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Loneliness at Older Ages in the United States: Lonely Life Expectancy and the Role of Loneliness in Health Disparities

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ABSTRACT We provide an empirical foundation for research on the demography of loneliness at older ages. First, we use published life tables and data from the U.S.-based Health and Retirement Study for the period 2008–2016 to calculate lonely life expectancy for Americans aged 55 or older. Using Sullivan's method, we demonstrate pronounced differences in lonely life expectancy by sex, race/ethnicity, and educational attainment that correspond to well-established patterns of stratification in other dimensions of well-being. Next, we estimate models that decompose observed sex, racial/ethnic, and educational differences in three key health outcomes into the part explained (in a statistical accounting sense) by loneliness and the part accounted for by other factors. We find little evidence of an important role for loneliness in understanding disparities in mortality and the onset of physical disability and cognitive impairment among Americans aged 55 or older, net of several established correlates of health disparities. These descriptive findings provide an empirical foundation for continued development of a demography of loneliness at older ages in response to the anticipated growth in scientific and policy emphasis on loneliness and the fundamental life changes that have accompanied the COVID-19 pandemic.

KEYWORDS Aging • Health • Health disparities • Life expectancy • Loneliness

Introduction

Loneliness at older ages is currently the subject of much attention. Media accounts of a loneliness epidemic and references to loneliness as a public health crisis are abundant, the United Kingdom and Japan have both appointed ministers of loneliness, and the World Health Organization now defines social support networks as a determinant of health. In the United States, loneliness has been linked to a rise in "deaths of despair" (Case and Deaton 2020), and evidence that loneliness is more pronounced at older ages and at the lower end of the socioeconomic distribution (Carr 2019; Hawkley et al. 2008) suggests its potential role for understanding health disparities among older Americans. Research on loneliness has been particularly abundant in the fields of public health and psychology, with the former typically examining relationships between loneliness and health outcomes, and the latter focusing on the definition and measurement

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of loneliness and documentation of its social and biological correlates. Loneliness is clearly associated with a range of unfavorable health outcomes, is multidimensional, and manifests in different ways (Dykstra et al. 2005; Hawkley et al. 2005; Holt-Lunstad 2018; National Academies of Sciences, Engineering, and Medicine 2020).

Sociological research has focused on the concept of social isolation, paying particular attention to social relationships, social connectedness, and social network size and density, and examining their correlates and their relationships with multiple measures of health and well-being (e.g., Carr et al. 2018; Cornwell et al. 2008; Cornwell and Waite 2009). However, social isolation and loneliness are not the same: the former refers to social relationships and interactions, and the latter to the evaluation of, or satisfaction with, those relationships (Cacioppo and Hawkley 2009; Hawkley et al. 2008). Reflecting this distinction between objective circumstances and subjective evaluations, loneliness is sometimes referred to in the sociological literature as "perceived isolation" (Cornwell and Waite 2009; Luo et al. 2012). Research on loneliness in the United States conducted by demographers and social stratification scholars is limited—a surprising gap considering the widely shared interest in the (sub)population prevalence of loneliness and its association with well-studied dimensions of stratification and inequality. It is also surprising given the aging of the U.S. population and the documented relationships of social interaction and emotional support with health and other dimensions of well-being in later life (Berkman et al. 2000; Hughes et al. 2004; Waite 2018).[1]

In this article, we take a first step toward understanding the demography of loneliness at older ages by describing change over time in the prevalence of loneliness among Americans in middle and late life (aged 55 or older) and how the prevalence of loneliness differs across three of the most well-studied dimensions of social stratification and health disparities: sex, race/ethnicity, and socioeconomic status (SES), as proxied by educational attainment (Herd et al. 2011; Rothman 2015). We begin with a summary of multiple measures of loneliness using the intuitive but underutilized metric of lonely life expectancy. This single summary measure of the average quality of life represents the average number of years that a synthetic cohort of individuals would expect to live lonely beyond a given age if exposed to prevailing age-specific rates of mortality and prevalence of loneliness. We are unaware of any previous analyses of lonely life expectancy, but a large number of related studies have examined healthy life expectancy (Zheng et al. 2020), active life expectancy (Geronimus et al. 2001), cognitively intact life expectancy (Bardo and Lynch 2021), happy life expectancy (Solé-Auró et al. 2018; Yang 2008; Yang and Waliji 2010), well-being life expectancy (Perenboom et al. 2004), empowered life expectancy (Lutz 2017), and satisfied life expectancy (Solé-Auró and Lozano 2019).

We then examine relationships between loneliness and health disparities across middle and older ages. These analyses decompose observed differences by sex, race/ethnicity, and educational attainment in three widely studied health outcomes into the part that can be attributed (in a statistical accounting sense) to loneliness and the part that can be attributed to other factors. The three outcomes we examine—onset

[1] See Hansen and Slagsvold (2016), Sundström et al. (2009), and numerous studies by de Jong Gierveld, Dykstra, and colleagues on loneliness at older ages in the Netherlands and other Western European countries.

of disability, onset of cognitive impairment and dementia, and mortality—represent different dimensions of health at older ages that are all central to research on health disparities (e.g., National Center for Health Statistics 2016) and have been examined in previous studies of loneliness and health (Luo et al. 2012; Wilson et al. 2007). Attention to mortality is also motivated by growing socioeconomic differentials in life expectancy, and we recognize that functional and cognitive limitations are of central policy relevance in the context of population aging given their relationships with employment status at older ages and with health care costs.

Our calculation of lonely life expectancy provides intuitive summary measures of both loneliness and mortality across later life by three core dimensions of social stratification. Our analyses of health outcomes provide an initial descriptive assessment of the degree to which differences in loneliness help us to understand disparities in three key health outcomes at middle and older ages. By employing conventional demographic tools, both sets of analyses bring new insights to the existing literature on the prevalence and correlates of loneliness in the United States and its role in understanding health disparities. By considering three different measures of loneliness, we also provide insights into the extent to which measurement matters—an important contribution considering the limited information on loneliness available in many surveys of older adults.

Background

What Is Loneliness?

Loneliness is, of course, easy to understand at an intuitive level. Its formal definition in the scientific literature is similarly straightforward: the "feeling of social isolation that accompanies perceived deficiencies in the number or quality of one's social relationships" (Hawkley et al. 2008:S375). A key distinction implied in this definition is between the objective state of having limited contact with others (e.g., living alone, having few friends) and the subjective perception that one's interactions with others are insufficient. The former refers to social isolation (Carney et al. 2016), while the latter is what we understand as loneliness.[2]

One important implication of this distinction is that it is harder to adequately measure loneliness than social isolation in the context of a social survey. This reflects the facts that loneliness is a subjective state that can be temporary or chronic, that stigma associated with loneliness can lead to underreporting, and that carefully validated measures of loneliness are not typically included in social surveys (e.g., de Jong Gierveld 1998; Shiovitz-Ezra and Ayalon 2010; Victor et al. 2005; Waite 2018). The resulting inconsistency in the use of the term and in its empirical measurement has hampered efforts to develop a solid empirical understanding of the prevalence of loneliness, trends over time, its demographic and socioeconomic correlates, and its relationships with health and other dimensions of well-being.

[2] Concepts closely related to social isolation include social integration, social connectedness, and social inclusion/exclusion—all of which have been linked with "successful aging" (Rowe and Khan 1997).

Scholars regularly emphasize the distinction between social isolation and loneliness, noting that it is possible to be socially isolated but not feel lonely (Cacioppo and Hawkley 2009), and vice versa. Although the two concepts are clearly related (Pinquart and Sörensen 2003), it is important to emphasize that widely used measures of each are typically not highly correlated (e.g., Coyle and Dugan 2012 report a correlation coefficient of .201), they seem to have independent relationships with health outcomes (Cornwell and Waite 2009), and relationships between the two appear to depend on social and cultural context (e.g., Jylhä and Jokela 1990; Sundstrom et al. 2009).

