

Elevated Risk of Cognitive Impairment Among Older Sexual Minorities: Do Health Conditions, Health Behaviors, and Social Connections Matter?

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ABSTRACT

Background and Objectives: Little research has examined cognitive health disparities between sexual minority and heterosexual populations. Further, most extant studies rely on subjective measures of cognitive functioning and non-probability samples. This study uses a performance-based cognitive screening tool and a nationally representative sample of older Americans to examine the disparity in cognitive impairment by sexual orientation and the potential mechanisms producing this disparity.

Research Design and Methods: Using data from the 2015-16 National Social Life, Health, and Aging Project (N=3,567), we analyzed respondents' scores on the survey-adapted Montreal Cognitive Assessment (MoCA-SA). We estimated ordinal logit regressions to examine the relationship between sexual orientation and cognitive impairment and used the Karlson-Holm-Breen method to assess how mental and physical conditions, health behaviors, and social connections mediate this relationship.

Results: The prevalence of cognitive impairment is significantly higher among sexual minority older adults than among heterosexual older adults when sociodemographic factors are adjusted for.

Depressive symptoms explain some of this prevalence gap. Although anxiety symptoms, physical comorbidity, health behaviors, and social connections may contribute to cognitive impairment, they do not explain the cognitive disparity by sexual orientation.

Discussion and Implications: The findings indicate that depressive symptoms are an important link between minority sexual orientation and cognitive impairment and highlight the importance of studying other potential mechanisms that we could not explore in this study. Future research should further investigate how minority stress processes may unfold to accelerate cognitive decline among sexual minorities over the life course.

Keywords: Dementia, Depression, Sexual orientation

Introduction

According to a national report, 2.7 million Americans age 50 and older are identified as LGBT and 1.1 million of these individuals are 65 and older (Movement Advancement Project and SAGE, 2017). Previous studies have found that LGB adults experience poorer health outcomes than their heterosexual counterparts, including greater psychological distress and higher risks of cardiovascular diseases and diabetes (Institute of Medicine 2011; Meyer 2003). Yet little is known about whether these health disparities extend to cognitive health—an emerging public health concern that has attracted increasing scholarly and public attention due to the rapid aging of the U.S. population. Because minority sexual orientations (e.g., lesbian, gay, and bisexual identities) are linked to multiple known risk factors for dementia, including elevated stress, social isolation, and poorer mental and physical health outcomes due to prejudice and discrimination (Fredriksen-Goldsen et al., 2018; Meyer, 2003; Seelman, 2019), sexual minorities may have a greater risk of developing cognitive health problems than their heterosexual peers (Correro & Nielson, 2020; Perales-Puchalt et al., 2019). Yet there is a paucity of research testing this possibility, and many of the extant studies have major methodological limitations (e.g., subjective measures of cognitive health and non-representative samples).

To address this important knowledge gap, the current study uses a performance-based cognitive screening instrument and a nationally representative sample of older adults to study two research questions: (1) Do older sexual minority adults have higher levels of mild cognitive impairment and early dementia than their heterosexual peers? (2) Do mental and physical conditions, health behaviors, and social connections contribute to the cognitive health disparity by sexual orientation (if any)? The findings contribute to the understanding of the unique health challenges faced by aging sexual minorities and can inform social and health services that seek to promote the well-being of sexual minority older adults.

Cognitive Health Disparities by Sexual Orientation

There is little empirical research on cognitive health and associated risk factors among older sexual minorities. Initial studies using LGBT community samples (without a comparison group of heterosexual older adults) have suggested that self-rated cognitive difficulty is quite prevalent among LGBT older adults (Flatt et al., 2018; Fredriksen-Goldsen et al., 2018). For example, using Aging with Pride data, Fredriksen-Goldsen and colleagues (2018) found that 10% of their LGBT sample reported severe or extreme difficulties and 38% reported moderate difficulties with at least one of six cognitive functions, including concentration, memory, problem solving, learning, comprehension, and communication. In addition, using data collected from the Center on Halsted in Chicago, Flatt and colleagues (2018) showed that 25% of their LGBT sample reported experiencing difficulty with memory and at least one other cognitive problem such as trouble with attention.

Research on cognitive health disparities between sexual minority and heterosexual older adults is also rare and has produced mixed evidence (Brown & Patterson, 2020; Perales-Puchalt et al., 2019; Seelman, 2019). Based on the Behavioral Risk Factor Surveillance System data collected from 21 states, Seelman (2019) found that older bisexual women had higher odds of reporting difficulty concentrating, remembering, or making decisions than older straight women, but older lesbian women rated their cognitive health similarly to older straight women. By contrast, using data from the Health and Retirement Study, Nelson and Andel (2020) found no difference in self-rated memory between lesbian, gay, and bisexual (LGB) older adults and their heterosexual peers. Similarly, using data from the National Alzheimer's Coordinating Center (collected from a combination of clinical and community samples), Perales-Puchalt and colleagues (2019) detected no disparity in the risk of dementia and mild cognitive impairment between older adults in same-sex relationships and those in different-sex relationships.

The inconsistencies in the extant findings may reflect differences in measures of cognitive health, sampling designs, and the dimensions of sexual orientation examined (as well as how sexual

and cardiovascular diseases and in turn increase the risk of cognitive impairment (Bostwick et al., 2010; Conron et al., 2010; Hatzenbuehler & McLaughlin, 2014; Parra et al., 2016). Prior studies have found that diseases or injuries that damage the heart and blood vessels, such as heart disease, hypertension, stroke, and diabetes, are linked to a higher risk of dementia (Justin et al., 2013; Strachan et al., 2008; Vijayan & Reddy, 2016). In addition, researchers have identified depression and anxiety as risk factors or prodromal symptoms of dementia (Becker et al., 2018; Byers & Yaffe, 2011; Gulpers et al., 2016; Richard et al., 2013). However, the extent to which these major health conditions contribute to cognitive health disparities between sexual orientation groups remains unclear.

