVD health in other populations (5,7,12,22–27). Higher educational attainment may confer a lower CVD risk profile through multiple pathways. Lower SEP may adversely affect health through higher rates of unhealthy behaviours (i.e. smoking, alcohol abuse, unhealthy diets and low physical activity) (15,19,34,35). In addition, lower SEP may be associated with higher levels of physiological and psychological stress impacting directly on physiological dysregulation including metabolic, inflammatory and endocrine pathways (16,45). Lower SEP is also associated with multiple barriers in access to high-quality medical care and exposure to disadvantaged residential and dangerous work environments all of which limits opportunities for a healthy lifestyle (6). We found that a higher offspring educational attainment was associated with smaller WC later in life, and this association was not explained by differences in offspring income or health behaviours. While the associations of offspring higher educational attainment and lower offspring SBP and fasting glucose were explained by offspring health behaviours and income, the estimates were only moderately attenuated in our full multivariable regression model. Our findings suggest that differences in income and health behaviours only partially explain observed associations between educational attainment and health indicators. However, they also highlight the need to discern the complexity of factors that explain observed disparities in CVD health in Latinos (2,3). Specifically, among Latinos with low educational attainment, multi-disciplinary interventions that target both individual and structural factors will likely be required to improve cardiovascular health (6,46).

We found that a higher parental educational attainment was associated with smaller offspring WC and that the association was not attenuated when considering differences in parental health behaviours. Rather, the association was partially explained by differences in offspring income and health behaviours. However, higher parental educational attainment did not confer significant protection among offspring with low educational attainment. On the other hand, parental educational attainment was not strongly associated with SBP or fasting glucose levels in the adult offspring. Our findings suggest that there may be heterogeneity in the association of parental educational attainment with different cardiovascular risk factors, as has been previously reported by our group and others (12,31). Parental educational attainment, as a marker of the SEP level experienced during childhood by the offspring, likely contributes to health later in life through cumulative exposure to increased stress, poor neighbourhood quality, lower access to care, exposure to cigarette smoke or poor diet early in life (2,15,46). The negative health effects may also be due to continuation of learned poor health habits into adulthood. Our findings suggest that, among Latinos, parental educational attainment may be associated with obesity later in adulthood partially due to differences in income and health behaviours of the offspring. Importantly, offspring educational attainment may be able to mitigate the negative effects of negative early childhood exposures as has been shown in a prior Norwegian study (18). The importance of other factors in explaining these associations requires further study.

We believe that our findings have important implications for the design of strategies to lower cardiovascular risk in Latinos. Our analyses support the notion that an individual's early-life disadvantage may be overcome by obtaining a higher level of education. The possibility of improving health by changing one's circumstances has been demonstrated by the Move to Opportunity for Fair Housing Demonstration Program. The Move to Opportunity, sponsored by the US Department of Housing and Urban Development, randomly assigned 4,600 low-income families with children living in disadvantaged urban neighbourhoods to remain in their neighbourhood versus obtaining vouchers to allow them to move to better housing. Adults who moved to better neighbourhoods had lower levels of obesity and diabetes but not hypertension (47). Data on the children in these families suggest that, among those who moved to better neighbourhoods, their offspring could achieve higher income levels if they moved before the age of 13 years, compared with families who remained in disadvantaged urban neighbourhoods (48). The mechanisms to explain improved health are not well known but may include improved mental health, well-being, lower crime or better access to resources (28). Whether or not 'changing' educational attainment by increasing opportunity for higher education can improve health is less well known.

A key strength of this study is the unique two-generation Latino cohort to examine intergenerational effects of educational attainment on cardiovascular risk factors. We used direct measurement of both parental and individual educational attainment and relevant health factors, while other studies have relied on recall of the offspring to identify parental education and characteristics (49). An additional strength of our study is that the majority of Latinos descended from parents of Mexican descent, which lowers the heterogeneity known to be present in Hispanics in the USA (1,2). Several limitations should be considered. Our analyses may be underpowered to fully ascertain the associations between parental education and the children's outcomes, particularly when adjusting for parental or offspring factors in the multivariable

regression models. As this is an observational study, unmeasured confounding remains. We are not able to examine other possible pathways by which education may affect health, such as differences in environmental exposures. Because this analysis was restricted to participants who had a study home visit with blood pressure, glucose and WC measurements, we may have limited power to adequately estimate associations. We were unable to examine the importance of paternal versus maternal education level, as complete data were not available for both parents. The mean age of the cohort was in the 50s, which limits our ability to understand the importance of education in earlier adulthood. We have one-time measurement of fasting glucose, blood pressure and WC and thus cannot ascertain the importance of education to longitudinal trends in these factors. In summary, we found that a higher educational attainment among Latino offspring was associated with lower levels of cardiovascular risk factors in adulthood despite low parental education level. Our study adds to the growing literature that social policy interventions that improve education and income can have lasting health effects.

Conflict of Interest Statement

There are no disclosures to report.

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