Measurement of Loneliness

Because validated, multi-item measures of loneliness are not included in many social surveys, much of the extant research on loneliness at older ages is based on a single question included in the Center for Epidemiologic Studies-Depression Scale (CES-D) (Radloff 1977). This question, included in most large-scale surveys of older adults, asks respondents "How often in the past week (two weeks, month) have you felt lonely?" Typical response options are "all of the time," "most of the time," "some of the time," and "never."[3]

Efforts to more comprehensively measure loneliness have produced indices, such as the Revised UCLA Loneliness Scale (Russell 1996; Russell et al. 1980), the de Jong Gierveld Loneliness Scale (de Jong Gierveld 1987; de Jong Gierveld and Van Tilburg 2006), the NSHAP Felt Loneliness Measure (NFLM) (Payne et al. 2014), and the Cornwell Perceived Isolation Scale (Cornwell and Waite 2009). The original 20-item UCLA Loneliness Scale was designed to be administered face-to-face and is considered too long for telephone interviews (Hughes et al. 2004), thus prompting abbreviated (11-item and three-item) versions. The de Jong Gierveld Loneliness Scale is typically a six-item version of an 11-item scale that captures both emotional and social loneliness via questions about feelings of emptiness and rejection, missing having people around, and having people who you trust, can rely on, and feel close to. The NFLM and the Cornwell Perceived Isolation Scale are similar to the three-item UCLA index used in the Health and Retirement Study (HRS) (Cornwell and Waite 2009; Payne et al. 2014).[4]

Importantly, the 20-item and 11-item UCLA loneliness measures encompass two or three factors (Hughes et al. 2004; Lee and Cagle 2017), whereas the three-item measure includes questions about only one—feelings of social isolation. The fact that the other two factors in the 11-item measure—available social connections and sense of belonging (Lee and Cagle 2017)—are not included in the three-item measure suggests that inferences about cross-group differences in loneliness may depend on the measure used. It is also important to note that these commonly used survey-based measures of loneliness are not designed to capture duration or severity. Because questions typically ask about feelings now (UCLA scale) or in the past week or two

[3] In some surveys, including the Health and Retirement Study (used here), respondents were asked whether they felt lonely "much of the time," with a simple "yes" or "no" response option.

[4] Note that, by the definition provided above, "perceived isolation" is equivalent to loneliness.

(CES-D measure), efforts to distinguish chronic and transitory loneliness have typically relied on repeated measures in panel surveys that collect data at intervals of a year or more.[5] Similarly, questions about frequency are used to assess the degree of loneliness, but survey questions rarely provide information about the strength or depth of those feelings.

Prevalence and Correlates of Loneliness

The prevalence of loneliness, like any outcome, depends on how it is measured, with meta-analyses indicating that 5–15% and 20–40% of older Americans report frequent and occasional loneliness, respectively (Pinquart and Sorensen 2001). More recent surveys also indicate that the prevalence of loneliness in the United States ranges from 20% to 35% (National Academies of Sciences, Engineering, and Medicine 2020). Data from the National Social Life, Health and Aging Project and from the HRS show that the proportion of older Americans with values of four or greater on the NFLM and the three-item Revised UCLA measure has remained stable in recent years at around 30% (Hawkley et al. 2019).[6] It is also clear that the prevalence of loneliness at older ages varies across countries, with higher levels documented in Eastern Europe than in Western and Northern Europe (de Jong Gierveld et al. 2012; Hansen and Slagsvold 2016; Jylhä and Jokela 1990). As in the United States, the prevalence of loneliness at older ages in other countries has also been relatively stable over time (Dahlberg et al. 2018; Victor et al. 2002).

Several studies have examined relationships between loneliness and sociodemographic characteristics, such as sex, age, race/ethnicity, and education. Findings vary across individual studies but typically indicate that older women are somewhat more lonely than similarly aged men (but see Maes et al. 2019); loneliness is higher among Blacks and Hispanics than Whites; age is positively associated with loneliness, particularly among the oldest individuals; and SES, employment, and good health are negatively associated with loneliness (e.g., Cohen-Mansfield et al. 2016; Hawkley et al. 2008, 2019; Pinquart and Sörensen 2003; von Soest et al. 2020). Other studies show that small social networks, loss of a spouse, and living alone (measures of social isolation) are positively associated with loneliness (Anderson and Thayer 2018; Chen and Short 2008; de Jong Gierveld et al. 2012; de Jong Gierveld and Van Tilburg 2006; Russell 2009). Multivariate analyses find that much of the racial/ethnic gradient in loneliness reflects lower levels of income and educational attainment among Blacks and Hispanics (Hawkley et al. 2008), and it also appears that greater social isolation among immigrants contributes to the higher observed levels of loneliness among Hispanics (Viruell-Fuentes et al. 2013; Viruell-Fuentes and Schulz 2009).

In contrast to this abundance of evidence on the socioeconomic and demographic correlates of loneliness, we know little about how the duration of loneliness varies across key dimensions of social stratification—a task complicated by the subjective

[5] One exception is Anderson and Thayer (2018), who used data from an AARP survey that included self-reports on the duration of loneliness to show that chronic loneliness is common, with 72% of those who are lonely reporting that they have felt lonely for one year or more.

[6] Four is the mean value of the NFLM.

and potentially transitory nature of loneliness. To the extent that longer exposure to loneliness—or chronic loneliness—is particularly detrimental for health outcomes of interest, it is important to address this limitation in a meaningful way. The ability to observe the same individuals over time in panel surveys is helpful; however, in most surveys, the duration between waves is arguably too long to effectively measure trajectories of loneliness at the individual level. In the HRS, for example, the CES-D measure of loneliness is asked at two-year intervals and the UCLA Loneliness Scale at four-year intervals. Under some assumptions, however, exposure to loneliness across later life can be meaningfully characterized for aggregations of individuals. We describe and implement this approach to produce measures of lonely life expectancy beyond age 55. As previously noted, this measure is analogous to widely used measures of healthy life expectancy or other state-specific life expectancies and offers an intuitive metric for summarizing both mortality and the prevalence of loneliness across later life (i.e., it is a measure of the duration of loneliness averaged across individuals comprising a synthetic cohort). To our knowledge, this is the first effort to construct measures of lonely life expectancy, despite the numerous aforementioned applications of Sullivan's method to measure life expectancy in a range of other subjective states.

Loneliness and Health at Older Ages

A substantial body of research on loneliness and health at older ages demonstrates significant associations between loneliness and a range of unfavorable health outcomes, such as mortality (Holt-Lustad et al. 2015; Luo et al. 2012; Patterson and Veenstra 2010), worse self-rated health (Hawkley et al. 2016), functional limitations (Luo et al. 2012; Warner and Kelley-Moore 2012), cognitive impairment (Wilson et al. 2007), depression (Cacioppo et al. 2006; Luo et al. 2012), and poor sleep (Cacioppo et al. 2002). Understanding these relationships is complicated by the fact that causal influences go in both directions.

Many studies demonstrate that indicators of poor health—such as functional limitations, chronic diseases, and low self-rated health—contribute to greater loneliness among older adults (Burholt and Scharf 2014; Luo et al. 2012; see also the review article by Cohen-Mansfield et al. 2016). At the same time, several studies focus on influences in the opposite direction, arguing that loneliness is an important risk factor for individuals' health via a host of interdependent behavioral, psychological, and biological pathways. For instance, feeling lonely may have a negative impact on health behaviors and lifestyle (e.g., sleep, exercise, smoking, diet) that, in turn, adversely affect health (Cacioppo et al. 2002; Patterson and Veenstra 2010). Loneliness can also elevate psychological stress, anxiety, or depression (e.g., Cacioppo et al. 2006)—mental health indicators often associated with heightened blood pressure, inflammation, and other processes that contribute to poor physical health outcomes (Jaremka et al. 2013). Recent research also documents physiological (e.g., cardiovascular, immune) and genetic linkages between loneliness and health outcomes (Goossens et al. 2015; see also National Academies of Sciences, Engineering, and Medicine 2020: chapter 5, for a summary of related research).

