Published in final edited form as:

Soc Sci Med. 2014 January ; 101: 52–60. doi:10.1016/j.socscimed.2013.10.040.

Socioeconomic inequalities in health after age 50: Are health risk behaviors to blame?

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Abstract

Recent studies indicate that socioeconomic inequalities in health extend into the elderly population, even within the most highly developed welfare states. One potential explanation for socioeconomic inequalities in health focuses on the role of health behaviors, but little is known about the degree to which health behaviors account for health inequalities among older adults, in particular. Using data from the Health and Retirement Study (N=19,245), this study examined the degree to which four behavioral risk factors – smoking, obesity, physical inactivity, and heavy drinking – are associated with socioeconomic position among adults aged 51 and older, and whether these behaviors mediate socioeconomic differences in mortality, and the onset of disability among those who were disability-free at baseline, over a 10-year period from 1998–2008. Results indicate that the odds of both smoking and physical inactivity are higher among persons with lower wealth, with similar stratification in obesity, but primarily among women. The odds of heavy drinking decrease at lower levels of wealth. Significant socioeconomic inequalities in mortality and disability onset are apparent among older men and women; however, the role that health behaviors play in accounting for these inequalities differs by age and gender. For example, these health behaviors account for between 23–45% of the mortality disparities among men and middle aged women, but only about 5% of the disparities found among women over 65 years. Meanwhile, these health behaviors appear to account for about 33% of the disparities in disability onset found among women survivors, and about 9–14% among men survivors. These findings suggest that within the U.S. elderly population, behavioral risks such as smoking and physical inactivity contribute moderately to maintaining socioeconomic inequalities in health. As such, promoting healthier lifestyles among the socioeconomically disadvantaged older adults should help to reduce later life health inequalities.

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Keywords

Aging; socioeconomic status; smoking; physical activity; obesity; disability; mortality

Population-based research conducted in a variety of industrialized countries suggests that socioeconomic inequalities in health persist into late life (Huisman, Read, Towriss, Deeg, & Grundy, 2013). Although some evidence indicates that the magnitude of these inequalities diminishes among the oldest old (von dem Knesebeck, Lüschen, Cockerham, & Siegrist, 2003), it has now become clear that socioeconomic position plays an important role, not only in determining who reaches old age, but also in shaping risk for poor health and mortality during old age (Fors, Lennartsson, & Lundberg, 2008).

That socioeconomic inequalities in health outcomes persist during late life, despite efforts to equalize access to health care (Card, Dobkin, & Meastas, 2008) and income (Crystal, Shea, & Krishnaswami, 1992) among older adults, is troubling. Some have suggested that programs for older adults, like Medicare, are ineffective at diminishing health inequalities because they do not provide equal access to the highest quality of care (Hoffmann, 2011). Others have argued that socioeconomic inequalities in old age health and mortality are largely a function of inequalities that were established much earlier in life, with the negative effects accumulating over time (Ferraro, Shippee, & Schafer, 2009).

The persistence of socioeconomic inequalities in health into late life may also be an indication that the individual lifestyles of older adults in different socioeconomic positions play a large role in maintaining health inequalities. Several studies have shown that health behaviors partially mediate socioeconomic inequalities in health among middle-aged adults (Lantz et al., 2001; Stringhini et al., 2011), and others have examined age differences in the health risks associated with socioeconomic and behavioral factors (Lantz, Golberstein, House, & Morenoff, 2010); however, few studies have examined the role of behaviors in maintaining socioeconomic inequalities in health among older adults (Fors, Agahi, & Shaw, 2012). Thus, it is currently not clear how much focus should be placed on reducing hazardous lifestyles among older adults as a means towards eliminating socioeconomic inequalities in late life health.

With the aim of gauging the role that health behaviors play in producing or maintaining socioeconomic inequalities in late life health, this study examines: a) how the prevalence of key health risk behaviors – including smoking, alcohol misuse, physical inactivity, and unhealthy body mass index (BMI) – differs across socioeconomic status among older adults; b) the extent to which these key health risk behaviors impact mortality and the initial onset of disability among older adults, and account for socioeconomic differences in these health indicators; and c) whether there are age and gender differences in the contribution of these health risk behaviors to socioeconomic inequalities in health among adults in later life. To follow is a brief review of our current knowledge pertaining to each of these areas.

Socioeconomic inequalities in health risk behaviors among older adults

Health behaviors are suspected mediators of socioeconomic inequalities in health, in part due to their socioeconomic stratification. The socioeconomic stratification of health behaviors is thought to be either due to indirect selection (Mackenbach, 2012), or the result of socioeconomic circumstances shaping the motivations and means of individuals to maintain a healthy lifestyle (Pampel, Krueger, & Denney, 2010). Indirect selection refers to a process whereby both socioeconomic achievement and health behaviors are determined by individual characteristics, like intelligence and personality. Alternatively, the influence of socioeconomic circumstances may be more direct; for example, psychological stress

resulting from financial deprivation may motivate socioeconomically disadvantaged individuals to engage in unhealthy behaviors, such as smoking and alcohol abuse, as a way of providing immediate relief from feelings of distress (Shaw, Agahi, & Krause, 2011). Similarly, socioeconomically disadvantaged individuals may be less motivated than advantaged individuals to invest the time and money necessary for engaging in healthy behaviors, such as physical activity or consuming a balanced diet, as these behaviors may be recognized as offering limited short-term, and inadequate long-term, payoff (e.g., in terms of longevity) (Blaxter, 1990). Furthermore, socioeconomic position can determine one's access to psychological, social, and environmental resources that facilitate the adoption and maintenance of healthy lifestyles (Ross & Mirowsky, 2011). Still, while the socioeconomic stratification of health behaviors in the general population has been well studied, the extent to which hazardous lifestyles are also more prevalent among socioeconomically disadvantaged groups of older adults is not well known.

