SSM - Population Health 3 (2017) 382–392

Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: www.elsevier.com/locate/ssmph

Links between primary occupation and functional limitations among older adults in Mexico

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ARTICLE INFO

Keywords:
Mobility limitations
Occupation
Education
Financial resources
Mexico

ABSTRACT

Social inequalities in health and disability are often attributed to differences in childhood adversity, access to care, health behavior, residential environments, stress, and the psychosocial aspects of work environments. Yet, disadvantaged people are also more likely to hold jobs requiring heavy physical labor, repetitive movement, ergonomic strain, and safety hazards. We investigate the role of physical work conditions in contributing to social inequality in mobility among older adults in Mexico, using data from the Mexican Health and Aging Survey (MHAS) and an innovative statistical modeling approach. We use data on categories of primary adult occupation to serve as proxies for jobs with more or less demanding physical work requirements. Our results show that more physically demanding jobs are associated with mobility limitations at older ages, even when we control for age and sex. Inclusion of job categories attenuates the effects of education and wealth on mobility limitations, suggesting that physical work conditions account for at least part of the socioeconomic differentials in mobility limitations in Mexico.

Introduction

Mortality, morbidity, and physical functioning among older adults vary considerably by socioeconomic status in most, if not all, countries (Bleich, Jarlenski, Bell, & LaVeist, 2012; He, Muenchrath, & Kowal, 2012; Hurst et al., 2013; Marmot, Allen, Bell, Bloomer, & Goldblatt, 2012; Smith & Majmundar, 2012; Toch et al., 2014). Individuals with more education and higher economic status are generally in better health. Although there is persuasive evidence about some of the mechanisms involved, including differential access to health care, early life conditions, environmental exposures, personal health behaviors, and stress (Braveman, Egerter, & Williams, 2011; Marmot & Allen, 2014), the picture is far from complete. This is particularly true for middle and low income countries which are experiencing rapid population aging and for which there is less evidence about the causes of health inequalities.

One of the factors that is likely to account for socioeconomic inequalities in health among older adults is work – specifically, the physical and psychosocial conditions of the work done throughout life (Burgard & Lin, 2013; Clougherty, Souza, & Cullen, 2010; Hoven & Siegrist, 2013; Landsbergis, Grzywacz, & LaMontagne, 2014; Marmot et al., 1991). For most adults, work is a major part of life, whether it involves paid employment, self-employment, or housework and child care. Work is highly stratified by socioeconomic status: educational attainment and family background play a large role in determining the type of work that adults do and the work conditions they are exposed to. Furthermore, extensive research on occupational health and safety has demonstrated a strong relationship between physical and psychosocial work conditions and health. Taken together, socioeconomic stratification in work conditions and the strong evidence that work conditions affect health suggest that work conditions are likely to play an important role in the creation of socioeconomic inequality in older adult health.

In this paper, our goal is to determine whether physical work conditions contribute significantly to the creation of socioeconomic inequalities in physical functioning among older adults in Mexico. The analysis addresses three questions. First, do work conditions account for a substantial portion of the socioeconomic differentials – as measured by educational attainment and wealth – in mobility limitations at older ages in Mexico? Specifically, we use a set of job categories as proxies for work conditions and assess whether their inclusion attenuates the coefficients for education and wealth. Second, do job categories as a

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http://dx.doi.org/10.1016/j.ssmph.2017.04.001
Received 17 October 2016; Received in revised form 31 March 2017; Accepted 3 April 2017
2352-8273/

group remain statistically significant after controlling for education and wealth? Third, which job categories are associated with the highest rates of mobility limitations at older ages, as a whole and by gender?

We use data from the nationally representative Mexican Health and Aging Survey (MHAS). As in most health interview surveys, physical functioning in MHAS is measured with a set of questions on functional limitations that primarily focuses on mobility. There are several reasons for focusing on mobility. Mobility is likely to be affected more strongly than many other health outcomes by a history of jobs with heavy physical demands. It is also an important determinant of individual wellbeing at older ages with significant implications for health care and daily assistance needs.

This paper makes three important contributions. First, it contributes to the literature on explanations for socioeconomic inequalities in health by investigating the role of physical work conditions. This literature has typically focused on causal mechanisms such as: the role of early life conditions, adult living standards, access to health care, experiences of discrimination (by race, gender, and other characteristics), health behaviors, and psychosocial conditions at work and in other environments (Adler & Stewart, 2010; Berkman, 2009; Braveman et al., 2011; Elo, 2009; Goldman, 2001; Kawachi, Adler, & Dow, 2010; Marmot & Allen, 2014). Despite the enormous evidence based on the effects of physical work conditions on health (Burton, 2010) and the fact that individuals from less advantaged backgrounds are more likely to work at more strenuous jobs, less attention has been paid in studies of socioeconomic inequalities in health to the role of lifetime physical work conditions in creating these inequalities.[1] Several recent studies which do examine these associations, primarily in Europe, are summarized below.

A second contribution is the focus on Mexico, a middle income country with a significant technology sector, a large industrial sector, but also large agricultural, small manufacturing, service, and informal employment sectors. Mexico has begun to implement occupational safety and health regulations more recently than high income countries. Like many lower and middle income countries, Mexico is also experiencing rapid population aging, making the growing prevalence of functional limitations and disability at older ages a serious health policy concern. Understanding the role of work in affecting older adult health in Mexico is important for Mexican policy makers and provides useful evidence about the role of work in socioeconomic health inequalities in similar countries.

Finally, this analysis also contributes to our knowledge of the determinants of limited physical functioning at older ages. The prevalence of functional limitations is increasing in many countries simply because of rapid population aging. In some countries, such as the U.S. and Mexico, functional limitations may also become more prevalent because of the dramatic growth in obesity and increased sedentariness during the past several decades (Himes & Reynolds, 2012; Rtveladze et al., 2014; Vincent, Vincent, & Lamb, 2010). Thus, old age functional limitations and other forms of disability are a key issue in public health policy and more research on ways to reduce old age functional limitations is essential (Chatterji, Byles, Cutler, Seeman, & Verdes, 2015; Jette & Field, 2007; Martin & Schoeni, 2014).