Despite evidence that loneliness is correlated with key dimensions of social stratification and with various health outcomes, efforts to document the role that loneliness may play in understanding health disparities have been relatively limited. Health disparities at older ages are widely recognized as a critical research focus in the aging and unequal U.S. population (Hummer et al. 2004; National Center for Health Statistics 2016), and a fuller understanding of their underlying correlates and mechanisms will benefit from attention to the complex relationships between loneliness and health. However, most research on loneliness and health inequality has simply included dimensions of health disparities such as sex, race/ethnicity, and educational attainment as covariates (e.g., Cacioppo et al. 2002, 2006; Hawkley et al. 2010; Luo et al. 2012; Sutin et al. 2020; Wilson et al. 2007). Similarly, research on educational attainment and race/ethnicity as fundamental causes of health inequality has rarely considered—conceptually or empirically—the potential role of loneliness (Hayward et al. 2000; Link and Phelan 1995; Phelan and Link 2015; Phelan et al. 2004).

Several key questions thus remain unanswered. Chief among them are the extent to which differences in loneliness help us to understand gender, racial/ethnic, and socioeconomic differences in health at older ages and whether these relationships depend on the health outcome considered. For example, are differences in loneliness more (or less) relevant for understanding observed disparities in mortality than in the onset of cognitive impairment? To begin answering these questions, we extend previous research on loneliness and health by estimating models for the onset of three widely studied health outcomes. These models partition relationships between health outcomes and key dimensions of health disparities into components that are and are not explained (in a statistical accounting sense) by loneliness.

Data and Methods

Data

Our primary data source was HRS Waves 9–13, provided by RAND (2016 V1 file). Beginning in Wave 4 (1998), weighted HRS data are representative of the U.S. population aged 52 or older.[7] The HRS is the most widely used source of survey data on Americans at middle and older ages, and characteristics of the data—including content, structure, sampling scheme, response rates, and patterns of attrition—are well documented (https://g2aging.org/?section=overviews&study=hrs; see also Juster and Suzman 1995; Sonnega et al. 2014). For our purposes, the HRS is ideal for its long coverage of multiple cohorts of older Americans, oversampling of racial/ethnic minorities, and inclusion of multiple measures of loneliness.

Our analyses of lonely life expectancy required a second data source: published life tables, by sex and by race/ethnicity, for the U.S. population over the time period of interest. We used a total of nine sets of annual life tables (for the period 2008–2016) downloaded from the Human Mortality Database (https://www.mortality.org/)

[7] We used sampling weights (RWTRESP) in all analyses to reflect oversampling and patterns of differential nonresponse that may be related to loneliness and to health (e.g., age, marital status, race/ethnicity, region of residence).

to construct summary life tables for the entire period. We did this by using mean values of the age-specific probabilities of death (q_x) to construct summary life tables representing average levels of mortality over the nine-year period. To examine evidence of change over time using the one loneliness measure collected in every HRS wave, we constructed a parallel set of life tables for the period 1998–2006.[8]

Measurement

The HRS contains three measures of loneliness: one asked of all respondents in all waves and the other two asked since 2006/2008 in the leave-behind Psychosocial and Lifestyle Questionnaire given to a rotating (random) 50% subsample of the core panel participants who completed the enhanced face-to-face interview.[9] The former is a single yes or no question (since Wave 2) included in the CES-D index that asks respondents whether they felt lonely for much of the time during the past week.[10] The latter two are the three-item and 11-item indices based on the 20-item Revised UCLA Loneliness Scale mentioned earlier (Russell 1996; Russell et al. 1980; Smith et al. 2017).

The three-item measure asks respondents how much of the time they feel lack of companionship, left out, and isolated from others (items a–c). These questions have been included in the HRS Psychosocial and Lifestyle Questionnaire since 2006. Beginning in 2008, the HRS added eight more items to enhance reliability and to allow researchers to examine subdimensions of loneliness.[11] Respondents were asked how much of the time they feel in tune with the people around him/her, alone, there are people he/she can talk to, there are people he/she can turn to, there are people who really understand him/her, there are people he/she feels close to, part of a group of friends, and he/she has a lot in common with the people around him/her (items d–k). For all items, response options are "1 = often," "2 = some of the time," and "3 = hardly ever or never."

We used both the three-item and the 11-item measures—the former for its simplicity and wide use in previous research (e.g., Cacioppo et al. 2006; Hawkley et al. 2019) and the latter for its enhanced reliability among older adults (Lee and Cagle 2017). The summed indices range from 3 to 9 and from 11 to 33, respectively, with higher values indicating more loneliness. To construct measures of lonely life expectancy, we dichotomized these indices by defining as lonely those respondents whose index value was in the highest quintile of the distribution.[12] Levels of loneliness are obviously sensitive to where this threshold is set, but our general conclusions are not

[8] Because the CDC has produced separate life tables for Hispanics only since 2006, our life tables for Hispanics over the period 1998–2006 are based on a subset of (more recent) years and thus overstate Hispanic life expectancy for that period.

[9] See Smith et al. (2017) for details about the leave-behind questionnaire.

[10] In Wave 1, response options for this loneliness question are "1 = all or almost all of the time," "2 = most of the time," "3 = some of the time," and "4 = none or almost none of the time."

[11] For the sake of consistency, we examined all loneliness measures from 2008, the first year in which both UCLA measures were included in the leave-behind questionnaire.

[12] Note that the threshold for the 80th percentile of the three-item measure is the same as that for the 75th percentile because the distribution of responses has relatively few (seven) unique values.

sensitive to alternative dichotomizations and our focus on the top quintile is similar to that in one of the few other studies to use a categorical version of this index (Cacioppo et al. 2002).[13]

We considered three health measures. First, we measured disability based on reported difficulties with six activities of daily living (ADLs): walking across the room, dressing, bathing, eating, getting in and out of bed, and using the toilet. Beginning in Wave 2, HRS respondents were asked if they have difficulty with each of these ADLs, and disability was constructed as a dichotomous variable with 1 indicating difficulty with at least one activity and 0 indicating no difficulties.[14] We examined the onset of disability—that is, the presence of disability at wave $t+1$ (age $x+2$) among those with no functional limitations at wave t (age x).[15] Second, following previous research (e.g., Crimmins et al. 2011; Stephan et al. 2017; Sutin et al. 2020), we measured cognitive impairment using the modified Telephone Interview for Cognitive Status (TICSm). The RAND data file includes a 27-point composite cognitive score calculated by summing scores of immediate and delayed recall tests (to assess short-term memory; range, 0–20), a serial 7 subtraction test (to assess working memory; range, 0–5), and a backward counting test (to assess mental processing speed; range, 0–2). This cognitive measure is available in Wave 2 (for certain cohorts) and in Waves 3–12 for all respondents. We constructed a three-category measure of cognitive impairment with scores of 12–27 representing normal cognitive function (coded as 0), scores of 7–11 indicating cognitive impairment without dementia (CIND) (coded as 1), and scores of 0–6 indicating dementia (coded as 2). The TICSm in the HRS has been used to track national trends in dementia (Langa et al. 2017), and these three thresholds have been validated against a comprehensive neuropsychological assessment and clinical diagnoses of dementia (Crimmins et al. 2011). We modeled the presence of CIND and dementia at wave $t+1$ (age $x+2$) among those who had normal cognitive function at wave t (age x). Finally, for respondents who died, year and month of death are included in the HRS Tracker File and the RAND Longitudinal File. Mortality at wave $t+1$ was ascertained based on this information (0=alive, 1=dead).

Our key stratifying variables were measured as follows. Race/ethnicity distinguishes White, non-Hispanic Black, and Hispanic (of any race) individuals. HRS respondents identifying as other racial/ethnic groups (e.g., Asian-Americans) represent a small part of the sample (2.5% of the unrestricted sample), so we excluded them from our life table analyses; we included them in the decomposition analyses, but do not present their less precisely estimated coefficients in the tables. Educational attainment is a three-category measure based on highest reported level of schooling

[13] In supplementary analyses, we also dichotomized the UCLA three- and 11-item measures to define "lonely" respondents as those in the top decile and top quartile of the distributions. This obviously resulted in slightly lower (higher) levels of loneliness and shorter (longer) lonely life expectancy relative to results based on the top quintile, but differences by sex, race/ethnicity, and educational attainment were very similar to those presented herein.