Health behaviors. To cope with minority stress, sexual minorities may engage in coping behaviors that can damage or enhance cognitive functioning. A large number of studies have noted that sexual minorities are more likely to smoke and drink than their heterosexual peers (Boehmer et al., 2012; Fredriksen-Goldsen et al., 2013; Gonzales et al., 2016). As smoking and excessive drinking are risk factors for cognitive impairment (Hagger-Johnson et al., 2013; Plassman, 2010), these behaviors may contribute to the cognitive health disadvantage of sexual minorities. However, prior research has also shown that during adulthood sexual minority individuals engage in more physical activity, on average, than heterosexual people even though some of the former groups, particularly sexual minority women, have greater body mass index, on average, than their heterosexual counterparts (Boehmer et al., 2012; Eliason et al., 2015; Hsieh & Ruther, 2016). Exercise is related to slower cognitive decline and lower dementia risk (Ogino et al., 2019; Plassman, 2010), and thus may serve as a protective factor for sexual minorities' cognitive health. Despite these findings, few studies have examined whether smoking, drinking, and exercise contribute to cognitive health disparities by sexual orientation.

Social connections. Finally, although social connections can offer companionship and support that helps individuals overcome minority stress and related illness (Meyer, 2003; Umberson & Montez, 2010), sexual minorities are less socially connected than heterosexual individuals during late adulthood

because of experiences of personal and institutional discrimination over the life course (Grossman et al., 2000; Hsieh & Liu, 2020; Kim & Fredriksen-Goldsen, 2016). Many studies have shown that relative to their heterosexual peers, older lesbian, gay, and bisexual adults are less likely to have a marital or cohabiting partner, adult children, and other close family members to rely on for instrumental or emotional needs, and relatedly, they are more likely to live alone (Grossman et al., 2000; Kim & Fredriksen-Goldsen, 2016). Some studies have further noted that older sexual minorities participate in community activities less often because they fear discrimination (Hsieh & Liu, 2020). Social isolation reduces mental stimulation and delays the diagnosis and treatment of dementia (Gow et al., 2013; Westwood, 2016), and thus may be another factor contributing to cognitive health disadvantages among sexual minorities. However, little empirical research has tested this potential link.

Hypotheses

Based on minority stress theory, this study tests the following hypotheses regarding sexual orientation disparities in cognitive health and associated factors:

1. Older sexual minorities experience a higher risk of cognitive impairment, including early dementia, than their heterosexual counterparts.
2. a. Disparities in cognitive health by sexual orientation are partially explained by differences in mental and physical health.
 b. Disparities in cognitive health by sexual orientation are partially explained by differences in health behaviors.
 c. Disparities in cognitive health by sexual orientation are partially explained by differences in social connections.

Research Design and Methods

Data and sample

This study uses data from the 2015-16 National Social Life, Health, and Aging Project (NSHAP), a population-based study of community-dwelling older adults in the United States. NSHAP provides information on physical and emotional health, cognitive function, social relationships, and sexuality, as well as other factors relevant to the well-being of older Americans. In 2015-16, NSHAP (Wave 3) began to collect data on sexual identity in its leave-behind questionnaire (LBQ), a self-administered component of the survey. The conditional response rate of the LBQ is 84%, and 4,072 participants completed the LBQ. After excluding participants who did not answer the sexual identity question ($n=366$), those under age 50 ($n=132$), and those missing key demographic information ($n=7$), our final sample includes 3,567 individuals age 50-97. In this sample, 81 individuals (2.3%) self-identified as lesbian, gay, or bisexual, and 3,486 individuals self-identified as heterosexual or straight.

Measures

Dependent variable

Cognitive health was measured by a survey-adapted version of the Montreal Cognitive Assessment (MoCA-SA), an 18-item cognitive screening tool that assesses temporal orientation; language; visuospatial skills; executive function; attention, concentration, and working memory; and short-term memory. The instrument was adapted from the original 28-item MoCA, a clinical tool for detecting cognitive impairment, to accommodate survey administration by trained, nonmedical interviewers and to reduce respondent burden (Kotwal et al., 2015). It has been validated by previous research that showed high correlation between MoCA and MoCA-SA (Kotwal et al., 2015; Shega et al., 2014). See Supplementary Table 1 in Online Supplementary Material for a comparison of the items used in these two instruments. MoCA-SA scores can be accurately converted into MoCA scores, which range from 0 to

30, with scores >22 indicating no cognitive impairment, scores 18–22 (inclusive) indicating mild cognitive impairment (MCI), and scores <18 indicating early dementia for community-dwelling samples. Although previous studies based on clinical samples favor higher cutoff values (e.g., scores >25 indicating no impairment), we used lower cutoff values following studies suggesting that the lower cutoffs may yield better sensitivity and specificity and may be more suitable for community samples (Freitas et al., 2013; Kotwal et al., 2016; Luis et al., 2009; Nasreddine et al., 2005; Rossetti et al., 2011). Finally, we used the categorical variable (no impairment, MCI, and early dementia) to present the analytical results, but supplementary analyses based on a binary or continuous variable produced consistent findings (See Supplementary Table 2 in Online Supplementary Material).

Independent variables

Sexual orientation was measured by whether the respondent self-identified as lesbian, gay, or bisexual (LGB) or as heterosexual or straight. Because the sample of older LGB adults was small and did not have enough statistical power, we did not further separate this group into lesbians, gays, and bisexuals in the analysis.