Health risk behaviors and socioeconomic inequalities in health among older adults

The role of health behaviors in mediating socioeconomic inequalities in health among older adults is also a function of the degree to which health risk behaviors are associated with health outcomes during later life, and the nature by which the socioeconomic stratification of health outcomes and health risk behaviors may change with advancing age. The powerful health effects of certain health risk behaviors, such as smoking, alcohol misuse, physical inactivity, and weight management, are well known (Mokdad, Marks, Stroup, & Gerberding, 2004). However, their effects on health during older ages are less clear, perhaps in part due to the selective survival into old age of only the most resilient individuals. This could result in a population of older adults who are relatively resistant to the negative health effects of traditional behavioral risks. Such a “survivor effect” has been cited as one possible explanation for the “reverse epidemiology” of obesity among older adults, whereby the relative mortality risks of overweight and obesity decline with age (Oreopoulos, Kalantar-Zadeh, Sharma, & Fonarow, 2009).

Regarding the question of how socioeconomic differences in health and health risk behaviors may change across the adult life course, two opposing theoretical perspectives inform our understanding. On the one hand, cumulative inequality theory (Ferraro et al., 2009) proposes that experiencing social disadvantages at one point in time increases one's future likelihood of exposure to health risks, while experiencing social advantages increases future chances for exposure to opportunities for health promotion. When applied to health behaviors, this suggests that with advancing age, the personal and environmental resources necessary for maintaining a healthy lifestyle are likely to be increasingly accessible to the socioeconomically advantaged, and increasingly inaccessible to the disadvantaged. Some support for the idea that socioeconomic inequalities in the prevalence of healthy behaviors accumulate with age has been reported, particularly with respect to physical activity (Shaw & Spokane, 2008).

On the other hand, the age-as-leveler perspective suggests that during later life, normative physical and social changes become stronger determinants of health than socioeconomic circumstances (Wray, Alwin, & McCammon, 2005). As a result, at advanced ages, the prevalence of risk behaviors, like smoking, may be expected to be universally low, as rates of cessation increase with age across the entire socioeconomic spectrum (Husten et al., 1997). In addition, the age-as-leveler perspective suggests that the role of health risk behaviors in mediating socioeconomic inequalities in health may diminish with advancing age, as the relative risk of some behaviors wanes in later life. This could occur because an adult's remaining life span is not sufficiently long to experience the negative consequences

of unhealthy behaviors. For instance, prior research has shown that quitting smoking during midlife can increase life expectancy by as much as 8 years, but the benefits of quitting decline progressively with increasing age (Taylor, Hasselblad, Henley, Thun, & Sloan, 2002). Similarly, Janssen and Bacon (2008) found that becoming obese during late life is not associated with elevated mortality risk. Still, the health impacts of other behaviors, like physical activity, may continue to be strong during late life (Petersen et al., 2012).

Age and gender differences

In order to assess these competing hypotheses regarding the role of health behaviors in accounting for socioeconomic inequalities in health during later life, the current study uses data from a nationally representative sample of U.S. adults over the age of 50 to examine the potentially differential role that health risk behaviors may play across four subgroups: late middle aged and older adults, as well as among men and women. If health risk behaviors play a role in accounting for socioeconomic inequalities in health in adults over age 50, and if this role is greater among the older segments of this population, then cumulative inequality theory would be supported. If, however, health risk behaviors play a minimal role, and less of a role in the older segments of the population, then the age-as-leveler perspective would be supported.

Additionally, recognizing that health behaviors may play a different role in explaining socioeconomic inequalities in health for men and women, gender comparisons are made as well. The primary justification for expecting gender differences is that many of the variables and associations in the current study are known to vary by gender, including a) health risk behaviors tending to be more common among men than women (Berrigan, Dodd, Troiano, Krebs-Smith, & Barbash, 2003); b) the socioeconomic gradient tending to be stronger in men than women (Koskinen & Martelin, 1994); and c) rates of mortality and disability differing significantly between older men and women (Gorman & Read, 2006).

Methods

Data Source

Data for this study came from the Health and Retirement Study (HRS), a nationally representative panel survey of community-dwelling older Americans (<http://hrsonline.isr.umich.edu>). The original HRS sample, born between 1931 and 1941, was selected in 1992. In 1998, this sample was merged with cohorts born between 1890 and 1930, and between 1942 and 1947. Baseline data for the current study come from respondents to the 1998 survey who were at least 51 years old. After excluding individuals with incomplete data on any of the key variables (n=519), as well as those who died during the baseline year (n=350), 19,378 respondents remained.