[14] The question about using the toilet was not asked in Wave 2.

[15] Results from our decomposition analyses were qualitatively similar when we used alternative measures of disability based on (1) reported difficulty with any ADLs or instrumental activities of daily living (IADLs) (using a telephone, taking medication, handling money, shopping, and preparing meals) and (2) a mobility index (walking several blocks, walking one block, walking across the room, climbing several flights of stairs, climbing one flight of stairs) (results available upon request).

completed: less than high school, high school (including GED), and more than high school (some college, bachelor's degree, or above). These are similar to the conventional categorization of U.S. educational attainment, except for the highest category, which combines some college and bachelor's degree or higher, because of the relatively small numbers of older Americans who completed college.

In the health models, we controlled for other sociodemographic covariates at wave *t* that we expected to be associated with both loneliness and health outcomes. These include respondents' sex (1 = male, 0 = female), age and age squared, marital status (0 = married, 1 = never married, 2 = separated/divorced/widowed), employment status [0 = working full-time, 1 = working part-time, 2 = retired/partly retired (respondents working part-time who report being retired), 3 = unemployed/not in the labor force], logged total household income in the previous year (adjusted for inflation, with 2015 as the index year), logged household net worth (total assets excluding secondary residence minus total debts, adjusted for inflation, with 2015 as the index year), number of living children, living alone (1 = yes, 0 = no), and region of residence (1 = large metropolitan area, 0 = other area). To reduce confounding by earlier health conditions when predicting later health limitations and mortality, we used one summary index of functional status—the large muscle index—to reflect respondents' overall objective health status at the first survey wave in which they were observed.[16] Functional status summarizes overall health and is related to other health measures in theoretically meaningful ways (Wallace and Herzog 1995). The large muscle index was constructed from questions asking respondents whether they have some difficulty in sitting for two hours; getting up from a chair; stooping, kneeling, or crouching; and pushing or pulling large objects. Scores range from 0 to 4, with higher values indicating worse functional status and health.

After excluding observations with missing values on the measures of loneliness (6.4% of the sample for the CES-D loneliness measure and more than 25% of the sample for the UCLA loneliness measures), we were left with a maximum analytic sample of 23,981 respondents aged 55 or older, who provided 80,017 person-waves of data. The higher prevalence of missing values on the UCLA loneliness measures reflects the relatively high nonresponse of HRS participants to the left-behind questionnaires in which they were included. Supplementary analyses showed that missing data for the loneliness measures were not random, with missing responses more common among men, racial/ethnic minorities, and the less educated and other socioeconomically disadvantaged groups. The HRS provides a separate sampling weight to account for nonresponse on the left-behind questionnaire, but we found that missing data for the UCLA Loneliness Scale remained missing not at random on key stratifying variables even after using this weight. Therefore, we constructed inverse probability weights for the three loneliness measures by estimating logistic regression models predicting their nonmissingness. These models included all covariates in our analyses, as well as self-rated health, household size, nativity status, survey wave, and HRS cohort. We used these weights along with the respondent-level analysis weight in all of our analyses.

[16] The large muscle index is missing for the HRS AHEAD entry cohort respondents in Wave 2. For these respondents, we used their large muscle index values in Wave 3 or 4 to reflect the baseline objective health.

Missing data for the three health measures were listwise deleted, and the analytic sample for models of disability and cognitive impairment included only respondents who were not disabled and had normal cognitive function when they were first observed in the HRS. Because other covariates had very few missing values (ranging from 0.02% for educational attainment to 1.94% for number of living children), we excluded cases with incomplete information on covariates (a detailed summary of sample restrictions is provided in Table A1 of the online appendix).

Analytic Strategy

Life Tables

Because loneliness is not—and cannot be—measured in a way that allows us to observe the timing of transitions into and out of the state, it is not possible to estimate conventional multistate life tables for loneliness. Instead, we used Sullivan's method, which is the approach commonly used to measure healthy life expectancy or disability-free life expectancy (Imai and Soneji 2007), as well as life expectancy in subjective states, such as happiness (Yang 2008). If we assume that loneliness as measured in the HRS is stable at the individual level for periods of one year (of age), Sullivan's method provides a straightforward and effective means of measuring lonely life expectancy. Because this assumption of individual-level stability is presumably not realistic (but see Anderson and Thayer (2018) for evidence that loneliness often persists for at least one year), it is important to note that it is not necessary. For this kind of synthetic cohort analysis, it is only necessary to assume that the proportion of individuals defined as lonely within a given group of interest (e.g., 70-year-old men with a high school education) remains stable for one-year periods. Our analyses of average years of life spent lonely rely on this untestable assumption, and results should be evaluated with that in mind.

While it is straightforward to calculate age-specific proportions of respondents who feel lonely by sex, race/ethnicity, and educational attainment, it is more challenging to produce the corresponding life tables. Because official life tables are produced only by sex and race/ethnicity, we used the procedure proposed by Dudel and Myrskylä (2017) to construct life tables for different categories of educational attainment. First, HRS data were used to estimate sex-specific models of mortality beyond age 55 as a function of age and educational attainment.[17] The age-specific probabilities of death generated from these mortality models allowed us to construct life tables separately for each combination of sex and education categories. We then adjusted these group-specific life tables using information about age-specific probabilities of death from the sex-specific life tables published by the Centers for Disease Control and Prevention (CDC) and weighted sums of the estimated q_x values, where the weights were the observed age-specific distributions of respondents by educational attainment. Adjusting group-specific q_x values so that their weighted sum equals the observed values in the published life tables ensured that overall levels of

[17] We estimated discrete-time event-history models using logistic regression with the log odds of death specified as a quadratic function of age.

life expectancy estimated based on HRS data were identical to those produced from vital statistics data (see Dudel and Myrskylä (2017) for details on this procedure for constructing group-specific life tables for which the weighted sum is equivalent to the observed life tables for the whole population).

We next tabulated the three different dichotomous measures of loneliness by (1) age and sex; (2) age, sex, and race/ethnicity; and (3) age, sex, and educational attainment. These observed proportions were then used to partition the age-specific years of life (L_x) in the life tables just described to produce years of life lonely and not lonely that were resummed to calculate lonely life expectancy. Previous research has shown that state-specific life expectancies produced using Sullivan's method are very similar to those from life tables generated via the estimation of multistate models (Imai and Soneji 2007; Mathers and Robine 1997). To examine differences in lonely life expectancy using the CES-D measure, we constructed a total of 28 life tables: 14 groups (two for sex, six for race/ethnicity by sex, and six for educational attainment by sex) for two time periods. When using the UCLA loneliness scales, we constructed 28 life tables: the same 14 groups for two loneliness measures (the 11-item and three-item scales). We used conventional procedures to construct 95% confidence intervals around our estimates of lonely life expectancy at age 55 (Molla et al. 2001).[18]

Decomposition

To quantify the potential role of loneliness in statistically accounting for health disparities by key social stratification indicators, we used the Karlson–Holm–Breen (KHB) method (Breen et al. 2013, 2018; Karlson et al. 2012) to decompose the total "effects" of sex, race/ethnicity, and educational attainment (after conditioning on covariates) on the three health outcomes into direct effects and indirect effects via loneliness. Specifically, we used the *khb* command in Stata to estimate binary logistic regression models for the onset of disability and mortality and multinomial logistic regression models for the onset of cognitive impairment and dementia. These models are not designed to estimate causal relationships—a task that is complicated by the bidirectional relationships between loneliness and poor health described earlier—and the term "effects" commonly used in describing these methods should not be given a causal interpretation.[19] We did, however, make use of the longitudinal nature of the HRS to measure loneliness temporally prior to the onset of health problems or death. As noted, in these models, loneliness was measured at wave t (age x) and health/mortality was measured at wave $t+1$ (age $x+2$).