Mental health was measured by two scales: depressive and anxiety symptoms. *Depressive symptoms* were assessed by the 10-item Center for Epidemiologic Studies Depression Scale (CES-D). The scale encompassed the reported frequencies of experiencing ten depressive symptoms, such as poor appetite, sadness, and restless sleep, during the past week. Scoring ranged from 0–30. *Anxiety symptoms* were assessed by the 7-item anxiety subscale from the Hospital Anxiety and Depression Scale (HADS), which included seven anxiety symptoms such as feeling tense, frightened, and restless. Scoring ranged from 0–21.

Physical health was assessed by a *physical comorbidity* scale, the Modified Charlson Comorbidity Index (CCI), which is a modified and validated version of CCI for surveys (Charlson et al., 1987; Katz et al.,

1996; Vasilopoulos et al., 2014). The original index included ten chronic conditions including heart disease, stroke, diabetes, cancer, and dementia. To avoid overestimating the relationship between comorbidity and cognitive health (the dependent variable), we excluded dementia from the index in the analyses. However, the results of supplemental analyses suggested that the findings remained the same when dementia was included in the index.

Health behaviors were examined via three variables. *Smoking* assessed whether the respondent smoked cigarettes, cigars, or a pipe at the time of survey (1=yes, 0=no). *Number of drinks per day of drinking* was measured by the average number of drinks the respondent had on a day of drinking in the past three months. For those who reported that they never drank in the past three months, the value was zero. *Exercise* was measured by the frequency of vigorous physical activity lasting 30 minutes or longer over the past 12 months, assessed in three categories: never or less than once a month (reference), 1-3 times per month or 1-2 times per week, and at least 3 times per week.

Social connections were represented by four types of social relationships that are relevant to health and well-being (Umberson & Montez, 2010). *Marital status* indicates whether the respondent was married/cohabiting (reference), previously married (divorced/separated/widowed), or never married. *Number of close family members* indicates the number of family members whom the respondent felt close to, not including a spouse or romantic partner. The variable includes five response categories: none (reference), 1, 2-3, 4-9, and 10 or more. *Living with other(s)* indicates if the respondent lived with someone else rather than alone (1=yes, 0=no). *Community participation* is a summary scale that integrates three survey items: frequency of volunteering for organizations, attending meetings of any organized groups, and attending religious services in the past 12 months. Exploratory factor analysis showed that these items loaded on one dimension (i.e., one factor had an eigenvalue ≥ 1 and explained almost 100% of the total variance). We created a factor score representing the overall frequency of activity participation using principle factor analysis with oblique rotation.

Finally, we adjusted for sociodemographic characteristics, including *age* (in years), *gender* (1=female, 0= male), *education* (less than high school [reference]; high school or equivalent; some college or associate's degree; bachelor's degree or above), and *race/ethnicity* (white [reference], black, Hispanic, other). According to previous research, these variables are important correlates of cognitive health (Alley et al., 2007; Zhang et al., 2016).

Statistical analysis

We conducted a series of ordinal logit regression models to examine the link between sexual orientation and cognitive health as well as the extent to which mental and physical conditions, health behaviors, and social connections contribute to this association. Model 1 estimated the basic association between sexual orientation and cognitive impairment controlling for sociodemographic covariates. Models 2-5 added mental health conditions, physical comorbidity, health behaviors, and social connection variables separately while retaining the sociodemographic covariates. Model 6 included all covariates.

We then conducted formal mediation tests using the Karlson-Holm-Breen (KHB) method to examine whether different sets of covariates were statistically significant mediators of the association between sexual orientation and cognitive impairment. All KHB analysis was adjusted for sociodemographic characteristics. The KHB method decomposes the total effect of a predictor variable on an outcome variable into direct and indirect (mediation) effects in nonlinear probability models such as ordinal logit models (Breen et al., 2013; Karlson et al., 2012). The method can accommodate multiple mediators in one model and has been used in other research on dementia (Liu et al., 2019).

Because some of the variables contained missing values, we conducted multiple imputations using multivariate imputation with chained equations to impute the missing cases. Supplementary Table 3 in Online Supplementary Material shows the number of imputed cases for each imputed variable. All analyses were adjusted for the survey sampling design using the *svy* functions in Stata 14 (StataCorp, 2015).

Results

Descriptive statistics

Table 1 shows the weighted descriptive statistics for the sociodemographic, cognitive, health and behavioral, and social connection variables by sexual orientation. The LGB sample was somewhat younger and had a smaller portion of female respondents than the heterosexual sample, although these differences did not reach statistical significance. Meanwhile, the LGB sample was significantly more educated, with a higher percentage completing some college education or receiving a college degree than older heterosexual adults. In addition, relative to the older heterosexual adults, the older LGB adults were significantly less likely to be non-Hispanic white.

[Table 1 about here]

The descriptive statistics for cognitive health show no significant differences in cognitive impairment between LGB and heterosexual older adults. Specifically, although a larger proportion of older LGB adults screened positive for mild cognitive impairment (MCI) and early dementia than older heterosexual adults, the differences were not statistically significant. Importantly, however, the differences in the sociodemographic compositions of the two groups may obscure differences in cognitive health.

Table 1 also shows that LGB individuals reported significantly higher levels of anxiety symptoms than heterosexual individuals, but no statistically significant differences between the LGB and heterosexual samples in other health conditions including depressive symptoms and physical comorbidity. Further, the focal health behaviors—smoking, drinking, and exercise—did not vary much by sexual orientation. Again, the lack of health disparities observed in the descriptive analysis may result from the LGB sample being more educated and/or younger than the heterosexual sample.

Finally, social connections differed between LGB and heterosexual individuals in certain

respects. In particular, older LGB adults were significantly less likely to be married or cohabiting with a partner and more likely to be never married than older heterosexual adults. Older LGB adults also reported having significantly fewer close family members. Although the percentage of living with other(s) and the frequency of community participation were lower among LGB individuals than among heterosexual individuals, the differences were not statistically significant.