All analyses utilize the HRS respondent-level population weights. These weight variables account for the probability of selection into the sample, and for differential non-response to the baseline survey, by age, race/ethnicity, and gender. The weights are scaled so as to yield weight sums which correspond to the number of individuals in the U.S. population, as measured by the Current Population Survey from March 1998. We normalized the weight variable by dividing it by its mean in order to scale it to the current study's sample size. The complete weighted analytic sample included 19,245 participants, 5,503 (28.6%) of whom died before the end of 2008. For some analyses, the weight variable was normalized separately within gender and age subgroups, resulting in the following analytic sample sizes: 4,396 middle-aged men, 4,069 older men, 5,485 middle-aged women, and 5,346 older women.

Analyses focusing on disability included only those respondents who had zero disabilities at baseline, and valid interviews in both 1998 and 2008. This resulted in an unweighted sample of 10,678, and weighted subsamples of 2,958 middle-aged men, 1,625 older men, 3,829 middle-aged women, and 2,304 older women.

Measures

Health Risk Behaviors—Smoking was measured with three categories: never smoked, former smoker, and current smoker. At baseline, 17.3% of respondents identified themselves as current smokers and 42.2% as former smokers. Respondents who never smoked (40.4%) served as the reference category.

Alcohol consumption was based on the self-reported number of alcoholic drinks a respondent consumed per week. We followed guidelines from the National Institute of Alcohol Abuse and Alcoholism (<http://www.niaaa.nih.gov/alcohol-health/special-populations-co-occurring-disorders/older-adults>) for older adults and defined heavy drinking as consuming an average of more than 7 drinks per week, with all others serving as the reference group. At baseline, 9.6% of respondents were defined as heavy drinkers.

Physical inactivity was measured with the following survey item: “On average over the last 12 months have you participated in vigorous physical activity or exercise three times a week or more? By vigorous physical activity, we mean things like sports, heavy housework, or a job that involves physical labor.” Responses were coded in a binary format (0 = Yes; 1 = No); at baseline, 55.6% of respondents answered “No” and were classified as inactive.

BMI was calculated from self-reported height and weight. BMI scores were trichotomized, with underweight defined as BMI < 18.5, and obesity as BMI ≥ 30. All other BMI scores were considered normal weight and served as the reference group. At baseline, 2.1% of respondents were categorized as underweight, 22.6% were classified as obese, and 75.3% had normal BMI scores.

Mortality—After excluding those who died during the baseline year, follow-up on mortality status was carried out from 1999 through the end of the year 2008. Date of death (month and year) was obtained from the National Death Index.

Disability—A dichotomous variable was used to measure the presence of disability (0=No; 1=Yes). Respondents who reported some difficulty with bathing, dressing, getting in and out of bed, eating, or walking across a room were considered to have a disability. At baseline, 14.6% of respondents had a disability. A dichotomous measure of disability was preferred over a continuous measure because the main aim of our disability analyses was to assess how socioeconomic and behavioral factors predict the initial onset of disability, rather than the progression of disability. A focus on disability onset not only has its own important public health significance (Matthews, Smith, Hancock, Jagger, & Spiers, 2005), but also helps to limit the possibility that any associations found between socioeconomic or behavioral factors and disability are a function of reverse causation (i.e., the influence of worsening disability on socioeconomic conditions and behavioral status).

Socioeconomic status—Socioeconomic status was measured by aggregate wealth. Previous research on socioeconomic inequalities in old age mortality, using HRS data, has compared different indicators of socioeconomic position (wealth, income, and education), and found wealth to be the strongest predictor of mortality (Hoffmann, 2011). Moreover, we favored the use of wealth over income for a study of older adults, as income is primarily derived from employment, and many older adults in our sample were retired. We favored

wealth over education for this sample due to concerns about gender differences in the economic returns on education investments (especially within the older cohort). Wealth was defined as the net value of all assets minus the net value of all debt for the respondent and his or her spouse/partner. The wealth measure was divided into quartiles.

Control Variables—All analyses were adjusted for age at baseline, race (white vs. non-white), and baseline marital status (married/partnered vs. not married/partnered). Also, the effects of baseline health were controlled for with a self-reported measure representing a count of the presence of 6 serious chronic conditions (i.e., high blood pressure, diabetes, cancer, heart disease, stroke, or lung disease) at baseline. For the mortality analyses, we also controlled for disability at baseline.

Data Analysis

Three sets of analyses were conducted, each stratified by gender and age. Age was stratified into two groups: baseline ages 51–65 to represent late middle-aged adults, and ages 66 and older to represent older adults (Papalia, Camp, & Feldman, 1996).

Socioeconomic inequalities in each health risk behavior at baseline were examined first. Socioeconomic inequalities in smoking and BMI were each assessed with multinomial logistic regression models, while socioeconomic inequalities in alcohol use and physical inactivity were each assessed with binomial logistic regression models. In all cases, the models were adjusted for age, race, chronic conditions, disability, and the other health behaviors.

The mortality analyses were conducted using Cox regression to compare the risks of dying over a 10-year period for respondents with different levels of wealth. These models were then re-estimated after controlling for each health risk behavior at baseline. The degree to which the health risk behaviors accounted for socioeconomic inequalities in health was measured by comparing the beta coefficients for each socioeconomic level in the first and second models. To control for the effects of undiagnosed disease and end of life decline on health behaviors, all respondents who died during the baseline year (1998) were excluded from the analyses.