In all models, we controlled for respondents' age, age squared, marital status, work status, logged household total income, logged household net worth, number of living children, living alone, region of residence, and the baseline large muscle index. Robust standard errors were clustered at the individual level to adjust for correlation

[18] Note that the confidence intervals for lonely life expectancy at age 55 do not reflect the sampling variation introduced by the partitioning procedure used to create the educational attainment–specific life tables and are thus underestimated.

[19] To minimize confusion on this point, we use the word "relationships" instead of "effects" when describing our results.

across repeated observations within respondents. In these analyses, we focused on differences by sex, first examining differences in health outcomes by sex and then examining racial/ethnic and educational health disparities, separately by sex. This reflects both well-documented gender differences in morbidity and mortality and the aforementioned evidence of higher levels of loneliness among older women. We conducted three sets of decomposition analyses using the different measures of loneliness for the period 2008–2016. As in the life table analyses, we also examined potential temporal changes by conducting supplemental decompositions using the CES-D measure for the period 1998–2006.

Results

Trends in Loneliness

Figure 1 presents mean values of the three dichotomous measures of loneliness (the yes or no CES-D question and the top quintiles of the 11-item and three-item UCLA scales), separately for men and women between 1998 and 2016 (CES-D) and 2008 and 2016 (UCLA). The figure shows that the prevalence of loneliness has remained relatively stable over time and that the absolute and relative prevalence depends on how it is measured. The prevalence of loneliness varies between 12% and 21% using the single-item CES-D measure, between 16% and 23% using the 11-item UCLA index, and between 23% and 28% using the three-item UCLA index.[20] Women have somewhat higher levels of loneliness than men according to the CES-D and three-item measures, but the reverse is generally true for the 11-item measure (which also shows a recent increase in loneliness among women and a decrease among men).

Table 1 presents mean values of the three loneliness measures, by sex, for different categories of race/ethnicity and educational attainment. These tabulations show that sociodemographic gradients in loneliness depend on the measure considered. Looking first at the CES-D measure for the period 2008–2016 (in the second column), we see pronounced gradients in loneliness for both men and women by race/ethnicity and by educational attainment. In particular, the prevalence of loneliness is inversely related to educational attainment, and Whites are less lonely than Blacks, who are less lonely than Hispanics (although not significantly so among men). Compared with the earlier period (1998–2006, first column), overall loneliness declined slightly and racial/ethnic and educational gradients changed little for men and women.

When we consider the UCLA 11-item measure (third column), not only do women have a somewhat lower prevalence of loneliness than men (as shown in Figure 1), but the racial/ethnic and educational gradients also appear to be smaller than those based on the CES-D measure. Indeed, differences between Blacks and Hispanics are not statistically different from zero for men or women using the UCLA 11-item measure. Figures based on the UCLA three-item measure (fourth column) are rather different, especially with respect to the racial/ethnic gradient. Using this measure, Black men and women

[20] As noted, the somewhat higher average level of loneliness for the three-item UCLA measure reflects the smaller range of values and the associated difficulty of dichotomizing precisely at the 80th percentile of the distribution.

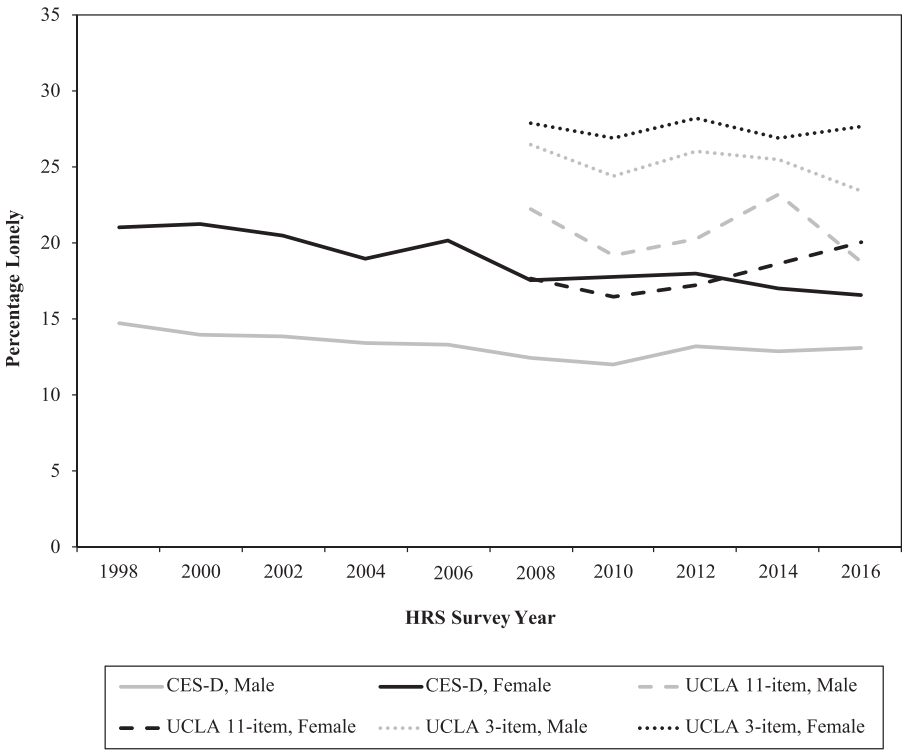

Fig. 1 Trends in three measures of loneliness, by sex, 1998–2016

have the highest prevalence of loneliness. As described earlier, the three-item measure includes only the feelings of social isolation subscale, whereas the 11-item measure also includes the perceptions of available social connections and sense of belonging subscales. Black men and especially women have similar values to Hispanics on the latter two subscales, but higher values (more loneliness) on the feelings of social isolation subscale (results not shown), resulting in the rather different racial/ethnic gradient for the UCLA three-item measure than for the other two measures.

Lonely Life Expectancy

Table 2 presents values of lonely life expectancy at age 55 using the three different loneliness measures, separately by sex, race/ethnicity, and educational attainment. The results, not surprisingly, mirror the patterns in Table 1. Looking first at the CES-D measure, we see strong racial/ethnic and educational gradients for both men and women. For example, using the CES-D data from 2008–2016, a synthetic cohort of 55-year-old men with less than a high school degree is expected to be lonely 1.6 years more than their college-educated peers (4.6 vs. 3.0), while a cohort of 55-year-old Hispanic men is expected to be lonely for 5.6 years—almost three years more than their White peers. These differences are even more pronounced for women, and there is no overlap in the 95% confidence intervals for these comparisons for either

Table 1 Three measures of the percentage of individuals who are lonely, by sex, race/ethnicity, and educational attainment

	CES-D 1998–2006	CES-D 2008–2016	UCLA 11-Item (top 20%) 2008–2016	UCLA 3-Item (top 20%) 2008–2016
Men				
Total	13.7	12.7	20.8	24.9
Race/ethnicity				
White	12.4	11.5	20.2	24.4
Black	20.5[a]	17.8[a]	24.8[a]	31.4[a]
Hispanic	22.3[a]	18.6[a]	22.4	22.9[b]
Educational attainment				
Less than high school	21.6	20.7	25.0	28.6
High school	14.2[a]	13.7[a]	22.2[a]	26.6
Some college+	9.8[a,b]	10.3[a,b]	18.9[a,b]	23.4[a,b]
Unweighted *N*	30,639	32,341	12,220	12,639
Women				
Total	20.3	17.1	18.0	27.3
Race/ethnicity				
White	18.4	15.1	16.4	26.2
Black	26.8[a]	21.6[a]	23.3[a]	33.9[a]
Hispanic	33.8[a,b]	30.3[a,b]	25.5[a]	30.0[a,b]
Educational attainment				
Less than high school	32.2	31.1	27.4	34.9
High school	18.9[a]	18.0[a]	19.0[a]	28.5[a]
Some college+	14.4[a,b]	12.8[a,b]	14.6[a,b]	24.5[a,b]
Unweighted *N*	44,341	44,928	16,862	17,538

[a] Significantly different from White or less than high school at $p < .05$.