Links between cognitive health, sexual orientation, and potential risk factors

Table 2 presents the results of the ordinal logit regression models of cognitive impairment. When sociodemographic covariates were controlled, older LGB adults experienced higher odds of MCI or early dementia than their heterosexual counterparts (Odds ratio [OR]=2.07, $p<0.01$, Model 1 in Table 2), which offers support for Hypothesis 1. In addition, individuals who were older, had lower levels of education, and were members of minority racial/ethnic groups had higher odds of cognitive impairment as found in previous studies.

[Table 2 about here]

Depressive symptoms were the only health condition that explained a portion of the disparity in cognitive health by sexual orientation (Hypothesis 2a). Specifically, reporting more depressive symptoms was related to higher odds of cognitive impairment (OR=1.06, $p<0.001$), and the odds ratio for cognitive impairment among older LGB adults declined significantly, from 2.07 to 1.91, when the model controlled for depressive symptoms (Model 2, Table 2). In contrast, anxiety symptoms were not significantly associated with cognitive impairment. Further, although physical comorbidity was associated with higher odds of cognitive impairment (OR=1.07, $p<0.05$), this variable played a negligible role in the cognitive disadvantage faced by older LGB adults (Model 3, Table 2). The odds ratio for cognitive impairment among LGB individuals remained unchanged when physical comorbidity was controlled. These results were validated by the results of the KHB tests. As shown in Table 3, the indirect or

mediating effect of mental health conditions was statistically significant (Coefficient [Coeff.]=0.078, $p<0.05$), whereas the mediating effect of physical comorbidity was not (Coeff.=−0.002, $p=0.87$).

Additional tests also confirmed that depressive symptoms, not anxiety symptoms, dominated the mediating effect of mental health conditions (results not shown but available upon request).

[Table 3 about here]

The empirical results did not support Hypothesis 2b: health behaviors did not explain the cognitive disparity between sexual minority and heterosexual adults. Although current smoking (OR=1.56, $p<0.001$) and drinking (OR=0.90, $p<0.01$) habits were both associated with cognitive health, controlling for these behavioral variables did not significantly lower the relative risk of cognitive impairment among older LGB adults (Model 4, Table 2). In addition, unexpectedly, the frequency of exercise was not linked to cognitive health in this sample of older adults. The KHB tests further confirmed that none of the focal health behaviors mediated the effect of sexual orientation on cognitive health (Table 3)—the indirect or mediating effect of these health behaviors was not statistically significant (Coeff.=0.057, $p=0.07$).

Next, among the four social connection variables, only the frequency of participation in community activities (OR=0.89, $p<0.05$) was related to lower odds of cognitive impairment (Model 5, Table 2). Marital status, number of close family members, and living arrangement, in contrast, were generally unrelated to cognitive health. Although controlling for the social connection variables reduced the odds ratio for cognitive impairment among LGB individuals from 2.07 to 1.95, this reduction was not statistically significant. This result was supported by the KHB mediation test, which showed that the indirect or mediating effect of the social connection variables was not significant (Coeff.=0.082, $p=0.17$) (Table 3). Overall, in contrast to Hypothesis 2c, these findings indicate that social connections make a very limited contribution to the cognitive disadvantage faced by older LGB adults.

Finally, when all sociodemographic, health, behavioral, and social connection covariates were

included in the analysis, LGB individuals still had 1.83 times greater odds of cognitive impairment than their heterosexual peers (Model 6, Table 2), a statistically significant difference. This result suggests that underlying factors that were not observed in the current study contribute to the cognitive health disparity by sexual orientation.

Discussion and Implications

This study is among the first few to provide population-based empirical evidence on cognitive health disparities faced by LGB older adults in the United States. We examined two research hypotheses: (1) older sexual minorities experience a higher risk of cognitive impairment than their heterosexual counterparts, and (2) the cognitive health disparity is partially explained by mental and physical conditions, health behaviors, and social connections, respectively. We found full support for the first hypothesis and partial support for the second hypothesis. In the following paragraphs, we discuss the major findings and implications of the study.

The analytical results suggest that LGB older adults have a significantly higher risk of cognitive impairment than their heterosexual peers. Population-based studies of cognitive health disparities by sexual orientation remain rare. Further, the few extant studies are based on self-reported cognitive measures and have produced mixed results: some noted that sexual minorities reported higher levels of cognitive difficulty than their heterosexual peers (Seelman, 2019), whereas others showed no differences in self-reported cognitive functioning across sexual orientation groups (Brown & Patterson, 2020; Nelson & Andel, 2020). Using a performance-based cognitive measure and a nationally representative sample of older Americans, the current results reveal major cognitive health disadvantages among LGB older adults at the population level. This finding is consistent with the broader literature on the general health disadvantages faced by sexual minority populations, in part due to the stigmatization of minority sexual orientations (Institute of Medicine, 2011).

The analysis moved beyond the previous literature by testing three key potential mechanisms—health conditions, health behaviors, and social connections—that may link sexual orientation to cognitive health. Surprisingly, we found that most of these factors did not explain the cognitive disadvantage among older LGB adults—depressive symptoms were the only underlying mechanism supported by the data. Building on prior research showing that sexual minority youth and adults suffer higher levels of mental illness such as depressive disorder than their straight peers (Bostwick et al., 2010; Meyer, 2003) and that depression is a risk factor for dementia (Byers & Yaffe, 2011; Richard et al., 2013), the findings imply that, for sexual minorities, the consequences of depression may accumulate over the life course and eventually lead to cognitive impairment in late life. However, depressive symptoms do not fully account for the cognitive health disparity by sexual orientation in our analysis, which indicates that factors not explored in the current study are also important. We encourage future research to take a life course perspective and investigate how early- and mid-life conditions that expose sexual minorities to greater hardships are linked to later-life cognitive functioning.