Work conditions and health

Workers with less education and from lower income backgrounds are more likely to have jobs that include heavy physical demands (e.g., carrying or moving heavy loads), repetitive movements, tiring or painful positions, ergonomic strain, extensive vibrations, noise, and heat, exposure to toxic or hazardous substances, and/or physical dangers. For example, blue collar jobs even in higher income countries often still involve exposure to heavy physical demands (Clougherty et al., 2010). Physical work conditions are typically worse in middle and lower income countries that have more limited occupational health and safety regulation and a higher proportion of workers in the unregulated informal sector (Haro-García, Juárez-Pérez, Sánchez-Román, & Aguilar-Madrid, 2014; Verbeek & Ivanov, 2013). In Mexico, for example, Sánchez-Román, Juárez-Pérez, Madrid, Haro-Gárcia, & Borja-Aburto (2006) report that high levels of underemployment (e.g., 39% in 2004) have favored informal and unregulated work.

A number of studies in higher income countries have shown that physically demanding work is associated with poorer health and functional ability in later adulthood. For example, in a U.S. national sample of individuals aged 65 or older, those whose occupation involved high levels of physical activity were less likely to be able to perform activities of daily living (ADLs) (Missikpode, Michael, & Wallace, 2016). Studies in other countries report similar results for older adult ADLs, physical functioning, and/or disability (da Costa & Vieira, 2010; Lahelma et al., 2012; Li, Wu, & Wen, 2000; Møller et al., 2015; Polvinen, Gould, Lahelma, & Martikainen, 2013; Russo et al., 2006). However, in a national Swedish sample, Rydwik et al. (2013) found little association between midlife occupation and later adult ADL or IADL disability.

A number of recent studies, mostly from European countries, have assessed the contributions of physical work conditions to socioeconomic inequalities in health. Using nationally representative survey and register data in Finland, Polvinen et al. (2013) found that socioeconomic inequalities in disability retirement – and particularly for musculoskeletal conditions – could be accounted for, in part, by differences in physical work requirements. Several studies based on the GAZEL cohort data in France found that physical work conditions contributed to socioeconomic inequalities in quality of life after retirement (Platts et al., 2013), back pain (Plouvier, Leclerc, Chastang, Bonenfant, & Goldberg, 2009), and sick days (Melchior et al., 2005). In the Netherlands, Monden (2005) showed that adverse physical work conditions, particularly over a lifetime, accounted for a significant portion of educational inequality in self-reported health (SRH) for men, but not for women. The sex difference appears to be due to educational differences in time out of the workforce (e.g., maternity and family leave) for women and limited educational variation in the physical work conditions to which women are exposed. Results of a study by Goh et al. (2015) in the United States also suggest that physical work conditions may contribute to socioeconomic inequalities in premature mortality.

The same jobs that have heavy physical work requirements may also have stressful psychosocial work conditions. Using national survey data from 27 European countries, Toch et al. (2014) examined the contribution of both physical and psychosocial work conditions to inequalities by social class categories in self-rated health (SRH). They found that physical work conditions accounted for a substantial amount of inequality in SRH and that they had a larger effect on SRH than psychosocial conditions. Plouvier et al. (2009) also found that physical work conditions, particularly biomechanical strains, had a large effect on social inequality in back pain in the GAZEL cohort study, whereas psychosocial factors played a relatively modest role. Parker et al. (2013) reached similar conclusions in Sweden. A five year longitudinal study of employed Danish adults (Borg & Kristensen, 2000; Borg, Kristensen, & Burr, 2000) also examined both physical and psychosocial work conditions and their effects on socioeconomic inequality in SRH. They also investigated whether adverse work conditions affected socioeconomic variation in the change in SRH over a five year period. They found that physical factors (repetitive work, high ergonomic exposures) and psychosocial factors both contributed to the observed social inequality in health. Only one work condition, low to moderate ergonomic exposure, contributed significantly to the probability of an improved SRH over the five year period.

The results of these and other studies suggest that adverse physical

[1] Exceptions include Clougherty et al. (2010), Burgard and Lin (2013), Toch et al. (2014), and Goh, Pfeffer, & Zenios (2015).

work conditions are an important part of the process that generates socioeconomic inequality in health in high income countries which have long standing regulation of occupation safety and health. Several of the studies suggest that the effects of physical work conditions on social inequality in health may be as important as, or more important than, adverse psychosocial conditions of work. Given the experience of these countries, we would expect that the role of physical work conditions in explaining socioeconomic inequality in health would be considerably greater in a middle income country such as Mexico where regulation of occupational safety and health is relatively recent.

Other causal and non-causal pathways

It is important to recognize that work and health may be related in other ways as well. Poor health or disability make it difficult for individuals to find good jobs – jobs which pay well, require little physical labor or hazardous exposure, and provide a safe work environment. Thus, poor health may lead to undesirable jobs rather than *vice versa*. In the case of physically demanding jobs, however, employers are more likely to hire healthier and stronger workers (Clougherty et al., 2010). If so, workers most likely to be exposed to work-related hazards may be selected from those in better initial health, thus complicating the assessment of the health effects of physical work. Deteriorating health over time – due to work or other causes – may also necessitate taking less desirable work. Blue collar workers and those in the informal sector may also be less likely to have access to high quality health care if injured, ill or exposed to environmental hazards.

A related issue is that children from disadvantaged families may be at higher risk of health problems and disability throughout life because of childhood illness and undernutrition. They are also more likely to inherit their parents' or similar occupations because of limited opportunities for social mobility. Thus, apparent associations between work and health problems may actually be due to childhood disadvantage and lack of social mobility rather than a direct causal relationship.

In this paper, we assess the degree to which socioeconomic differentials in mobility limitations (by educational attainment and wealth) are associated with major life occupation, but we cannot determine the extent to which the relationships we observe are causal.