[b] Significantly different from Black or high school at $p < .05$.

sex. When we account for differences in mortality by calculating the percentage of remaining life lonely (rather than absolute years), we see that synthetic cohorts of Hispanic men and women and cohorts without a high school education spend, on average, roughly twice as much of their remaining lives lonely than Whites and those who attended at least some college, respectively. The patterns in the earlier period (1998–2006) are similar.

Using the UCLA 11-item measure, differences by race/ethnicity are smaller and not statistically significant for men, but are still large for women. For men, White, Black, and Hispanic synthetic cohorts spend an average of 5–6 years of remaining life lonely—about 20% of their remaining life. For women, lonely life expectancy remains significantly longer for Hispanics than for Whites (7.7 years vs. 4.7). Importantly, our results based on the three-item UCLA measure show that racial/ethnic differentials are quite sensitive to how loneliness is measured. The rightmost panel of Table 2 shows that, among men, Blacks spend the largest part of their remaining life lonely—in both absolute and relative terms (but these differences are not statistically significant). Hispanic women continue to have the longest lonely life expectancy (9.7 years), but it is the synthetic cohort of Black women that spends the largest percentage of remaining life lonely (33% vs. 31% for Hispanics and 26% for Whites).

Table 2 Life expectancy at age 55 (years lonely, percentage of remaining life lonely), by sex, race/ethnicity, educational attainment, and measure of loneliness

	CES-D 1998–2006			CES-D 2008–2016			UCLA 11-Item (top 20%) 2008–2016			UCLA 3-Item (top 20%) 2008–2016		
	Years Lonely	95% CI	% Lonely	Years Lonely	95% CI	% Lonely	Years Lonely	95% CI	% Lonely	Years Lonely	95% CI	% Lonely
Men												
Total	3.4	[3.2–3.6]	14	3.3	[3.1–3.5]	13	5.0	[4.7–5.4]	20	6.1	[5.7–6.5]	24
Race/ethnicity												
White	3.1	[2.9–3.3]	13	3.0	[2.8–3.2]	12	5.0	[4.5–5.4]	19	6.0	[5.6–6.5]	24
Black	4.4	[3.8–5.0]	21	4.0	[3.5–4.5]	17	5.1	[4.1–6.0]	22	6.6	[5.6–7.6]	29
Hispanic	6.4	[5.3–7.4]	2	5.7	[4.8–6.5]	21	5.8	[4.6–7.1]	21	6.1	[4.8–7.4]	22
Educational attainment												
Less than high school	4.8	[4.3–5.3]	22	4.6	[4.1–5.1]	20	6.0	[5.0–7.0]	26	6.7	[5.7–7.6]	29
High school	3.5	[3.1–3.8]	15	3.3	[3.0–3.6]	13	5.3	[4.6–5.9]	21	6.4	[5.7–7.1]	26
Some college+	2.8	[2.5–3.1]	11	3.0	[2.8–3.3]	11	4.9	[4.3–5.4]	17	6.0	[5.4–6.6]	2
Women												
Total	5.9	[5.6–6.1]	21	5.2	[5.0–5.5]	18	5.1	[4.7–5.4]	18	7.8	[7.4–8.2]	27
Race/ethnicity												
White	5.3	[5.1–5.6]	19	4.6	[4.4–4.9]	16	4.7	[4.3–5.1]	16	7.5	[7.0–8.0]	26
Black	7.0	[6.4–7.5]	27	6.0	[5.5–6.6]	22	6.0	[5.0–6.9]	22	9.0	[8.0–10.0]	33
Hispanic	10.6	[9.6–11.7]	35	10.1	[9.1–11.0]	32	7.7	[6.2–9.2]	25	9.7	[8.1–11.4]	31
Educational attainment												
Less than high school	8.2	[7.8–8.7]	32	8.4	[7.8–8.9]	31	7.7	[6.7–8.6]	28	9.6	[8.6–10.6]	36
High school	5.6	[5.2–5.9]	20	5.2	[4.9–5.6]	18	5.3	[4.7–5.8]	19	8.0	[7.4–8.7]	28
Some college+	4.8	[4.3–5.2]	16	4.5	[4.1–4.9]	15	4.4	[3.8–4.9]	14	7.5	[6.8–8.1]	24

Notes: Years lonely refers to the synthetic cohort lonely life expectancy at age 55 and reflects both mortality and loneliness. Percentage lonely refers to the percentage of remaining life that is lonely life (i.e., lonely life expectancy / total life expectancy).

Health Disparities

We first present decomposition results by sex (with race/ethnicity and educational attainment included as covariates) and then by race/ethnicity and educational attainment, separately by sex. Panels A–C of Table 3 demonstrate significant gender differences in health conditions (total relationships) during the period 2008–2016 regardless of how loneliness is measured, with men more likely to experience disability, mortality, and mild cognitive impairment than women. In many cases, the indirect relationships between sex and health (via loneliness) are also statistically significant—a pattern that is particularly clear for disability and mortality using the UCLA loneliness measures. In supplementary analyses using the CES-D measure to examine change over time, we see that the indirect role of loneliness in accounting for sex differences in disability was slightly lower in the later period (2008–2016), while that for cognitive function was somewhat higher (results not shown). The proportion of the total gender difference accounted for by loneliness varies depending on both the health outcome and the loneliness measure used, ranging from a high of 20.4% for onset of disability using the 11-item UCLA measure to a low of 0.5% for mortality using the CES-D measure.[21] Overall, these results demonstrate that men and women differ significantly in terms of both health outcomes and the indirect role of loneliness in accounting for those disparities. The former pattern is, of course, well documented; however, the latter is, to our knowledge, a new insight into the relationship between loneliness and gender disparities in health.

In the interest of parsimony, we show in Tables 4–6 the total, direct, and indirect relationships of race/ethnicity and educational attainment, by sex, using the CES-D measure for the period 2008–2016, and we present parallel results based on the two UCLA loneliness measures in Tables A2–A7 (online appendix). Contrary to our expectations, analyses using the CES-D measure provide weak support for a mediating role of loneliness in linking race/ethnicity and educational attainment with health outcomes. Panel A in Table 4 shows that, after controlling for a variety of individual, family, and social characteristics, there are no significant racial and educational differences (insignificant total relationships) in the onset of disability for men, leaving no room for an indirect role of loneliness. For women, disparities in disability onset remain statistically significant net of covariates, but loneliness plays only a small role in accounting for these disparities. For instance, the proportion of the White–Hispanic difference in disability onset accounted for by loneliness (12%) is significant only at $p < .10$. Compared with women who do not have a high school degree, those with more education are significantly less likely to become disabled and—while loneliness accounts for 8–14% of these educational differences—this indirect relationship is not statistically significant. These patterns suggest that other observed and unobserved social and economic factors are more important than loneliness for understanding disparities in disability onset.

The pattern of results for mortality in Table 5 is similar. Net of covariates, loneliness does little to account for racial/ethnic differences in mortality for men or women;

[21] Note that the indirect contribution is negative for onset of dementia using the UCLA 11-item measure of loneliness (i.e., the indirect pathway through loneliness contributes to lower men's somewhat higher, but not statistically significant, likelihood of the onset of dementia).