The study has several limitations. First, although we used a nationally representative sample, the sample size for sexual minorities was small and did not provide enough statistical power to explore differences between sexual minority subgroups (e.g., between bisexual, gay, and lesbian older adults). Second, even with mediation analysis, we were unable to overcome causality issues due to the cross-sectional data. Although NSHAP is a longitudinal study, it only began to collect sexual identity information in its most recent wave. Future research should use longitudinal datasets to examine cognitive decline over time when such data become available. Third, we cannot examine HIV status in our analysis because NSHAP Wave 3 does not include this information. Studies have shown that HIV-associated neurocognitive disorders are risk factors for dementia among people living with HIV/AIDS (Cysique & Brew, 2019). Future research would benefit from studying whether HIV/AIDS is a correlate of

cognitive disadvantage among older sexual minorities. Finally, it is likely that the quality of any self-reported information, including sociodemographic, health, behavioral, and social relationship data, decreases with cognitive impairment. Individuals with more cognitive loss may report less reliable data. Although NSHAP does not study institutionalized older adults (who are more likely to have disabling cognitive impairment), reporting bias could still obscure relationships between sexual orientation and major covariates.

Despite these limitations, the study contributes to the fields of aging and minority health by offering new evidence on the cognitive health disparity between sexual minorities and heterosexual individuals in later life. Using a performance-based cognitive screening tool and a population-based sample, the findings indicate the importance of depressive symptoms in linking minority sexual orientation to cognitive impairment; in addition, the results reveal the potential importance of factors not explored in this study. Future research examining how minority stress processes may unfold to accelerate cognitive decline over the life course will further enhance the understanding of cognitive health concerns among older sexual minorities.

References

- Alley, D., Suthers, K., & Crimmins, E. (2007). Education and Cognitive Decline in Older Americans: Results From the AHEAD Sample. *Research on Aging*, 29(1), 73–94. <https://doi.org/10.1177/0164027506294245>
- Becker, E., Rios, C. L. O., Lahmann, C., Rücker, G., Bauer, J., & Boeker, M. (2018). Anxiety as a risk factor of Alzheimer's disease and vascular dementia. *The British Journal of Psychiatry*, 213(5), 654–660. <https://doi.org/10.1192/bjp.2018.173>
- Boehmer, U., Miao, X., Linkletter, C., & Clark, M. A. (2012). Adult health behaviors over the life course by sexual orientation. *American Journal of Public Health*, 102(2), 292–300. <https://doi.org/10.2105/AJPH.2011.300334>
- Bostwick, W. B., Boyd, C. J., Hughes, T. L., & McCabe, S. E. (2010). Dimensions of sexual orientation and the prevalence of mood and anxiety disorders in the United States. *American Journal of Public Health*, 100(3), 468–475. <https://doi.org/10.2105/AJPH.2008.152942>
- Breen, R., Karlson, K. B., & Holm, A. (2013). Total, direct, and indirect effects in logit and probit models. *Sociological Methods & Research*, 42(2), 164–191. <https://doi.org/10.1177/0049124113494572>
- Brown, M. J., & Patterson, R. (2020). Subjective cognitive decline among sexual and gender minorities: Results from a U.S. population-based sample. *Journal of Alzheimer's Disease*, 73(2), 477–487. <https://doi.org/10.3233/JAD-190869>
- Byers, A. L., & Yaffe, K. (2011). Depression and risk of developing dementia. *Nature Reviews Neurology*, 7(6), 323–331. <https://doi.org/10.1038/nrneurol.2011.60>

- Charlson, M. E., Pompei, P., Ales, K. L., & MacKenzie, C. R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases*, 40(5), 373–383. [https://doi.org/10.1016/0021-9681\(87\)90171-8](https://doi.org/10.1016/0021-9681(87)90171-8)
- Conron, K. J., Mimiaga, M. J., & Landers, S. J. (2010). A population-based study of sexual orientation identity and gender differences in adult health. *American Journal of Public Health*, 100(10), 1953–1960. <https://doi.org/10.2105/AJPH.2009.174169>
- Correro, A. N., & Nielson, K. A. (2020). A review of minority stress as a risk factor for cognitive decline in lesbian, gay, bisexual, and transgender (LGBT) elders. *Journal of Gay & Lesbian Mental Health*, 24(1), 2–19. <https://doi.org/10.1080/19359705.2019.1644570>
- Cysique, L. A., & Brew, B. J. (2019). Vascular cognitive impairment and HIV-associated neurocognitive disorder: A new paradigm. *Journal of NeuroVirology*, 25(5), 710–721. <https://doi.org/10.1007/s13365-018-0706-5>
- Eliason, M. J., Ingraham, N., Fogel, S. C., McElroy, J. A., Lorvick, J., Mauery, D. R., & Haynes, S. (2015). A Systematic Review of the Literature on Weight in Sexual Minority Women. *Women's Health Issues*, 25(2), 162–175. <https://doi.org/10.1016/j.whi.2014.12.001>
- Flatt, J. D., Johnson, J. K., Karpiak, S. E., Seidel, L., Larson, B., & Brennan-Ing, M. (2018). Correlates of Subjective Cognitive Decline in Lesbian, Gay, Bisexual, and Transgender Older Adults. *Journal of Alzheimer's Disease*, 64(1), 91–102. <https://doi.org/10.3233/JAD-171061>
- Fredriksen-Goldsen, K. I., Jen, S., Bryan, A. E. B., & Goldsen, J. (2018). Cognitive impairment, Alzheimer's Disease, and other dementias in the lives of lesbian, gay, bisexual and