Disability gradients at older ages in Mexico

Using data from the Mexican Health and Aging Study, Wave 1 (also used in this paper), Smith and Goldman (2007) examined whether physical functioning, self-rated health, and health behaviors varied by socioeconomic status (educational attainment, income, and wealth) in later adulthood for Mexicans age 50 and older. They found significant socioeconomic variation in the two measures of physical functioning they analyzed (number of mobility limitations and difficulty performing any activity of daily living). With few exceptions, these associations were statistically significant for respondents living in areas with 100,000 or more inhabitants, but not for those who lived in less urban areas. Part of the reason for the geographic differential may be greater heterogeneity in socioeconomic status and better access to health-related services in urban areas. Smith and Goldman (2007) also found that socioeconomic differentials in physical functioning were smaller for women than for men, particularly in urban areas. This study extends the Smith and Goldman (2007) analysis by assessing whether job categories as proxies for physical work conditions can account for part of the socioeconomic inequality in mobility limitations.

Data and methods

Data for this analysis come from the first wave of the Mexican Health and Aging Survey (MHAS), a nationally representative panel study of older Mexicans (Mexican Health and Aging Study, 2001). The first wave in 2001 was based on a nationally representative sample of Mexicans born prior to 1951, living in Mexico. The sample included residents of all 32 Mexican states and of urban and rural areas (Wong et al., 2007, 2015). Interviews were completed with 15,186 individual respondents. If the respondent was married or in a consensual union and the spouse/partner lived in the household, the spouse/partner (regardless of age) was also interviewed. Of the respondents, 13,463 were ≥ 50 years old and 1723 were spouse/partners < 50. Interviews were conducted in person, with proxy interviews (typically, with family members) in cases of poor health, hospitalization, and temporary absence. The individual response rate was 91.8% (Wong et al., 2007; Wong et al., 2015).

In this paper, we use the sample who completed questions on mobility limitations and on primary job (N = 15,146). We eliminated proxy respondents (N = 1030) because they did not answer mobility limitation questions, and we also restricted the sample to individuals aged 50 or older at the time of the survey (N = 12,452). We excluded the few respondents with missing values in the variables of interest: mobility limitations (n = 5), main job (n = 1), education (n = 8), and net worth (n = 19). The final analytic sample comprised 12,419 respondents, 5690 men and 6729 women (see Appendix A).

Independent variables

Of central interest in this analysis is the type of work the respondent did during adulthood. We use the respondent's primary job, which was assessed by the following survey question: "For the following questions, please think about the activities that you performed *in your main job throughout your life*. What is the name of the job, profession, post, or position you held in your main job?" The original wording in Spanish is as follows: "Para las siguientes preguntas, por favor piense acerca de las actividades que realizó en su trabajo principal a lo largo de su vida. ¿Cuál es el nombre del oficio, profesión, puesto o cargo que desempeña en su trabajo principal?" Textual responses to these questions were coded by the MHAS project using the Mexican occupation classification system created by the Mexican National Institute of Statistics, Geography and Informatics (INEGI).

We would ideally like to have data indicating the physical and psychological work conditions each respondent experienced in his/her main job, but unfortunately, this information does not exist. Instead, we use job categories as proxies for exposure to heavy physical work demands. We created a set of categories which reflect the likely physical work demands of jobs. We began with the 19 groups from the original INEGI classification corresponding to the "major categories" in the list of occupations (e.g., professionals; technicians; educators; domestic workers; etc.) (see Appendix B). We then combined four jobs with a low level of physical strain (professionals; technicians; educators; and directors in the public, private, and social sectors) into a single category. Finally, we further subdivided some of the remaining 15 groups to identify specific job categories that are likely to entail physical strain and injury (e.g., workers in the making of foods, beverages and tobacco products; artisans and workers in the production of textiles, leather products and related goods; etc.), consistent with the results in Sánchez-Román et al. (2006). Table 1 shows the sample distribution by the final set of job categories as well as the mean number of mobility limitations reported for each category (Appendix B additionally shows the median and maximum number of limitations). The distribution by job category varies markedly by sex. The most common jobs for men are (in order of frequency): agricultural laborer, professional/technician/educator, construction and maintenance worker, and driver/assistant driver. A large share of women did not report a primary job, though many of them were likely to have worked at home. The most common jobs for women who did report outside work are: domestic worker, professional/technician/educator, agricultural laborer, and merchant.

The distribution of limitations by job category indicates a heterogeneous population with most job categories having a wide range in the

Table 1
Unweighted Distribution of Job Categories for the Total Population and by Sex: MHAS, Wave I.

Job Category	Code	Total		Men		Female	
		N	Mob lim mean	N	Mob lim mean	N	Mob lim mean
No main job		2183	2.7	30	1.6	2153	2.7
Professionals, Technicians, Educators, Officials and Directors in the Public, Private, and Social Sectors	110–139, 210–219	1094	1.5	589	1.0	505	2.1
Workers in Art, Shows, and Sports	140–149	60	1.8	56	1.6	4	3.8
Agriculture, Livestock, Forestry, and Fishing	411–419	236	2.1	204	1.9	32	3.4
Bosses, Supervisors, etc. in Artistic and Industrial Production and in Repair and Maintenance Activities	510–519	119	1.3	104	1.3	15	1.5
Artisans and Workers in Production, Repair, and Maintenance	521,523,525,527–529	349	1.8	285	1.8	64	1.9
Operators of Fixed Machinery and Equipment for Industrial Production	530–539	294	2.0	198	1.6	96	2.7
Assistants, Laborers, etc. in Industrial Production, Repair, and Maintenance	540–549	292	2.3	174	1.8	118	3.1
Drivers and Assistant Drivers of Mobile Machinery and Transport Vehicles	550,551,553–559	114	1.6	114	1.6	NA	NA
Department Heads, Coordinators, and Supervisors in Administrative and Service Activities	610–619	173	1.6	131	1.4	42	2.3
Administrative Support Staff	621–629	292	1.6	158	1.4	134	1.8
Merchants and Sales Representatives	712–719	129	1.6	68	1.6	61	1.7
Traveling Salespeople and Traveling Salespeople of Services	720–729	244	2.2	103	1.5	141	2.7
Workers in the Service Industry	810–811,813–819	231	2.2	83	1.2	148	2.8
Domestic Workers	820	1263	3.1	37	1.9	1226	3.1
Safety and Security Personnel	830–839	181	1.7	171	1.7	10	2.0
Other Workers	990–992	59	1.5	44	1.3	15	2.1
Agricultural Laborers	410	1790	2.5	1369	2.2	421	3.2
Workers in the Making of Foods, Beverages and Tobacco Products	520	419	3.1	110	2.0	309	3.4
Artisans and Workers in the Production of Textiles, Leather Products and Related Goods	522	304	2.4	88	1.8	216	2.6
Artisans and Workers in the Treatment of Metals and in the Reparation and Maintenance of Vehicles, Machines, Equipment, Instruments, etc.	524	274	1.5	268	1.5	6	1.3
Construction and Facilities Maintenance Workers	526	467	1.7	465	1.7	2	2.5
Drivers and Assistant Drivers of Motorized Surface Transport	552	337	1.9	335	1.9	2	3.0
Secretaries, Data Entry Clerks, etc.	620	267	1.9	17	1.5	250	1.9
Merchants	710	591	2.0	245	1.4	346	2.4
Sales Associates in Retail Facilities	711	356	2.0	87	1.2	269	2.3
Porters, Concierges, Elevator Operators, and Cleaning, Gardening, and Loading Workers	812	301	2.1	157	1.6	144	2.7
Total		12,419		5690		6729	