Finally, a series of logistic regression models were estimated to examine the role of health risk behaviors in accounting for socioeconomic inequalities in disability. These analyses were restricted to only those respondents who reported no disabilities at baseline and who survived until 2008 (N=10,678). Thus, these analyses are used to examine the role of health risk behaviors in mediating socioeconomic inequalities in the development of new disabilities for those who were disability free at baseline. Whereas new disabilities could occur in people who were previously disability free, or in people who already had one or more disability, the current analyses focused only on the initial onset of disability, primarily in order to limit the possibility that any associations found between baseline health behaviors and subsequent disability were actually a function of a worsening disability influencing one's health behavior, as opposed to the health behaviors influencing the development of subsequent disability. Initial models examined the associations between socioeconomic status at baseline and the odds of having 1 or more disability at the end of the 10-year follow-up period, and then the models were re-estimated after accounting for the health risk behaviors.

Results

Table 1 presents descriptive data on the demographic characteristics, health risk behaviors, and health status of the HRS sample, as well as the lowest and highest wealth groups. The

sample has a larger proportion of women (55.4%) than men (44.6%), and is predominately white (88.7%). The average age at baseline is 65.4.

Socioeconomic inequalities in health behaviors

As each of the 4 behaviors was assessed separately within each gender and age subgroup, Table 2 presents the results from 16 separate models. The relative risk ratios (RRR) for the smoking models represent the risk of being a current smoker, compared to never having smoked, for those in the lowest three quartiles of wealth. The models show substantial socioeconomic inequalities in smoking for each subgroup, with the estimated risk of smoking being higher at progressively lower levels of wealth. In supplemental analyses (not shown here), a significant wealth by gender by age interaction ($p<.05$) indicates the presence of age differences in the association between wealth and smoking among women, but not men. More specifically, among women, the risk of smoking associated with the lowest wealth category is smaller within the older subgroup (RRR=1.75, 95% Confidence Interval (CI)=1.26–2.43) than the younger subgroup (RRR=3.74, 95% CI=2.94–4.75). Furthermore, these analyses found that the likelihood of being a former smoker was higher among men with low wealth, but among women, no such association was found.

The RRRs for the obesity models represent the risk of being obese compared to normal weight for those in the lowest 3 quartiles of wealth (the risk of being underweight was also estimated, but is not presented here). For men in both age groups, low wealth is associated with only a slight increase in the risk of obesity. On the other hand, women ages 51–65 who are in the lowest wealth category experience a more than two-fold risk for being obese compared to those in the highest wealth category (RRR=2.20, 95% CI=1.79–2.71). Risk of obesity associated with low wealth is also apparent among the older women (RRR=1.85, 95% CI=1.44–2.38). Supplemental analyses testing interaction terms confirm that the association between wealth and obesity is stronger among older women compared to older men ($p<.05$).

The odds ratios (ORs) for the physical inactivity models represent the likelihood of being physically inactive, compared to active, for those in the lowest 3 quartiles of wealth. As with smoking, the increased likelihood of physical inactivity that is associated with low wealth is apparent in each gender and age subgroup; and there is a trend towards progressively increasing odds as wealth decreases. The association between wealth and physical inactivity does not appear to differ by gender or age (and no interaction tests were statistically significant in supplemental analyses).

The ORs for the heavy drinking models represent the likelihood of consuming more than 1 drink per day. In contrast to the other behaviors, the results from these models show that for men and women over the age of 50, low wealth is associated with lower odds of heavy drinking.

Socioeconomic inequalities in mortality risk

Table 3 presents the results of the Cox regression models estimating the association between wealth and the risk of mortality (Model 1), and the mediating effects of the health behaviors (Model 2) within each subgroup. Each Model 1 shows that mortality risk increases with decreasing wealth. For both men and women, however, the size of the mortality risk associated with the lowest wealth category is smaller among the older subgroup (a test of the interaction between wealth and age confirms the statistical significance of this age difference). In particular, men ages 51–65 who are in the lowest wealth category experience a two-fold risk for dying (Hazard Ratio (HR)=2.08, 95% CI=1.62–2.66), whereas men ages 66 and older in the lowest wealth category experience a less than 50% increase in mortality

risk (HR=1.43, 95% CI=1.25–1.65). Among women ages 51–65, being in the lowest wealth quartile is associated with a nearly two-fold increase in mortality risk (HR=1.87, 95% CI=1.40–2.51), while the equivalent increase in mortality risk is 25% among women ages 66 and older (HR=1.25, 95% CI=1.09–1.43).

The results from Model 2 within each subgroup show that only two of the four behaviors are consistently associated with mortality risk. In particular, both smoking and inactivity are associated with increased mortality risk within each subgroup, while neither obesity nor heavy drinking are consistently associated with increased risk. Among the older subgroups, obesity is associated with a lower risk of mortality. Furthermore, for each subgroup, Model 2 shows that the mortality risk associated with low wealth is attenuated when the health risk behaviors are accounted for. For the younger subgroup of men, the mortality risk associated with the lowest wealth group is elevated by 76% (HR=1.76, 95% CI=1.38–2.25), which represents a 23% attenuation of risk after the health risk behaviors were included in the model. That is, the health risk behaviors accounted for 23% of the elevated mortality risk associated with the lowest wealth category among men ages 51–65. Among older men, the health risk behaviors accounted for 45% of the mortality risk associated with the lowest wealth category. For women, the health risk behaviors accounted for 32% of the mortality risk associated with the lowest wealth category among 51–65 year olds, but only 5% of the mortality risk associated with the lowest wealth category among the older women.