- transgender (LGBT) older adults and their caregivers: Needs and competencies. *Journal of Applied Gerontology*, 37(5), 545–569. <https://doi.org/10.1177/0733464816672047>
- Fredriksen-Goldsen, K. I., Kim, H.-J., Barkan, S. E., Muraco, A., & Hoy-Ellis, C. P. (2013). Health disparities among lesbian, gay, and bisexual older adults: Results from a population-based study. *American Journal of Public Health*, 103(10), 1802–1809. <https://doi.org/10.2105/AJPH.2012.301110>
- Freitas, S., Simões, M. R., Alves, L., & Santana, I. (2013). Montreal cognitive assessment: Validation study for mild cognitive impairment and Alzheimer disease. *Alzheimer Disease and Associated Disorders*, 27(1), 37–43. <https://doi.org/10.1097/WAD.0b013e3182420bfe>
- Gonzales, G., Przedworski, J., & Henning-Smith, C. (2016). Comparison of health and health risk factors between lesbian, gay, and bisexual adults and heterosexual adults in the United States: Results from the National Health Interview Survey. *JAMA Internal Medicine*, 176(9), 1344–1351. <https://doi.org/10.1001/jamainternmed.2016.3432>
- Gow, A. J., Corley, J., Starr, J. M., & Deary, I. J. (2013). Which social network or support factors are associated with cognitive abilities in old age? *Gerontology*, 59(5), 454–463. <https://doi.org/10.1159/000351265>
- Grossman, A. H., D’Augelli, A. R., & Hershberger, S. L. (2000). Social support networks of lesbian, gay, and bisexual adults 60 years of age and older. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 55(3), P171–P179. <https://doi.org/10.1093/geronb/55.3.P171>
- Gulpers, B., Ramakers, I., Hamel, R., Köhler, S., Oude Voshaar, R., & Verhey, F. (2016). Anxiety as a predictor for cognitive decline and dementia: A systematic review and meta-

- analysis. *The American Journal of Geriatric Psychiatry*, 24(10), 823–842.
<https://doi.org/10.1016/j.jagp.2016.05.015>
- Hagger-Johnson, G., Sabia, S., Brunner, E. J., Shipley, M., Bobak, M., Marmot, M., Kivimaki, M., & Singh-Manoux, A. (2013). Combined impact of smoking and heavy alcohol use on cognitive decline in early old age: Whitehall II prospective cohort study. *The British Journal of Psychiatry*, 203(2), 120–125. <https://doi.org/10.1192/bjp.bp.112.122960>
- Hatzenbuehler, M. L., & McLaughlin, K. A. (2014). Structural stigma and hypothalamic–pituitary–adrenocortical axis reactivity in lesbian, gay, and bisexual young adults. *Annals of Behavioral Medicine*, 47(1), 39–47. <https://doi.org/10.1007/s12160-013-9556-9>
- Hsieh, N., & Liu, H. (2020). Social relationships and loneliness in late adulthood: Disparities by sexual orientation. *Journal of Marriage and Family*. <https://doi.org/10.1111/jomf.12681>
- Hsieh, N., & Ruther, M. (2016). Sexual minority health and health risk factors: Intersection effects of gender, race, and sexual identity. *American Journal of Preventive Medicine*, 50(6), 746–755. <https://doi.org/10.1016/j.amepre.2015.11.016>
- Institute of Medicine. (2011). *The Health of Lesbian, Gay, Bisexual, and Transgender People: Building a Foundation for Better Understanding*. National Academies Press.
- Justin, B. N., Turek, M., & Hakim, A. M. (2013). Heart disease as a risk factor for dementia. *Clinical Epidemiology*, 5, 135–145. <https://doi.org/10.2147/CLEP.S30621>
- Karlson, K. B., Holm, A., & Breen, R. (2012). Comparing regression coefficients between same-sample nested models using logit and probit: A new method. *Sociological Methodology*, 42(1), 286–313. <https://doi.org/10.1177/0081175012444861>

- Katz, J. N., Chang, L. C., Sangha, O., Fossel, A. H., & Bates, D. W. (1996). Can comorbidity be measured by questionnaire rather than medical record review? *Medical Care*, 34(1), 73–84. <https://doi.org/10.1097/00005650-199601000-00006>
- Kim, H.-J., & Fredriksen-Goldsen, K. I. (2016). Living arrangement and loneliness among lesbian, gay, and bisexual older adults. *The Gerontologist*, 56(3), 548–558. <https://doi.org/10.1093/geront/gnu083>
- Kotwal, A. A., Kim, J., Waite, L., & Dale, W. (2016). Social function and cognitive status: Results from a US nationally representative survey of older adults. *Journal of General Internal Medicine*, 31(8), 854–862. <https://doi.org/10.1007/s11606-016-3696-0>
- Kotwal, A. A., Schumm, L. P., Kern, D. W., McClintock, M. K., Waite, L. J., Shega, J. W., Huisingh-Scheetz, M. J., & Dale, W. (2015). Evaluation of a brief survey instrument for assessing subtle differences in cognitive function among older adults. *Alzheimer Disease and Associated Disorders*, 29(4), 317–324. <https://doi.org/10.1097/WAD.0000000000000068>
- Liu, H., Zhang, Z., Choi, S., & Langa, K. M. (2019). Marital status and dementia: Evidence from the Health and Retirement Study. *The Journals of Gerontology: Series B*. <https://doi.org/10.1093/geronb/gbz087>
- Luis, C. A., Keegan, A. P., & Mullan, M. (2009). Cross validation of the Montreal Cognitive Assessment in community dwelling older adults residing in the Southeastern US. *International Journal of Geriatric Psychiatry*, 24(2), 197–201. <https://doi.org/10.1002/gps.2101>