Mob lim, mobility limitations.

number of limitations (from 0 to a maximum of at least 8, see Appendix B), but the mean and median number of limitations of each job category is generally low. As expected, workers in jobs involving more physical labor (e.g., agriculture, livestock, forestry, and fishing, domestic workers, and service industry workers) had higher levels of mobility limitations than other groups. Those who were not employed also reported relatively high levels of limitations.

Following previous research, we use years of education as our primary measure of socioeconomic status. Educational attainment is almost always completed by early adulthood, thus mitigating potential problems of reverse causality. We also include the MHAS measure of net worth or wealth that represents the monetary value of all assets (including businesses, land, housing, stocks and bonds, savings, etc.) minus debts for individuals (or for the couple if the respondent was married/cohabiting) as an additional measure of socioeconomic status. We use wealth as a measure of longer term economic status, because we are interested in the cumulative effects of socioeconomic status throughout adulthood on respondents' health at older ages. By contrast, current income represents a respondent's situation only at the time of interview. The MHAS project estimated wealth values while imputing missing values in the components of wealth using the method of sequence regressions (see Wong, Espinoza and Palloni, 2007 for further details on imputation). The imputation method has several advantages including allowing variable values to be zero, accounting for other imputed variables, and incorporating responses that are based on categorical responses ("unfolding brackets") (e.g., for respondents who refused to provide a specific number for the value of their home but were willing to answer which of several categories the value was in). In this analysis, we divide wealth values into deciles and use three categories (deciles 1 to 5, 6 to 9, and 10) to assess differentials in mobility limitations between respondents in the top 10% and in the 60–90% of the distribution relative to the bottom half of the net worth distribution. This parameterization permits a non-linear association between wealth and mobility yet is relatively parsimonious; exploratory analysis revealed little variation in mobility within each of these net worth categories.

We recognize that the causal ordering with type of work is likely to differ between education and wealth: i.e., whereas educational attainment typically precedes time spent in a person's main job, wealth generally accumulates before, during and after prime adult working ages. Thus, a person's main job may serve as a mediator in the association between education and functional ability, whereas type of work has a more complex and time-varying association with wealth. Given the cross-sectional nature of our data, we are not able to assess these relationships.

Control variables

The analysis also includes age and sex because of their strong association with mobility limitations. We include terms for age and age-squared to account for non-linearities. Previous research suggests the prevalence of functional limitations is generally higher for women than men, even with controls for age (Arber & Cooper, 1999; Díaz-Venegas et al., 2016; Merrill, Seeman, Kasl, & Berkman, 1997; Wong et al., 2011).

Dependent variable

The dependent variable in this analysis is mobility limitations, derived from a set of MHAS questions about whether the respondent can perform specified activities. The measurement of mobility and other types of functional limitations has been operationalized in a

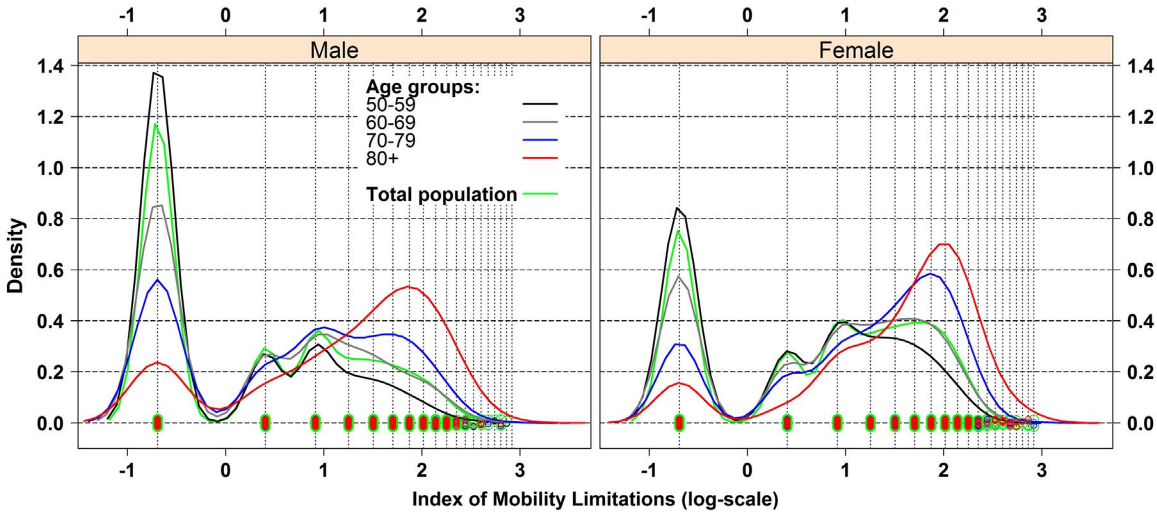

Fig. 1. Unweighted distribution of (log) mobility limitations by age and sex. MHAS Wave I. Note: we added 0.5 to the sum of mobility limitations and then log-transformed it. Vertical lines indicate actual values of mobility limitations ranging from 0 to 18 (see Appendix C).

multitude of ways. Long and Pavalko (2004) evaluate more than 100 scales designed to measure functional limitations reflecting physical limitations in mobility. They suggest that these scales perform better when they are based on a large number of survey questions, combine activities into a single scale, and include finer gradation in each activity than just a binary coding. We follow this approach and use nine survey questions related to difficulty with activities (Appendix C). Each activity was coded as having no difficulty (0), difficulty (1), or unable to perform (2). For each respondent, we simply summed all items so the total ranges from 0 to 18.