Socioeconomic inequalities in the late life onset of disability

Socioeconomic inequalities in the odds of disability onset after age 50 are presented in Table 4. The results from Model 1 within each subgroup show a consistent pattern of elevated odds for disability onset among those in the lowest wealth category. The odds of disability onset are sizable among the lowest wealth men ages 51–65 (OR =2.11, 95% CI=1.41–3.17), and the lowest wealth women ages 51–65 (OR=2.15, 95% CI=1.53–3.02). Within the older subgroups, the odds associated with the lowest wealth category are smaller, but statistically significant (and statistically indistinguishable from the associations found in the younger subgroups, based on non-significant tests of interaction between wealth and age).

According to each Model 2 in this table, obesity is the most consistent risk factor for disability onset after the age of 50, as it shows significant associations with disability within each age and gender subgroup. Among men, being obese is associated with a 43–71% increase in the odds of disability onset. Among women, being obese is associated with a 34–92% increase in these odds. Physical inactivity is associated with an elevation in the odds of disability onset only among the older group of women (OR=1.64, 95% CI=1.33–2.00). Furthermore, while smoking is not significantly associated with increased odds of disability onset among men, smoking is associated with a 66–76% increase in the odds of disability onset among women.

When the health risk behaviors are accounted for in Model 2, the odds associated with low wealth decline within each subgroup. The degree of attenuation associated with the lowest wealth category is 29% and 36% for the younger and older subgroups of women, respectively, and 9% and 14%, respectively, for the men.

Discussion

The primary aim of this study was to examine the role of health risk behaviors in accounting for these disparities in risk observed after age 50, and persisting beyond age 65. With a focus on what are widely regarded as the most important behavioral risks in the U.S. population, we found that these behavioral risk factors account for approximately one-quarter or more of the elevated mortality risk among the least wealthy in each gender and

age subgroup, with the exception of women over the age of 65. This proportion of risk attributed to risk behaviors among men and late-middle aged women is somewhat higher than has been found in a recent study of Swedish adults ages 56–76 (Fors et al., 2012). Therefore, our findings suggest that while the current health risk behaviors of middle-aged and older adults are not the only factors responsible for late life socioeconomic inequalities in health, the health risk behaviors of adults at this stage of life do play an important role in creating, maintaining, or exacerbating health inequalities. This finding indicates that while the aging process is associated with some degree of leveling of socioeconomic inequalities, it is not enough to overcome the inequalities in health behaviors and health outcomes that have already accumulated. As such, these findings suggest that health risk behaviors remain a suitable target for interventions aiming to reduce disparities in health among the aging population in the U.S.

At the same time, however, it is important to consider that the impact of health risk behaviors in accounting for socioeconomic inequalities in late life health varies across age and gender subgroups of the population. For example, with respect to mortality, our findings suggest that health risk behaviors are less responsible for socioeconomic inequalities in mortality risk among old aged women compared to late-middle aged women, as well as men. Other studies, focusing on younger populations, have found similar cross-group variation in the role that health behaviors play in accounting for socioeconomic inequalities in health. For example, a recent comparison of socioeconomic inequalities in mortality between British and French middle-aged adults found that smoking, alcohol consumption, diet, and physical activity together accounted for about 75% of the inequalities observed among the British, but only 19% of the inequalities observed among the French (Stringhini et al., 2011). The primary explanation offered to explain this difference was that health risk behaviors – particularly smoking and poor diet – were more socioeconomically stratified within the British population than within the French population.

In our current study, we observed some variation in the degree of socioeconomic stratification of health risk behaviors between older women and the other gender and age subgroups. In particular, smoking appears to be less steeply stratified among older women compared to the other groups. This lower level of stratification in smoking among the older women supports the age-as-leveler perspective, in that this perspective predicts the impact of socioeconomic status on smoking to become less evident at older ages. Alternatively, this finding may be indicative of historically low rates of smoking among this entire cohort of women, combined with an overrepresentation of older women in the lowest wealth quartile. Or, perhaps this finding reflects that within older cohorts of women, smoking is disproportionately concentrated among the higher socioeconomic groups, whereas in more recent cohorts of women, smoking is concentrated among the lower socioeconomic groups (Escobedo & Peddicord, 1996). Therefore, while health risk behaviors – and in particular smoking – may play a relatively small role in accounting for socioeconomic disparities in mortality risk among the current cohort of older women, this role may be expected to increase in future cohorts of older women who have had more lifetime experience, and more socioeconomic stratification, with respect to smoking.