- Meyer, I. H. (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: Conceptual issues and research evidence. *Psychological Bulletin*, 129(5), 674–697. <https://doi.org/10.1037/0033-2909.129.5.674>
- Movement Advancement Project and SAGE. (2017). *Understanding Issues Facing LGBT Older Adults*. <https://www.lgbtmap.org/understanding-issues-facing-lgbt-older-adults>
- Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., Cummings, J. L., & Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society*, 53(4), 695–699. <https://doi.org/10.1111/j.1532-5415.2005.53221.x>
- Nelson, C. L., & Andel, R. (2020). Does sexual orientation relate to health and well-Being? Analysis of adults 50+ years of age. *The Gerontologist*. Advance online publication. <https://doi.org/10.1093/geront/gnz187>
- Ogino, E., Manly, J. J., Schupf, N., Mayeux, R., & Gu, Y. (2019). Current and past leisure time physical activity in relation to risk of Alzheimer's disease in older adults. *Alzheimer's & Dementia*, 15(12), 1603–1611. <https://doi.org/10.1016/j.jalz.2019.07.013>
- Parra, L. A., Benibgui, M., Helm, J. L., & Hastings, P. D. (2016). Minority stress predicts depression in lesbian, gay, and bisexual emerging adults via elevated diurnal cortisol. *Emerging Adulthood*, 4(5), 365–372. <https://doi.org/10.1177/2167696815626822>
- Perales-Puchalt, J., Gauthreaux, K., Flatt, J., Teylan, M. A., Resendez, J., Kukull, W. A., Chan, K. C. G., Burns, J., & Vidoni, E. D. (2019). Risk of dementia and mild cognitive impairment among older adults in same-sex relationships. *International Journal of Geriatric Psychiatry*, 34(6), 828–835. <https://doi.org/10.1002/gps.5092>

- Plassman, B. L. (2010). Systematic review: Factors associated with risk for and possible prevention of cognitive decline in later life. *Annals of Internal Medicine*, 153(3), 182–193. <https://doi.org/10.7326/0003-4819-153-3-201008030-00258>
- Richard, E., Reitz, C., Honig, L. H., Schupf, N., Tang, M. X., Manly, J. J., Mayeux, R., Devanand, D., & Luchsinger, J. A. (2013). Late-life depression, mild cognitive impairment, and dementia. *JAMA Neurology*, 70(3), 383–389. <https://doi.org/10.1001/jamaneurol.2013.603>
- Rossetti, H. C., Lacritz, L. H., Cullum, C. M., & Weiner, M. F. (2011). Normative data for the Montreal Cognitive Assessment (MoCA) in a population-based sample. *Neurology*, 77(13), 1272–1275. <https://doi.org/10.1212/WNL.0b013e318230208a>
- Seelman, K. L. (2019). Differences in mental, cognitive, and functional health by sexual orientation among older women: Analysis of the 2015 Behavioral Risk Factor Surveillance System. *The Gerontologist*, 59(4), 749–759. <https://doi.org/10.1093/geront/gnx215>
- Shega, J. W., Sunkara, P. D., Kotwal, A., Kern, D. W., Henning, S. L., McClintock, M. K., Schumm, P., Waite, L. J., & Dale, W. (2014). Measuring cognition: The Chicago Cognitive Function Measure in the National Social Life, Health and Aging Project, Wave 2. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 69(Suppl 2), S166–S176. <https://doi.org/10.1093/geronb/gbu106>
- StataCorp. (2015). *Stata: Release 14*. Statistical Software. College Station, TX: StataCorp LLC.
- Strachan, M. W. J., Reynolds, R. M., Frier, B. M., Mitchell, R. J., & Price, J. F. (2008). The relationship between type 2 diabetes and dementia. *British Medical Bulletin*, 88(1), 131–146. <https://doi.org/10.1093/bmb/ldn042>

Umberson, D., & Montez, J. K. (2010). Social relationships and health a flashpoint for health policy. *Journal of Health and Social Behavior*, 51(S), S54–S66.

<https://doi.org/10.1177/0022146510383501>

Vasilopoulos, T., Kotwal, A., Huisingh-Scheetz, M. J., Waite, L. J., McClintock, M. K., & Dale, W. (2014). Comorbidity and chronic conditions in the National Social Life, Health and Aging Project (NSHAP), Wave 2. *The Journals of Gerontology: Series B*, 69(Suppl_2), S154–S165. <https://doi.org/10.1093/geronb/gbu025>

Vijayan, M., & Reddy, P. H. (2016). Stroke, vascular dementia, and Alzheimer's disease: Molecular links. *Journal of Alzheimer's Disease*, 54(2), 427–443.

<https://doi.org/10.3233/JAD-160527>

Westwood, S. (2016). Dementia, women and sexuality: How the intersection of ageing, gender and sexuality magnify dementia concerns among lesbian and bisexual women. *Dementia*, 15(6), 1494–1514. <https://doi.org/10.1177/1471301214564446>

Zhang, Z., Hayward, M. D., & Yu, Y.-L. (2016). Life course pathways to racial disparities in cognitive impairment among older Americans. *Journal of Health and Social Behavior*, 57(2), 184–199. <https://doi.org/10.1177/0022146516645925>

Table 1: Descriptive Statistics by Sexual Orientation, N=3,567.