Fig. 1 shows the log-distribution of mobility limitations by age and sex (see Appendix C for a table of values). For the purpose of this figure – but not for the remaining analysis – we added 0.5 to the sum and then log-transformed the result to reduce the influence of higher values (Long & Pavalko, 2004). The figure confirms the higher prevalence of limitations among women: men have a higher concentration than women of 0–1 limitations at all ages, and women have a higher prevalence of 2+ limitations.

Analytical strategy

We use a discrete measure of mobility limitations ranging from 0 to 18 as described above. Although this measure does not technically reflect the number of limitations – since it combines the number of limitations (up to nine) with severity (difficulty with a task vs. unable to perform) – for simplicity we refer to it as a count of limitations. An inherent methodological issue when modeling mobility limitations in a non-elderly population is the large fraction of individuals reporting zero limitations (38.8% in our sample; 48.5% and 30.7% for men and women, respectively). As a result, standard models for counts (e.g., Poisson) provide a poor fit to the observed data. A common strategy to overcome this problem is to estimate zero-inflated Poisson or zero-inflated negative binomial models. Zero-inflated models, however, combine two types of zero counts – structural zeros (an implausible group of individuals that are never at risk of developing limitations) and sampling zeros (those who have no limitations by chance) – making interpretation of the resulting estimates difficult.

As an alternative, we use a hurdle model (Cragg, 1971; Mullahy, 1986; Winkelmann, 2008). Although this modeling strategy has been applied to a broad range of count data with excessive zeroes, particularly in public health (e.g., numbers of symptoms, health risk behaviors, or adverse vaccine events (Hu, Pavlicova, & Nunes, 2011; Rose, Martin, Wannemuehler, & Plikaytis, 2006)), it has less frequently been applied to physical function and disability. In our analysis, the hurdle model estimates the mobility limitation process in two stages: (1) the probability of reporting any mobility limitation (unconditional), and (2) the number of mobility limitations given that the individual reports at least one (conditional). For the first part, which we refer to as the "binary component," we estimate a conventional logistic model to identify those with and without limitations. For the second part, called the "conditional component," we use a truncated negative binomial model based only on those who report at least one limitation (i.e., truncated for counts below one). We include the same set of covariates in both parts of the hurdle model. As derived in Appendix D, the overall mean number of limitations based on the hurdle model can be obtained simply as the product of (1) the mean of the truncated negative binomial distribution and (2) the probability of having at least one limitation, obtained from the logit model.

Results

Summary statistics for the explanatory variables in the analytic sample are presented in Appendix Table A1. The male sample is slightly older than the female sample and has almost one year of additional schooling.

Our first question in this analysis is: do physical work conditions contribute to socioeconomic differentials – as measured by educational attainment and wealth – in mobility limitations at older ages in Mexico? More specifically, are the coefficients on education and wealth attenuated when job categories (as proxies for physical work conditions) are included in the model? The results are presented in Table 2. The top panel presents the coefficients from the binary component based on the logistic model (zero vs. one or more limitations). The coefficients in the bottom panel are from the truncated negative binomial model (the number of limitations conditional on having at least one), referred to here as the conditional component. In each panel, we show results for the entire sample and separately for males and females. All models control for age and age-squared and those for the entire sample also control for sex.

The first column examines the effects of a set of dummy variables for the job categories shown in Table 1. The coefficients themselves for these categories are not presented in the table but are available in Appendix D. We jointly test the statistical significance of these job category coefficients and present the results as a p-value in each panel. As shown in Model 1, the job categories are significantly associated with mobility limitations in both parts of the model and for both sexes (generally $p < .001$).

Models 2 and 3 in Table 2 include educational attainment without and with job category dummies, respectively. Additional schooling is generally associated with significantly lower odds of having any

Table 2
Coefficients from hurdle models for the total population, for men and women. Wave I (unweighted).

A) Binary component: logistic model

	Gross effect					Net effect
	(1) job	(2) educ	(3) educ + job	(4) nworth	(5) nworth + job	(6) nworth + educ + job
Total Population						
Age	0.025 ***	0.007 ***	0.010 ***	0.036 ***	0.028 ***	0.012 ***
Age-squared	0.000	0.000	0.000	0.000	0.000	0.000
Female	0.921 ***	0.777 ***	0.881 ***	0.821 ***	0.917 ***	0.881 ***
Net worth (ref = deciles 1–5)						
deciles 6–9				-0.171 ***	-0.109 **	-0.078
decile 10				-0.345 ***	-0.188 **	-0.066
Education (years)		-0.059 ***	-0.053 ***			-0.051 ***
Job categories (p-value)[1]	0.000	na	0.000	na	0.000	0.000
Males						
Age	0.054 ***	0.037 ***	0.035 ***	0.073 ***	0.057 ***	0.037 ***
Age-squared	0.000	0.000	0.000	0.000	0.000	0.000
Net worth (ref = deciles 1–5)						
deciles 6–9				-0.226 ***	-0.165 **	-0.148 *
decile 10				-0.376 ***	-0.200*	-0.067
Education (years)		-0.058 ***	-0.052 ***			-0.051 ***
Job categories (p-value)[1]	0.000	na	0.098	na	0.000	0.102
Females						
Age	0.001	-0.018	-0.010	0.005	0.002	-0.010
Age-squared	0.000	0.001	0.000	0.000	0.000	0.000
Net worth (ref = deciles 1–5)						
deciles 6–9				-0.111	-0.046	-0.014
decile 10				-0.317 ***	-0.155	-0.045
Education (years)		-0.059 ***	-0.053 ***			-0.052 ***
Job categories (p-value)[1]	0.000	na	0.000	na	0.000	0.000