Beyond smoking, our findings show that inactivity contributes substantially to the perpetuation of mortality inequalities; that is, within each of these subgroups, the prevalence of physical inactivity is socioeconomically stratified, and is associated with increased risk for mortality. In contrast, obesity appears to play less of a role. While socioeconomic stratification in obesity is evident during later life, the mortality risks associated with obesity in this sample were found to be minimal. In fact, among the older subgroups, obesity was found to be associated with a lower risk of mortality, a finding that is likely a reflection of selective survival/mortality (Lang, Llewellyn, Alexander, & Melzer, 2008). Heavy drinking

also appears to have a minimal impact on later life socioeconomic inequalities in mortality risk, as the prevalence of this behavior tends to be higher among socioeconomically advantaged older adults, and its association with mortality risk is negligible. Thus, overall, our findings seem to implicate smoking and inactivity as the health risk behaviors most responsible for maintaining socioeconomic inequalities in mortality during late life.

In addition, the current findings indicate that these risk behaviors are partially responsible for socioeconomic inequalities in the risk of disability onset, especially among women. Our data suggest two main reasons for why risk behaviors may play a larger role among women than men when it comes to inequalities in late life disability onset. First, whereas obesity is strongly associated with disability onset in all groups, the socioeconomic stratification of obesity appears to be stronger among women. Second, it appears as if smoking may be more clearly associated with disability onset within women compared to men, perhaps due to a selective survival of only the most resilient older male smokers.

Thus, it is clear from these findings that certain risk behaviors are partially responsible for socioeconomic inequalities in the risks of mortality and disability onset among later life adults in the U.S. As such, promoting healthier lifestyles among the most socioeconomically disadvantaged older adults could be a worthwhile endeavor in pursuit of reducing later life socioeconomic health inequalities. According to our findings, key behavioral targets should include smoking and physical inactivity for the purpose of addressing inequalities in mortality risk, as well as obesity and smoking among women when it comes to addressing inequalities in risk for disability onset.

At the same time, our findings raise interesting questions for future research about other sources of influence on socioeconomic inequalities in late life health. For instance, why are socioeconomic inequalities in late life health relatively small among older women, and what role do healthy behaviors play in keeping these inequalities in check? Furthermore, among men, why do health risk behaviors appear to play a smaller role in accounting for socioeconomic inequalities in disability onset than they do in accounting for socioeconomic inequalities in mortality?

In reviewing these findings and considering their potential implications, it is important to also consider this study's limitations. The primary limitations of this study involve the measurement of health risk behaviors. The measure of smoking used in the current study did not distinguish between levels of smoking (e.g., heavy vs. light) or smoking history, both of which may have important implications for mortality risk (Jacobs et al., 1999). Also, our measure of physical activity was based on a single survey item regarding vigorous physical activity, with just two response options. Thus, moderate activity, which is also associated with survival benefits (Lee & Paffenbarger, 2000), could not be captured. And, insufficient variability in some of our measures of behavioral risks (i.e., underweight and heavy drinking) may have reduced our power to find significant associations between these measures and our outcomes. Furthermore, because dietary behavior was not measured in the HRS, this important aspect of health lifestyles could not be included in the current study. Also, only baseline measures of behavioral risks were utilized in this study. While others have shown the value of accounting for behavioral changes over time when examining the impact of behavior on socioeconomic inequalities in health (Stringhini et al., 2010), these approaches introduce uncertainty about the degree to which health changes may lead to behavior changes. To reduce this uncertainty, we adopted the approach of relying only on baseline behavioral status. Nevertheless, without accounting for health behavior and socioeconomic histories prior to baseline, it is still possible that associations between socioeconomic position and health behaviors could reflect either socioeconomic influences on behavior, or health behavior influences on socioeconomic position (Pampel et al., 2010).

An additional limitation that should be considered involves our disability analysis, which excluded individuals with prior disabilities as well as those who died throughout the study period. These exclusions allowed us to study associations between health behaviors and the initial onset of disability among older adults. However, excluding the deceased from this portion of the analysis may not reveal the full effects of socioeconomic and behavioral factors on disability onset, as it is likely that many cases of mortality were preceded by disability.

Conclusions

This study sought to examine whether health risk behaviors continue to shape socioeconomic inequalities in health during later life, or whether the impact of behaviors is relatively trivial during this stage of life, when many of the least healthy members of the population have already died, and when virtually every member of the population has access to basic health care services. Our findings indicate that prevalence rates of key behavioral risks are relatively high among the most socioeconomically disadvantaged adults over age 50, and this stratification remains even after age 65. These behavioral risks, and their patterns of stratification in our aging society, contribute moderately to maintaining socioeconomic inequalities in health during later years. These inequalities could lead to an expanding period of late life morbidity that is disproportionately experienced by those older adults with the fewest socioeconomic resources. Therefore, within populations in which health risk behaviors remain stratified during later life, promoting healthier lifestyles among the poorest older adults may be an effective way to reduce later life health inequalities.

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Highlights

1. Smoking and physical inactivity are strongly stratified by wealth during later life;
2. Obesity is more socioeconomically stratified among older women than men;
3. Smoking and inactivity partially mediate socioeconomic inequalities in mortality;
4. Smoking and obesity partially mediate socioeconomic inequalities in disability onset.

Table 1

Demographic and health characteristics of sample.