	LGB (n=81)		Heterosexual (n=3,486)	
	Mean/%	SD	Mean/%	SD
Sociodemographics				
Age (mean; range: 50-97)	62.1	10.7	64.1	10.5
Gender (% female)	43.1		54.2	
Education (%) *				
Less than high school	5.0		8.4	
High school or equivalent	11.8		23.1	
Some college/associate degree	43.3		37.1	
Bachelor's degree or more	39.9		31.4	
Race/ethnicity (%) *				
White	66.1		80.1	
Black	13.3		10.2	
Hispanic	11.1		5.8	
Other	9.4		3.8	
Cognitive health/MoCA-SA (%)				
No impairment, score > 22	68.3		75.5	
Mild impairment, score 18-22	20.2		18.5	
Early dementia, score <18	11.4		5.9	
Health Conditions and Behaviors				
Depressive symptoms/CES-D (mean)	11.0	4.1	10.1	3.9
Anxiety symptoms/HADS (mean)*	7.1	6.6	5.9	5.8
Physical comorbidity/Modified CCI (mean)	0.9	1.2	1.0	1.6
Smoking (%)	24.2		16.1	
Number of drinks per day of drinking (mean)	1.1	1.3	1.2	1.4

Exercise (%)				
Never or less than once a month	28.1		26	
1-3 times a month – 1-2 times a week	17.7		26.6	
At least 3 times a week	54.3		47.5	
Social Connections				
Marital status (%) *				
Married/cohabiting	44.6		70.2	
Divorced/separated/widowed	27.5		25.1	
Never married	27.9		4.7	
Number of close family members (%) *				
0	8.8		3.5	
1	11.4		8.8	
2-3	50.3		39.1	
4-9	21.3		37.3	
10+	8.2		11.3	
Living with other(s) (%)	68.4		80.8	
Community participation (mean)	-0.3	0.8	0.0	0.9

Note: * Difference between LGB and heterosexual groups is at the $p < .05$ significance.

Table 2. Ordinal Logit Regression Models of Cognitive Impairment on Risk Factors (Odds Ratios).

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sexual orientation (ref: heterosexual)						
LGB	2.07** (0.54)	1.91* (0.52)	2.07** (0.55)	2.00* (0.53)	1.95** (0.49)	1.83* (0.49)
Age	1.06*** (0.00)	1.06*** (0.00)	1.06*** (0.00)	1.06*** (0.00)	1.06*** (0.00)	1.06*** (0.00)
Female	0.91 (0.09)	0.86 (0.09)	0.92 (0.09)	0.89 (0.09)	0.93 (0.09)	0.88 (0.09)
Education (ref: less than high school)						
High school or equivalent	0.33*** (0.05)	0.35*** (0.06)	0.34*** (0.05)	0.34*** (0.05)	0.34*** (0.05)	0.37*** (0.06)
Some college/associate degree	0.17*** (0.03)	0.18*** (0.03)	0.17*** (0.03)	0.18*** (0.03)	0.18*** (0.03)	0.19*** (0.03)
Bachelor's degree and more	0.05*** (0.01)	0.06*** (0.01)	0.05*** (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.06*** (0.01)
Race/ethnicity (ref: white)						
Black	4.83*** (0.53)	4.94*** (0.55)	4.81*** (0.52)	4.72*** (0.54)	5.12*** (0.61)	5.05*** (0.60)

Hispanic	3.97***	4.25***	4.07***	4.14***	3.90***	4.31***
	(0.62)	(0.66)	(0.63)	(0.66)	(0.62)	(0.69)
Other	2.93***	3.05***	2.91***	2.97***	2.93***	3.05***
	(0.72)	(0.75)	(0.73)	(0.74)	(0.72)	(0.77)
Depressive symptoms		1.06***				1.06***
		(0.01)				(0.01)
Anxiety symptoms		1.01				1.01
		(0.02)				(0.02)
Physical comorbidity			1.07*			1.04
			(0.03)			(0.03)
Smoking				1.56***		1.42**
				(0.19)		(0.18)
Number of drinks per day of drinking				0.90**		0.89***
				(0.03)		(0.03)
Exercise (ref: never or less than once a month)						
1-3 times a month – 1-2 times a week				0.94		1.05
				(0.14)		(0.15)
At least 3 times a week				1.00		1.16
				(0.12)		(0.14)
Marital status (ref: married/cohabiting)						
Divorced/separated/widowed					1.20	1.11
					(0.18)	(0.16)
Never married					1.01	0.96
					(0.23)	(0.22)
Number of close family (ref: 0)						
1					1.04	1.08
					(0.29)	(0.32)
2-3					0.86	0.91

	(0.22)	(0.24)
4-9	0.73	0.80
	(0.18)	(0.21)
10+	0.64	0.70
	(0.17)	(0.19)
Living with other(s)	1.08	1.11
	(0.19)	(0.20)
Community participation	0.89*	0.91
	(0.05)	(0.06)

Note: ***p<0.001, **p<0.01, *p<0.05. Standard errors are in parentheses.

Table 3. KHB Analysis on Mediating Roles of Mental Health Conditions, Physical Comorbidity, Health Behaviors, and Social Connections.

	Coefficient	SE
<i>Sexual Orientation --> Mental Health Conditions --> Cognitive Impairment</i>		
Total effect	0.727*	0.294
Direct effect	0.649*	0.293
Indirect effect ^a	0.078*	0.036
<i>Sexual Orientation --> Physical Comorbidity --> Cognitive Impairment</i>		
Total effect	0.725*	0.291
Direct effect	0.727*	0.291
Indirect effect	-0.002	0.010
<i>Sexual Orientation --> Health Behaviors --> Cognitive Impairment</i>		
Total effect	0.752*	0.300
Direct effect	0.695*	0.301
Indirect effect	0.057	0.032
<i>Sexual Orientation --> Social Connections --> Cognitive Impairment</i>		
Total effect	0.749**	0.289
Direct effect	0.667*	0.295
Indirect effect	0.082	0.060

Note: **p<0.01, *p<0.05. SE=standard error. ^a Indirect effect is the mediating effect in KHB analysis. A statistically significant indirect effect suggests that the variable or variable set (e.g., mental health conditions) mediates some or all of the effects of sexual orientation on cognitive impairment. All the analysis is adjusted for the effects of age, gender, education, and race/ethnicity. Mental health conditions include two variables: depressive and anxiety symptoms. Physical comorbidity is a composite scale that integrates nine chronic conditions. Health behaviors include three variables: smoking, drinking, and exercise. Social connections include four variables: marital status, number of close family members, living with other(s), and community participation.