B) Conditional component: truncated-at-zero negative binomial

	Gross effect					Net effect
	(1) job	(2) educ	(3) educ + job	(4) nworth	(5) nworth + job	(6) nworth + educ + job
Total Population						
Age	-0.004 ***	-0.009 ***	-0.007 ***	-0.002 *	-0.004 ***	-0.006 ***
Age-squared	0.000	0.000	0.000	0.000	0.000	0.000
Female	0.239 ***	0.216 ***	0.231 ***	0.222 ***	0.235 ***	0.229 ***
Net worth (ref = deciles 1–5)						
deciles 6–9				-0.062 ***	-0.047 *	-0.041 *
decile 10				-0.162 ***	-0.120 ***	-0.099 **
Education (years)		-0.017 ***	-0.013 ***			-0.011 ***
Job categories (p-value) [1]	0.000	na	0.003	na	0.000	0.0048
Males						
Age	0.005 **	0.001	0.003	0.008 ***	0.005 ***	0.003 *
Age-squared	0.000	0.000	0.000	0.000	0.000	0.000
Net worth (ref = deciles 1–5)						
deciles 6–9				-0.018	-0.014	-0.010
decile 10				-0.151 *	-0.114	-0.101
Education (years)		-0.013 **	-0.008			-0.007
Job categories (p-value) [1]	0.011	na	0.076	na	0.023	0.081
Females						
Age	-0.011 ***	-0.014 ***	-0.015 ***	-0.006 ***	-0.009 ***	-0.013 ***
Age-squared	0.000	0.000	0.000	0.000	0.000	0.000
Net worth (ref = deciles 1–5)						
deciles 6–9				-0.085 ***	-0.068 **	-0.059 **
decile 10				-0.166 ***	-0.127 ***	-0.101 *
Education (years)		-0.019 ***	-0.018 ***			-0.016 ***
Job categories (p-value) [1]	0.000	na	0.004	na	0.000	0.009

*** $p < 0.001$,
** $p < 0.01$,
* $p < 0.05$.
[1] p-value for overall significance of all job categories (see Appendix D for a full table of results).
Note: job, job category; educ, education in years; nworth, net worth. Net worth represents the value of all assets (including businesses, land, housing, stocks and bonds, savings, etc.) ***minus*** debts for individuals or for the couple if married/cohabiting.

Table 3
Percentage reduction in the magnitude of the education and net worth coefficients when adding job categories to the hurdle model.

SES indicator	Binary component		Conditional component	
	Gross effect	Net effect	Gross effect	Net effect
Total Population				
Education (years)	10.2	8.9	23.5	21.4
Net worth (ref= deciles 1–5)				
deciles 6–9	36.3	13.3	24.2	10.9
decile 10	45.5	15.4	25.9	9.2
Males				
Education (years)	10.3	7.3	38.5	36.4
Net worth (ref= deciles 1–5)				
deciles 6–9	24.6	0.7	22.2	-100.0[a]
decile 10	46.8	14.1	24.5	3.8
Females				
Education (years)	10.2	8.8	5.3	5.9
Net worth (ref= deciles 1–5)				
deciles 6–9	58.6	58.8	20.0	11.9
decile 10	51.1	47.7	23.5	8.2

Note: change in coefficients computed from Table 2.
[a] This value corresponds to a doubling in magnitude in the coefficient estimate (more negative), from -0.005 in the gross effects model (not shown) to -0.010 in the net effects model (model 6).

limitations and with significantly fewer limitations (among those with at least one). We show the percent change in the coefficients between models 2 and 3 in Table 3 ("gross effect").

The results in Table 3 show that, for the total sample, the education coefficient is reduced by 10% in the binary component and 23% in the conditional component with the inclusion of the occupational categories.

Models 4 and 5 in Table 2 present the analogous models with controls for wealth instead of educational attainment. In Model 4, higher asset values are significantly associated with a lower likelihood of any limitations as well as fewer limitations among those that have them. The net worth coefficients remain significant for the total sample (but not always for the sex-specific samples) in the presence of the occupation variables (Model 5) but are reduced by more than 35% in the binary component and about 25% in the conditional component (Table 3, "gross effect").

Model 6 in Table 2 includes all socioeconomic measures. As shown in Table 3 ("net effect"), the reduction in the education coefficients is 9% in the binary component and 21% in the conditional component, and, for wealth, the corresponding reductions are at least 13% and 9% for the binary and conditional components respectively.

The second question in the analysis is: do job categories as a group remain statistically significant after controlling for education and wealth? As shown in Table 2 model 3, when education level is included in the model, job categories remain a significant predictor of both components of the mobility limitation model for the total sample and for females (but not males). When wealth is held constant, job categories also remain significant, in this case, for all models (Table 2, model 5). Finally, for the total sample and the female (but not the male) sample, job categories are significantly associated with limitations in both components of the model when education and wealth are held constant (Table 2, model 6). Thus, the relationship between physical work conditions, as represented by job categories, and mobility limitations is robust to inclusion of education and wealth, except in the case of males and education. We speculate that the result for males may be due to a stronger tie between education and type of work among men than among women, but we have no means of testing this conjecture.

The third question in this analysis is: which occupational categories are associated with the highest rates of mobility limitations at older ages, as a whole and by gender? To answer this question, we use the estimates from the regression models shown in Table 2 and Appendix D to assess the magnitude of the inequalities by job category. In particular, we identify job categories associated with the highest rates of mobility limitations, for the total sample and by sex. Fig. 2 presents the results of Model 6 for each of the job categories shown in Table 1 in terms of the overall mean number of limitations, calculated by combining estimates from the two components of the hurdle model, as described earlier (Appendix D). Predicted values for each component of the hurdle model are shown in Appendix E. These estimates were obtained by retaining all variables except occupation at their observed values and then aggregating the individual estimates to obtain the binary and conditional components. To avoid estimates with very large sampling errors, Fig. 2 presents estimates only for categories (overall or by sex) with at least 50 cases.

We begin by describing the predicted overall means for the entire sample and subsequently discuss the sex differences in the results.