	Total	Least Wealth (<\$38,100)	Most Wealth (>\$319,000)
Gender			
-Men (%)	44.6	38.8	49.6***
-Women (%)	55.4	61.2	50.4
Age (mean/sd)	65.4 (10.4)	65.6 (11.4)	65.3 (9.6)
Race/ethnicity			
-White (%)	88.7	74.7	96.5***
-Other (%)	11.3	25.3	3.5
Married/Partnered %	65.8	39.7	83.0***
Smoking			
-Current (%)	17.3	25.3	10.7***
-Former (%)	42.2	37.3	45.1***
-Never (%)	40.4	37.4	44.1***
BMI			
-Underweight (%)	2.1	3.1	1.5***
-Normal (%)	75.3	68.7	82.1***
-Obese (%)	22.6	28.2	16.3***
Inactive (%)	55.6	67.6	45.8***
Heavy Drinking (%)	9.6	7.5	13.3***
# of Diseases (mean/sd)	1.0 (1.0)	1.3 (1.1)	0.8 (0.9)***
ADL Limitations (%)			
No limitation	85.4	73.4	92.3***
Any Limitation	14.6	26.7	7.7***
Weighted N	19,245	4,441	5,112

p < .001, based on F-tests in ANOVA (for means) and Pearson chi-square tests (for %'s).

Table 2

Weighted multinomial and binary logistic regression models examining wealth differences in health risk behaviors, 1998.

	Men				Women			
	Ages 51–65		Ages 66+		Ages 51–65		Ages 66+	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Current Smoking ^a								
Wealth(×1000)								
< \$38.3	3.14***	(2.41–4.09)	5.09***	(3.52–7.37)	3.74***	(2.94–4.75)	1.75**	(1.26–2.43)
\$38.3–\$125.8	2.43***	(1.90–3.11)	3.31***	(2.33–4.72)	2.51***	(2.00–3.15)	1.74*	(1.28–2.36)
\$125.8–\$320	1.69***	(1.33–2.15)	2.81***	(2.01–3.92)	1.90***	(1.51–2.38)	1.22	(0.89–1.66)
> \$320	1.00		1.00		1.00		1.00	
Obesity ^b								
Wealth(×1000)								
< \$38.3	1.28*	(1.03–1.59)	1.28	(0.96–1.70)	2.20***	(1.79–2.71)	1.85***	(1.44–2.38)
\$38.3–\$125.8	1.32***	(1.08–1.60)	1.34*	(1.05–1.72)	2.04***	(1.68–2.48)	1.72***	(1.36–2.18)
\$125.8–\$320	1.15	(0.95–1.39)	1.25	(0.99–1.58)	1.52***	(1.25–1.84)	1.31*	(1.03–1.66)
> \$320	1.00		1.00		1.00		1.00	
Physical Inactivity ^c								
Wealth(×1000)								
< \$38.3	1.47***	(1.21–1.78)	2.02***	(1.62–2.53)	1.61***	(1.35–1.92)	1.68***	(1.39–2.05)
\$38.3–\$125.8	1.33***	(1.11–1.58)	1.48***	(1.23–1.79)	1.32***	(1.12–1.55)	1.34***	(1.13–1.60)
\$125.8–\$320	1.27***	(1.07–1.50)	1.10	(0.92–1.30)	1.21*	(1.03–1.41)	1.00	(0.85–1.18)
> \$320	1.00		1.00		1.00		1.00	
Heavy Drinking ^d								
Wealth(×1000)								
< \$38.3	0.76*	(0.60–0.97)	0.58**	(0.42–0.80)	0.36***	(0.24–0.52)	0.28***	(0.16–0.50)
\$38.3–\$125.8	0.65***	(0.51–0.79)	0.68**	(0.52–0.88)	0.42***	(0.30–0.58)	0.42***	(0.27–0.67)
\$125.8–\$320	0.74**	(0.60–0.92)	0.62***	(0.48–0.79)	0.41***	(0.30–0.57)	0.63*	(0.43–0.93)
> \$320	1.00		1.00		1.00		1.00	
Weighted N		4,396		4,069		5,485		5,346

p < .001,
**
p<.01,
*
p<.05

^aMultinomial logistic regression with reference category of never smoked; adjusted for age, race, marital status, number of chronic conditions, functional health status, physical inactivity, heavy drinking, and obesity.

^bMultinomial logistic regression with reference of normal weight; adjusted for age, race, marital status, number of chronic conditions, functional health status, smoking, heavy drinking, and physical inactivity.

^cLogistic regression; adjusted for age, race, marital status, number of chronic conditions, functional health status, smoking, heavy drinking, and obesity.

^dLogistic regression; adjusted for age, race, marital status, number of chronic conditions, functional health status, smoking, physical inactivity, and obesity.