Table 3 Decomposition of the relationship of sex (male = 1, female = 0) with health outcomes

	Disability		Mortality		Cognitive Impairment			
					CIND		Dementia	
	Log Odds	%	Log Odds	%	Log Odds	%	Log Odds	%
A. CES-D Measure, 2008–2016								
Total relationship	0.205**	100.0	0.667**	100.0	0.336**	100.0	0.209	100.0
	(0.057)		(0.049)		(0.065)		(0.149)	
Direct relationship	0.200**	97.4	0.663**	99.5	0.329**	97.9	0.202	96.9
	(0.057)		(0.049)		(0.065)		(0.149)	
Indirect relationship (via loneliness)	0.005	2.6	0.004†	0.5	0.007*	2.1	0.006†	3.1
	(0.003)		(0.002)		(0.003)		(0.004)	
Unweighted *N*	40,004		61,549		25,190			
B. UCLA 11-Item (top 20%), 2008–2016								
Total relationship	0.192*	100.0	0.585**	100.0	0.349**	100.0	0.082	100.0
	(0.075)		(0.080)		(0.094)		(0.214)	
Direct relationship	0.153*	79.6	0.563**	96.4	0.344**	98.8	0.096	116.2
	(0.075)		(0.081)		(0.095)		(0.214)	
Indirect relationship (via loneliness)	0.039**	20.4	0.021**	3.6	0.004	1.2	−0.013	−16.2
	(0.008)		(0.007)		(0.008)		(0.020)	
Unweighted *N*	15,960		24,232		9,817			
C. UCLA 3-Item (top 20%), 2008–2016								
Total relationship	0.203*	100.0	0.594**	100.0	0.378**	100.0	0.142	100.0
	(0.074)		(0.077)		(0.092)		(0.207)	
Direct relationship	0.181*	89.3	0.581**	97.9	0.370**	97.9	0.132	93.2
	(0.074)		(0.078)		(0.092)		(0.209)	
Indirect relationship (via loneliness)	0.022**	10.7	0.013**	2.1	0.008†	2.1	0.010	6.8
	(0.006)		(0.004)		(0.004)		(0.008)	
Unweighted *N*	16,493		25,162		10,120			

Notes: Data are weighted using the person-level analysis weight and the inverse probability weight to correct for missingness on loneliness variables. Covariates include age, age squared, marital status, working status, region, education, race, logged household total income in previous year, logged household net worth in previous year, number of living children, living alone, and the baseline large muscle index. Robust standard errors are shown in parentheses. CIND = cognitive impairment without dementia.

†$p < .10$; *$p < .05$; **$p < .01$ (two-tailed test)

indeed, the Hispanic mortality advantage becomes larger after accounting for their higher levels of loneliness. Loneliness also does not play a significant role in our understanding of educational disparities in men's mortality. Among women, however, the indirect relationship (via loneliness) accounts for 13% of the mortality difference between those with at least some college and those who did not complete high school; however, this relationship is significant only at $p < .10$. Again, these results suggest a limited role for loneliness in our understanding of mortality disparities by race/ethnicity and educational attainment.

Results presented in Table 6 show pronounced racial/ethnic and educational gradients in the onset of cognitive impairment for both men and women, net of covariates.

Table 4 Decomposition of the relationships of race/ethnicity and educational attainment with disability, by sex, using the CES-D measure of loneliness for 2008–2016

	Black		Hispanic		High School		Some College or More	
	Log Odds	%	Log Odds	%	Log Odds	%	Log Odds	%
A. Men								
Total relationship	–0.029	100.0	0.189	100.0	–0.135	100.0	–0.177	100.0
	(0.127)		(0.143)		(0.124)		(0.118)	
Direct relationship	–0.031	105.7	0.185	97.9	–0.114	84.5	–0.151	85.5
	(0.127)		(0.143)		(0.124)		(0.118)	
Indirect relationship (via loneliness)	0.002	–5.7	0.004	2.1	–0.021	15.5	–0.026	14.5
	(0.026)		(0.026)		(0.026)		(0.026)	
Unweighted *N*	16,509							
B. Women								
Total relationship	0.375**	100.0	0.351**	100.0	–0.216*	100.0	–0.221*	100.0
	(0.096)		(0.128)		(0.098)		(0.100)	
Direct relationship	0.386**	103.0	0.308*	87.7	–0.200*	92.5	–0.190†	86.2
	(0.096)		(0.129)		(0.098)		(0.100)	
Indirect relationship (via loneliness)	–0.011	–3.0	0.043†	12.3	–0.016	7.5	–0.030	13.8
	(0.024)		(0.025)		(0.024)		(0.024)	
Unweighted *N*	23,495							

Notes: Reference categories are White for race/ethnicity and less than high school for educational attainment. Data are weighted using the person-level analysis weight and the inverse probability weight to correct for missingness on loneliness variables. Covariates include age, age squared, marital status, working status, region, education, race, logged household total income in previous year, logged household net worth in previous year, number of living children, living alone, and the baseline large muscle index. When examining effects of a specific stratification variable (e.g., race/ethnicity), we also included the other stratification variable as a covariate in the regression models (e.g., educational attainment). Robust standard errors are shown in parentheses.

$^{\dagger}p<.10$; *$p<.05$; **$p<.01$ (two-tailed test)

As with disability and mortality, loneliness does very little to account for cognitive health disparities. Unlike disability and mortality, however, the indirect relationship between race/ethnicity or educational attainment and cognitive impairment via loneliness does not depend on whether we control for covariates. It is statistically indistinguishable from zero in both cases.

Analyses of the earlier time period using the CES-D loneliness measure provide little evidence of temporal change: loneliness plays little or no role in accounting for disparities in the onset of disability, mortality, and cognitive impairment (results not shown). And comparison of results based on the CES-D measure (in Tables 3–6) with corresponding results based on the two UCLA loneliness measures (Tables A2–A7, online appendix) showed no meaningful difference. For the onset of disability, educational gradients for both sex and racial/ethnic variation for men were not statistically significant after controlling for covariates. Although significant racial variation exists among women, loneliness did not account for these differentials (Tables A2 and A5, online appendix). Similar to the mortality and cognitive impairment results based on

Table 5 Decomposition of the relationships of race/ethnicity and educational attainment with mortality, by sex, using the CES-D measure of loneliness for 2008–2016

	Black		Hispanic		High School		Some College or More	
	Log Odds	%	Log Odds	%	Log Odds	%	Log Odds	%
A. Men								
Total relationship	−0.066	100.0	−0.494**	100.0	−0.165†	100.0	−0.351**	100.0
	(0.111)		(0.159)		(0.091)		(0.094)	
Direct relationship	−0.064	97.3	−0.503**	101.8	−0.150†	91.1	−0.335**	95.4
	(0.111)		(0.159)		(0.091)		(0.094)	
Indirect relationship (via loneliness)	−0.002	2.7	0.009	−1.8	−0.015	8.9	−0.016	4.6
	(0.012)		(0.013)		(0.013)		(0.014)	
Unweighted *N*	25,609							
B. Women								
Total relationship	−0.003	100.0	−0.483**	100.0	0.034	100.0	−0.177†	100.0
	(0.102)		(0.139)		(0.085)		(0.092)	
Direct relationship	0.003	−122.7	−0.514**	106.3	0.051	151.5	−0.154†	86.6
	(0.102)		(0.139)		(0.085)		(0.092)	
Indirect relationship (via loneliness)	−0.006	222.7	0.030*	−6.3	−0.017	−51.5	−0.024†	13.4
	(0.013)		(0.014)		(0.013)		(0.014)	
Unweighted *N*	35,940							

Notes: Reference categories are White for race/ethnicity and less than high school for educational attainment. Data are weighted using the person-level analysis weight and the inverse probability weight to correct for missingness on loneliness variables. Covariates include age, age squared, marital status, working status, region, education, race, logged household total income in previous year, logged household net worth in previous year, number of living children, living alone, and the baseline large muscle index. When examining effects of a specific stratification variable (e.g., race/ethnicity), we also included the other stratification variable as a covariate in the regression models (e.g., educational attainment). Robust standard errors are shown in parentheses.

†$p<.10$; *$p<.05$; **$p<.01$ (two-tailed test)

the CES-D measure, analyses using the UCLA measures also show little or no role for loneliness in explaining estimated racial/ethnic and educational differences for either men or women (Tables A3, A4, A6, and A7, online appendix).