Results for the entire sample

The job categories with the largest mean number of limitations can be subdivided into: (1) the most hazardous group, i.e., those with an average of more than 3 limitations and (2) a second group, those with an average of 2 to 3 limitations. The most hazardous group includes only two job categories: domestic workers and food/beverage/tobacco workers. In a study of occupational safety and health in Mexico in 2004 using different job categories, Sánchez-Román et al. (2006) found that workers in food and beverage preparation and service had the highest rate of occupational accidents among those they examined. These results suggest that for these workers physical limitations at older ages may be higher, at least in part, because of frequent on-the-job injury. For domestic workers Sánchez-Román et al. (2006)'s most comparable category was "personal services for the home and diverse" which had relatively low injury rates. We speculate that, in contrast to food and beverage workers, the high level of limitations among older domestic workers may be due to the constant wear and tear of heavy physical

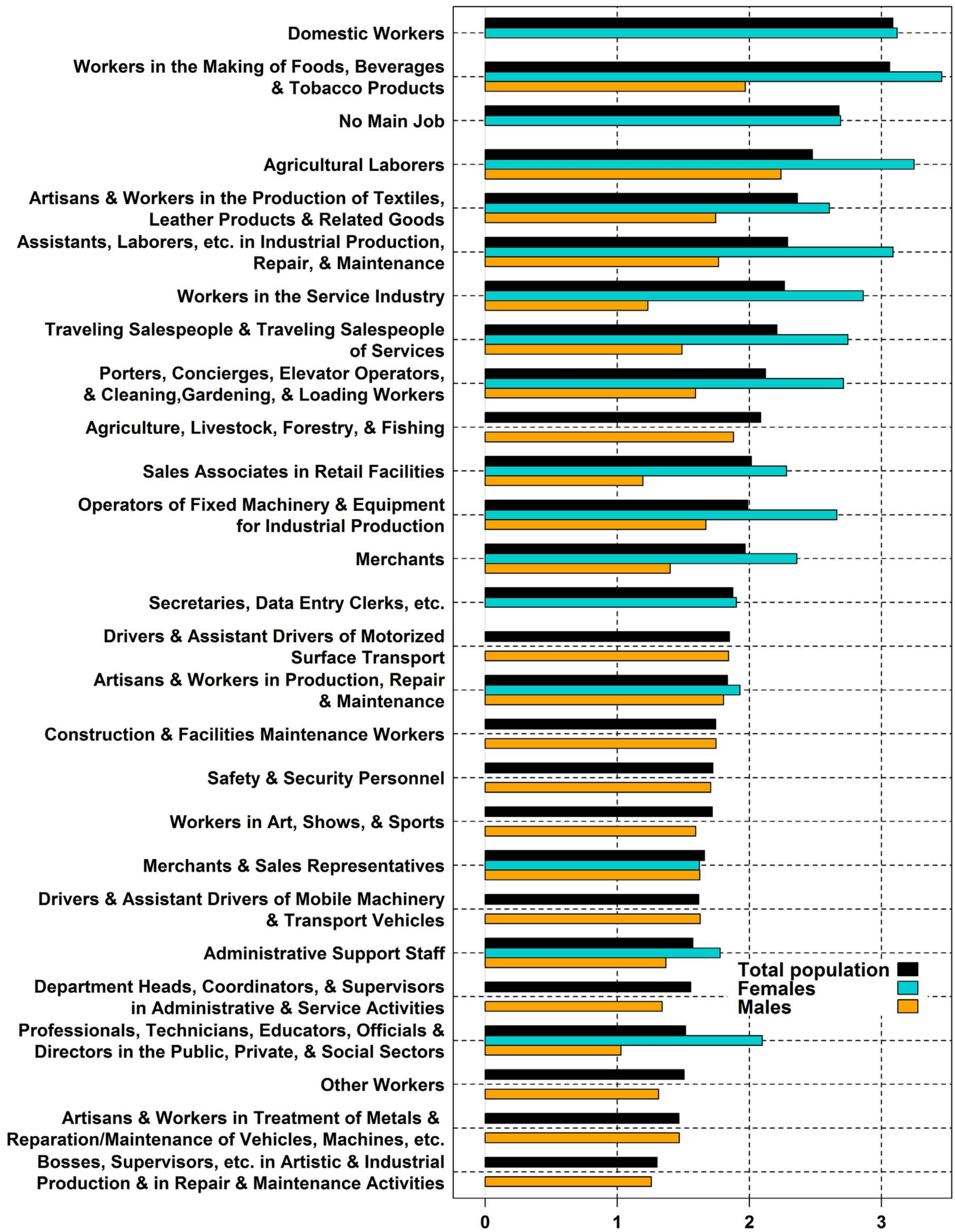

Fig. 2. Predicted overall mean number of mobility limitations from hurdle models for the total population and for women and men (model 6 in Table 2). Note: We only show predicted values for job categories with at least 50 observations (see Table 1). Appendix E shows actual values.

work and repetitive, uncomfortable positions rather than to overtly visible injuries, but additional research would be required to draw any conclusion.

The second most hazardous group includes: those who report no main job; agricultural laborers; artisans and workers in textiles, leather, etc.; assistants, laborers, etc. in industrial production, repair, and maintenance; service industry workers; traveling salesmen; porters, concierges, elevator operators and cleaning, gardening, and loaders; operators of fixed machinery and equipment; those in agriculture/livestock/forestry/fishing; and sales associates. Almost all of these occupations involve at least some physical labor and many require heavy physical labor on a daily basis. One important caveat is that domestic laborers are overwhelmingly female and, as discussed below, part of the higher mean for this group may be due to the fact that women have higher rates of limitations than men, *ceteris paribus*. Those reporting no main job are also predominantly female. In this case, the reason for the large number of limitations may be, in part, that individuals remained outside the labor force if they had physical limitations or disability rather than *vice versa*.

By contrast, the groups with the lowest overall mean limitations for the total sample are primarily managers and supervisors and/or in jobs with little physically strenuous work. The categories with an overall average of 1.5 or fewer limitations include: (1) professionals, technicians, educators, etc., (2) other workers, (3) artisans and workers in the treatment of metals, etc., and (4) bosses, supervisors etc. in artistic and industrial production, etc. Inclusion of artisans and workers in the treatment of metals, etc. in the low risk group is unexpected because Sánchez-Román et al. (2006) find that the rate of occupational accidents and permanent disabilities is unusually high for people working in the "manufacture of metal products." However, it is unclear whether the categories used by MHAS and Sánchez-Román et al. (2006) are comparable.