Table 3
Weighted Cox regressions models examining associations between mortality risk, wealth, and health behaviors, 1998–2008^a

	Men										Women													
	Ages 51–65					Ages 66+					Ages 51–65					Ages 66+								
	% Died	Model 1	HR	95% CI	Δ % ^b	% Died	Model 1	HR	95% CI	Model 2	Δ %	% Died	Model 1	HR	95% CI	Model 2	Δ %	% Died	Model 1	HR	95% CI	Model 2	Δ %	
Wealth(<1000)																								
< \$38.3	24	2.08***	(1.62–2.66)	1.76***	(1.38–2.25)	23	63	1.43***	(1.25–1.65)	1.22**	(1.06–1.40)	45	16	1.87***	(1.40–2.51)	1.54**	(1.14–2.08)	32	59	1.25***	(1.09–1.43)	1.23**	(1.08–1.41)	5
\$38.3–\$125.8	16	1.75***	(1.38–2.22)	1.60***	(1.26–2.03)	17	58	1.50***	(1.33–1.70)	1.38***	(1.22–1.57)	21	11	1.55**	(1.16–2.06)	1.38*	(1.03–1.84)	27	47	1.20***	(1.05–1.36)	1.19**	(1.04–1.35)	3
\$125.8–\$320	12	1.37**	(1.07–1.75)	1.33**	(1.04–1.70)	9	49	1.18**	(1.05–1.34)	1.13*	(1.00–1.28)	26	7	1.10	(0.81–1.48)	1.04	(0.76–1.41)	60	41	1.15*	(1.01–1.31)	1.17*	(1.02–1.33)	0
>\$320	9	1.00		1.00			41	1.00		1.00			6	1.00		1.00		32	1.00					
Smoking																								
Never										1.00						1.00					1.00			
Former										1.31***	(1.17–1.46)					1.66***	(1.33–2.07)				1.27***	(1.16–1.39)		
Current										2.17***	(1.85–2.53)					2.49***	(1.98–3.13)				1.78***	(1.55–2.05)		
BMI																								
Underweight										1.48*	(1.09–2.00)					2.86***	(1.94–4.24)				1.67***	(1.42–1.96)		
Normal										1.00						1.00					1.00			
Obese										0.77***	(0.68–0.88)					1.00	(0.82–1.22)				0.80***	(0.71–0.90)		
Inactive										1.47***	(1.33–1.62)					1.71***	(1.40–2.09)				1.32***	(1.20–1.46)		
Heavy Drinker										0.96	(0.84–1.10)					1.14	(0.80–1.63)				0.88	(0.68–1.15)		
Weighted N										4,396						5,485					5,346			

p < .001,
**
p < .01,
*
p < .05

^a Adjusted for age, race, marital status, number of chronic conditions, functional health status.
^b Percent attenuation in log HR = $100 \times (\beta \text{ Model I} - \beta \text{ Model II})/(\beta \text{ Model I})$, where $\beta = \log(\text{HR})$.

Table 4

Weighted logistic regression models examining associations between physical disability incidence, wealth, and health behaviors, 1998–2008^a

	Men										Women												
	Ages 51–65					Ages 66+					Ages 51–65					Ages 66+							
	% New Dis.	Model 1	OR	95% CI	Model 2	Δ % ^b	% New Dis.	Model 1	OR	95% CI	Model 2	Δ % ^b	% New Dis.	Model 1	OR	95% CI	Model 2	Δ % ^b	% New Dis.	Model 1	OR	95% CI	
Wealth(<1000)																							
< \$38.3	14	2.11***	(1.41–3.17)	1.98**	(1.32–2.98)	9	29	1.80***	(1.20–2.70)	1.65*	(1.09–2.51)	14	17	2.15***	(1.53–3.02)	1.73**	(1.22–2.46)	29	38	1.40*	(1.02–1.92)	1.24	(0.90–1.71)
\$38.3–\$125.8	10	1.63*	(1.11–2.38)	1.47	(1.00–2.16)	21	26	1.52*	(1.09–2.13)	1.44*	(1.02–2.03)	13	11	1.48*	(1.07–2.06)	1.26	(0.90–1.77)	40	31	1.21	(0.92–1.59)	1.13	(0.85–1.49)
\$125.8–\$320	5	0.81	(0.53–1.23)	0.78	(0.51–1.20)	0	21	1.08	(0.79–1.48)	1.06	(0.77–1.45)	34	7	1.00	(0.71–1.41)	0.90	(0.64–1.28)		26	1.11	(0.85–1.44)	1.09	(0.84–1.42)
>\$320	6	1.00		1.00			19	1.00		1.00			7	1.00		1.00		23	1.00			1.00	
Smoking																							
Never				1.00						1.00						1.00						1.00	
Former				1.13	(0.81–1.56)					0.94	(0.71–1.25)					1.19	(0.92–1.54)					1.03	(0.83–1.28)
Current				1.28	(0.86–1.91)					1.40	(0.87–2.28)					1.66***	(1.25–2.22)					1.76***	(1.24–2.50)
BMI																							
Underweight				7.48**	(2.07–27.03)					1.41	(0.32–6.26)					0.83	(0.30–2.33)					1.34	(0.68–2.64)
Normal				1.00						1.00						1.00						1.00	
Obese				1.71***	(1.27–2.30)					1.43*	(1.03–1.99)					1.92***	(1.51–2.43)					1.34*	(1.04–1.72)
Inactive				1.18	(0.90–1.56)					1.10	(0.85–1.41)					1.15	(0.92–1.45)					1.64***	(1.33–2.00)
Heavy Drinker				0.92	(0.64–1.33)					1.09	(0.76–1.57)					0.86	(0.52–1.42)					1.07	(0.64–1.78)
Weighted N				2,958						1,625						3,829						2,304	

p <f001,

**
p<.01,

*
p<.05

^aAdjusted for age, race, marital status, number of chronic conditions.

^bPercent attenuation in log HR = 100 × (β Model I – β Model II)/(β Model I), where β=log(HR).