Discussion

Research on loneliness and well-being is a burgeoning field in which the work of demographers and stratification scholars is not yet well represented. This is a critical limitation given the many important advances in research on loneliness in public health and psychology, as well as the obvious relevance for demographers of trends in loneliness, differentials in loneliness, and the potential role of loneliness in understanding health disparities. Our goal in this study was to use basic demographic tools—life table analysis and decomposition analysis—to provide an empirical basis for subsequent research on the demography of loneliness at older ages.

Table 6 Decomposition of the relationships of race/ethnicity and educational attainment with cognitive impairment and dementia, by sex, using the CES-D measure of loneliness for 2008–2014

	Black		Hispanic		High School		Some College or More	
	Log Odds	%	Log Odds	%	Log Odds	%	Log Odds	%
Outcome: CIND								
A. Men								
Total relationship	1.011**	100.0	0.600**	100.0	–0.778**	100.0	–1.286**	100.0
	(0.137)		(0.184)		(0.146)		(0.141)	
Direct relationship	1.005**	99.4	0.585**	97.5	–0.757**	97.3	–1.263**	98.3
	(0.137)		(0.185)		(0.146)		(0.141)	
Indirect relationship (via loneliness)	0.006	0.6	0.015	2.5	–0.021	2.7	–0.022	1.7
	(0.024)		(0.024)		(0.024)		(0.024)	
Unweighted *N*	9,672							
B. Women								
Total relationship	1.099**	100.0	0.683**	100.0	–0.883**	100.0	–1.401**	100.0
	(0.110)		(0.137)		(0.106)		(0.111)	
Direct relationship	1.115**	101.5	0.645**	94.4	–0.862**	97.7	–1.369**	97.8
	(0.110)		(0.138)		(0.106)		(0.111)	
Indirect relationship (via loneliness)	–0.016	–1.5	0.038	5.6	–0.020	2.3	–0.031	2.2
	(0.025)		(0.025)		(0.025)		(0.025)	
Unweighted *N*	15,518							
Outcome: Dementia								
C. Men								
Total relationship	0.879*	100.0	0.310	100.0	–1.719**	100.0	–1.925**	100.0
	(0.528)		(0.528)		(0.325)		(0.329)	
Direct relationship	0.875*	99.6	0.300	96.9	–1.705**	99.2	–1.910**	99.2
	(0.441)		(0.530)		(0.323)		(0.328)	
Indirect relationship (via loneliness)	0.004	0.4	0.010	3.1	–0.013	0.8	–0.015	0.8
	(0.016)		(0.018)		(0.020)		(0.020)	
Unweighted *N*	9,672							
D. Women								
Total relationship	1.648**	100.0	1.054**	100.0	–1.083**	100.0	–1.513**	100.0
	(0.214)		(0.274)		(0.184)		(0.211)	
Direct relationship	1.664**	101.0	1.016**	96.4	–1.062**	98.1	–1.482**	97.9
	(0.215)		(0.274)		(0.185)		(0.211)	
Indirect relationship (via loneliness)	–0.016	–1.0	0.038	3.6	–0.020	1.9	–0.031	2.1
	(0.025)		(0.027)		(0.025)		(0.026)	
Unweighted *N*	15,518							

Notes: Reference categories are White for race/ethnicity and less than high school for educational attainment. Data are weighted using the person-level analysis weight and the inverse probability weight to correct for missingness on loneliness variables. Covariates include age, age squared, marital status, working status, region, education, race, logged household total income in previous year, logged household net worth in previous year, number of living children, living alone, and the baseline large muscle index. When examining effects of a specific stratification variable (e.g., race/ethnicity), we also included the other stratification variable as a covariate in the regression models (e.g., educational attainment). Robust standard errors are shown in parentheses. CIND=cognitive impairment without dementia.

*$p<.05$; **$p<.01$ (two-tailed test)

We found that the prevalence of loneliness at older ages is high (with levels depending on how it is measured) and has remained stable during the first two decades of this century. In addition, under some plausible assumptions and using synthetic cohorts, older Americans spend an average of several years of their remaining life lonely, and racial/ethnic and educational differences in lonely life expectancy are pronounced (but, again, depend on how loneliness is measured). We view our findings of racial/ethnic and educational differentials in lonely life expectancy as an important extension of the large literature on healthy life expectancy or disability-free life expectancy demonstrating that Americans experience later life in very different ways depending on their race/ethnicity and SES. Well-documented relationships between loneliness and a wide range of health outcomes suggest that differences in lonely life expectancy may play an important role in understanding health disparities. Life tables, however, can provide little insight into the nature of that role.

To address this limitation of life table analysis, we estimated models for the onset/experience of three important health outcomes that allow for portioning of health disparities into direct pathways and indirect relationships through loneliness. That is, we decomposed educational differences in mortality, for example, into the role of differences in loneliness and the role of all other factors (including those not in our models). Our results show that loneliness appears to be of limited relevance for understanding racial/ethnic and educational health disparities. Unlike our life table results, the role of loneliness in health disparities does not depend on how we measure loneliness—it is small in all cases.

Although our decomposition results provide little support for an indirect role of loneliness, it would be unwise to dismiss loneliness as a potentially important factor in health inequalities. First, because our models included a range of social and economic characteristics linked to both health and loneliness, the total relationships of race/ethnicity or educational attainment with health outcomes—net of these covariates—are typically quite small, leaving little room for a role for loneliness. Preliminary analyses including only a few basic sociodemographic variables showed that the indirect role of loneliness is often substantively large and statistically significant (results available upon request). Second, we examined only three health outcomes. Previous research shows that loneliness is an important risk factor for other health outcomes, such as cardiovascular disease (Goossens et al. 2015; Jaremka et al. 2013). Results using other health outcomes may reveal different patterns. Hence, we view our findings as an invitation for demographers of health and aging to investigate the role of loneliness in their analyses of health disparities using a wide range of outcomes among diverse populations.

Of course, there are many limitations to our descriptive analyses. First, our synthetic cohort estimates of lonely life expectancy constructed using Sullivan's method provide no information about the (in)stability of loneliness across later life for individuals of varying sociodemographic profiles. Distinguishing transient or situational feelings of loneliness from chronic loneliness—and better understanding how each is related to health outcomes of interest—is of critical importance, but is also extremely difficult given the relatively long intervals between waves of the HRS and other large-scale surveys of the older population. Collecting and modeling data on loneliness across individual lives is an important but complicated task for future research. Second, comparison of results based on the three measures of loneliness

show marked differences in some cases (e.g., racial/ethnic differences in lonely life expectancy), and these clear cross-group differences in the nature of loneliness merit further theoretical and empirical attention. Of particular interest is evidence that Hispanic men and women have lower perceptions of available social connections and sense of belonging, whereas Blacks report higher levels of perceived social isolation. Third, our analyses do not fully account for the small but meaningful correlation between loneliness and social isolation. We included in the health models information about marital status, number of children, and living alone, but these measure only a part of the potentially relevant information about social isolation. In contrast to the decomposition models, our measures of lonely life expectancy do not account for the correlation between loneliness and social isolation. The three measures of loneliness we used reflect both objective circumstances (social isolation) and subjective perceptions of those circumstances (loneliness), and we did not attempt to isolate the latter from the former. Subsequent efforts to better understand the prevalence and correlates of loneliness per se (net of social isolation) will benefit from a more thorough conceptual and analytical distinction between these two related concepts.

Despite these limitations, we believe that our analyses provide a much-needed descriptive basis upon which to build. This study points to the need for more research on the specific causes of loneliness, the circumstances under which elderly people may experience loneliness, and the frequency and severity of their loneliness, particularly among disadvantaged social groups. Further effort is also needed to better conceptualize, measure, and monitor loneliness across various subpopulations. Efforts to reduce stigma associated with admitting and reporting loneliness—perhaps by raising public awareness of its prevalence, causes, and consequences—will also be important. We anticipate that these efforts will be supported by growing scientific attention to loneliness, accelerated by the fundamental life changes that have accompanied the COVID-19 pandemic. Insights from this work can support more effective, targeted interventions and provision of support to reduce loneliness among older people, with the ultimate goal of promoting successful and healthy aging. ■

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