Sex-specific results

The results in Fig. 2 by sex differ from those of the total sample both because of overall sex-specific differences in physical limitations and because of the highly divergent distribution of job categories by sex (see also Table 1). For example, as noted above, domestic workers and those with no main job are almost exclusively female whereas other occupations (e.g., bosses, supervisors, etc. in artistic and industrial production and in repair and maintenance; construction and facility maintenance personnel) are almost exclusively male.

As in the entire sample, men's jobs with the highest overall mean number of limitations generally are those involving heavy physical labor: agricultural workers, food and beverage workers, those in agriculture, livestock, forestry and fishing, drivers and assistant drivers, artisans and workers in production, repair and maintenance, operators of industrial production machinery and equipment, assistants and laborers in industrial production, drivers, and construction and maintenance workers. The lowest overall means are primarily for managerial jobs, although workers in the service industry and retail sales workers have low means as well.

For women, the jobs associated with the highest overall mean number of limitations differ from men but also are jobs involving physical labor: food and beverage workers, agricultural workers, domestic workers, assistants and laborers in industrial production, and workers in the service industry. As for the entire sample and for men, the lowest means for women are predominantly for "white collar" jobs, but, in this case, for administrative support staff, secretaries, and data entry clerks rather than for supervisorial or managerial occupations. Few women are in these latter jobs. Women who have been merchants and sales representatives – also "white collar" jobs – have the lowest overall mean number of limitations. Female professionals, technicians, and educators have a higher mean number of limitations (> 2) than these other groups.

In every job category with an adequate sample size for each sex, the overall mean number of limitations is larger for women than for men, except in the case of merchants and sales representatives where the means are about equal. Comparison of the results for men and women yields some surprising contrasts. In the service industry and in retail sales, men and women have sharply different overall means. Women who worked in the service industry have a relatively high mean compared to women who had worked in other jobs, but men in service jobs have a relatively low mean number of limitations compared to men in other jobs. In the service industry and retail sales – and in many other jobs – men and women may perform different work, on average, and/or work in different types of establishments. Thus, although they work in the same large job category, men and women may have very different distributions of exposure to work-related hazards.

Discussion

With population aging and longer life expectancies, the prevalence of older age disability is increasing in low, middle, and high income countries (World Health Organization, 2011). Wong et al. (2011) argue that the burden of disability is heavier in lower and middle income countries like Mexico, because older people faced a high prevalence of infectious disease and poverty in their youth, but also greater longevity and burgeoning chronic disease in more recent years. As older age disability has become more common, socioeconomic inequality in older age disability is more apparent (World Health Organization, 2011). A clear understanding of the root causes of this socioeconomic inequality is essential to develop measures to reduce the burden of older age disability.

In this paper, we have examined socioeconomic inequalities in a particular aspect of older age disability, mobility limitations, and the role of physical work conditions in contributing to this inequality. The results suggest that physical work conditions account for an important, albeit modest amount of socioeconomic inequality in mobility limitations. Our study makes a contribution by highlighting the potential importance of the physical work demands experienced by people at different ends of the socioeconomic spectrum in accounting for inequalities in physical functioning by education and wealth. Workers on the lower end of the spectrum often spend much of their adulthood in jobs requiring hours of standing, moving and carrying heavy objects, hauling and pulling, working in overheated and/or hazardous environments, sitting in moving vehicles all day, working overhead or bent over, and other similar tasks. It is not surprising to find that the cumulative effects of these types of activities are associated with higher rates of mobility limitations, as we have shown.

Although both men and women in these types of jobs face similar hazards, women are likely to have higher levels of mobility limitations than men, even controlling for the effects of age. These sex differentials may be due, in part, to selection of men and women into these job categories, differences in tasks assigned to men and women within the same job category, average body size and strength differences, and greater susceptibility of women to physical disability. Future research with more detailed data should try to distinguish women's apparently greater susceptibility to physical disability from the fact that types of work are frequently "gendered," i.e., more likely to be performed by women or men (Clougherty et al., 2011).

Our study focuses on Mexico where occupational safety and health were not strongly regulated, particularly during the period when MHAS respondents were in the work force (roughly from the 1940s to 2000). The association observed between work and mobility limitations may be weaker in more regulated contexts. On the other hand, our results are likely to underestimate the size of the effects of particular types of jobs because, given the limits of MHAS sample size, we use relatively broad job categories, which may combine more and less hazardous occupations into a single category.

Another limitation of this analysis is that MHAS contains only a single question about each respondent's "main" job rather than a complete occupational history. Many people work in multiple jobs during their lives. Furthermore, the consequences of a particular type of work likely vary by duration in the job and whether it is preceded and/or followed by another type of potentially hazardous work. Analysis of occupational histories with a larger sample and more detailed occupations would allow future researchers to more specifically pinpoint work trajectories which lead to serious disability in older adults. We are also limited in drawing inferences about causality by the fact that we use cross-sectional data.

For policy makers in Mexico and elsewhere concerned about social inequality in health, our results suggest that a greater focus on improving conditions in the workplace could be a cost-effective investment for reducing mobility limitations (and probably other health conditions) among older adults. This is particularly salient in the Mexican context where subsidized or free health insurance is available to all citizens, including older adults. Mexico has a long history of providing health insurance coverage for many formal sector workers and implemented a publicly-funded universal health insurance system for others beginning in 2005 (Knaul & Frenk, 2005). Thus, the costs of mobility limitations and other forms of disability are not only greater difficulty in daily life for individuals and their families but also higher costs of health care for health insurance programs.

Declaration of interest

We acknowledge there is no actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, our work.

Acknowledgements

We acknowledge support from grants by the National Institute on Aging (R01AG052030), a pilot grant from the USC-UCLA Biodemography center (P30AG017265), grants from the Eunice Kennedy Shriver National Institute of Child Health and Human Development to the California Center for Population Research at UCLA (P2CHD041022) and to the Office of Population Research at Princeton University (P2CHD047879).

The funding agencies had no involvement in the conduct of research; in study design; in the collection, analysis and interpretation of data; in the writing of the articles; and in the decision to submit it for publication.

Appendices A-E. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.ssmph.2017.04.001.

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