Article

# Determinants of Physical Functioning and Health-Related Quality of Life among Sexual and Gender Minority Older Adults with Cognitive Impairment

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## Abstract

**Objectives:** To examine risk and protective factors predicting physical functioning and physical and psychological healthrelated quality of life (HRQOL) among sexual and gender minority (SGM) older adults with cognitive impairment. **Methods:** This study analyzed longitudinal data from Aging with Pride: National Health, Aging, and Sexuality/Gender Study with a subsample of 855 SGM older adults who reported difficulties in cognitive performance. **Results:** Physical functioning and HRQOL linearly declined over time, and the decline of physical functioning was steeper for those with low levels of physical and outdoor leisure activities. The overall levels of physical functioning and HRQOL over time were associated with physical and outdoor leisure activities, optimal sleep, and sufficient food intake. HRQOL was negatively associated with lifetime discrimination and victimization, identity stigma, and smaller social network. **Discussion:** These findings can be used to develop interventions to improve physical functioning and HRQOL of SGM older adults living with cognitive impairment.

#### Keywords

dementia, cognitive decline, physical impairment, health-promoting factors, LGBTQ (lesbian, gay, bisexual, transgender, queer)

# Introduction

With increasing life expectancy and the dramatic growth of the aging population, the number of people living with cognitive impairment is increasing exponentially, and sexual and gender minority (SGM) older adults, constituting lesbian, gay, bisexual, transgender, queer, and other sexual and gender diverse individuals, have been found to be at greater risk. This marginalized population is known to have elevated health disparities compared to heterosexual cisgender counterparts (Fredriksen-Goldsen, Kim, Shui et al., 2017), and emerging evidence suggests that the risk of cognitive impairment is higher among SGM older adults. According to populationbased studies, lesbian, gay, and bisexual older adults are at heightened risks of substance use, cardiovascular disease, HIV/AIDS, and mental distress (Fredriksen-Goldsen, Kim, Shui et al., 2017), which are known to be predictors of cognitive impairment in later life (Cooper et al., 2015). A recent study found that the prevalence of subjective cognitive impairment for lesbian, gay, and bisexual adults aged 45 and older was greater than that for their heterosexual counterparts (Fredriksen-Goldsen et al., 2021). Population-based disparities associated with increased risks for cognitive impairment were

also found among transgender people as compared with cisgender people including the number of chronic conditions, disability, and poor mental health (Fredriksen-Goldsen et al., 2022). This study found that transgender people had higher odds for subjective cognitive decline than cisgender counterparts. In a national, community-based survey, approximately 80% of the SGM older adults aged 50 and older reported mild difficulties in at least one of the following areas: concentration, memory, problemsolving, learning, comprehension, and communication.

Cognitive impairment occurs when an individual has difficulties in memory and/or other cognitive functions including language, attention, or visuo-spatial skills, and depending on the severity of conditions, it ranges from mild cognitive impairment to dementia (Knopman & Petersen, 2014). The two clinical terms indicating the phase preceding dementia include cognitive impairment not dementia (CIND)

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that requires complaint of symptoms or compromised test performance and mild cognitive impairment (MCI) that requires both. However, cognitive impairment either CIND or MCI has been found to have an association with higher likelihood of progression to dementia than no cognitive impairment (Plassman et al., 2011). Cognitive impairment, regardless of its progression to dementia, is known to be a major source of morbidity and loss of independence in activities of daily living (Lee et al., 2019; Nelis et al., 2019). An increase in the need for caregiving, health care utilization, hospitalization, and institutionalization accounts for an estimated monetary cost of up to \$255 billion a year in 2020, and the total cost is estimated to double by 2040 (Hurd et al., 2013). Promoting and maintaining independence in daily living activities among those with cognitive impairment is crucial for reducing public health cost.

The progression of cognitive impairment increases the likelihood of deterioration in physical functioning and mobility, which is needed to perform everyday activities without additional assistance (Oleske et al., 1995; Pitkala et al., 2013). Decline in physical functioning may be observed even in early phases of cognitive impairment (Maeshima et al., 2021). As cognitive impairment progresses, functional limitations may lead to limited indoor and outdoor activities, weight loss, and loss of muscle tissue and tone (Ogawa et al., 2018), which increase the likelihood of falls (Allan et al., 2009) and limit daily living activities (Vermeersch et al., 2015). In addition, previous research suggests that cognitive impairment carries a complex burden that can adversely affect health-related quality of life (HRQOL), an indicator of a person's overall physical and mental health status (Pusswald et al., 2015). Thus, it is important to understand risk and protective factors associated with physical functioning and HRQOL among SGM older adults with cognitive impairment and to develop targeted interventions tailored to address their needs and help them to maintain independence in daily living activities and well-being.

To better understand physical functioning and HRQOL among SGM older adults with cognitive impairment, this study is guided by the Health Equity Promotion Model (HEPM; Fredriksen-Goldsen, Simoni et al., 2014). As an integrative framework, the model takes into account life course development and health risk and health-promoting factors influencing SGM individuals' opportunities to achieve HRQOL and well-being. The HEPM posits that health and well-being of SGM older adults, who have intersecting social positions, such as sexual and gender identity and older age, are influenced by historical and structural constraints (e.g., discrimination and victimization). Furthermore, it suggests that changes in their health and well-being over time should be understood in the interplay with psychological, behavioral, social, and biological factors, including those unique to SGM older adults and those experienced by older adults in general. According to an empirical study utilizing the HEPM, SGM-specific discrimination and victimization and SGM identity stigma were negatively associated with physical health and HRQOL of SGM older adults (Fredriksen-Goldsen, Emlet et al., 2013; Fredriksen-Goldsen et al., 2015). Another study revealed that the relationship between discrimination and victimization and physical health was partially mediated by health behaviors (e.g., physical activity and insufficient food intake), social connectedness, and psychological stress (Fredriksen-Goldsen, Kim, Bryan et al., 2017).

To date, little is known about factors that contribute to physical functioning and HRQOL for SGM older adults living with cognitive impairment. Existing literature suggests that HRQOL for individuals with cognitive impairment is associated with morbidity and engagement in behavioral and social activities, including exercise, leisure activities, sleep, energy intake, and social participation as well as physical functioning (Forbes et al., 2015: Jing et al., 2016: Letts et al., 2011; Nelis et al., 2019; Petrovsky et al., 2018; Salminen et al., 2019). In terms of predictors of physical functioning, previous studies have primarily focused on older adults in general. According to results from longitudinal studies of older adults, lack of physical activity was associated with decline in both cognitive and physical functioning, even after controlling for some potentially disabling chronic conditions such as lung conditions and hypertension (Brunner et al., 2017). Another longitudinal study, National Health and Nutrition Examination Survey (NHANES) found that food insecurity was associated with limitations in physical functioning and independence in instrumental activities of daily living among older adults (Jackson et al., 2019). Systematic reviews suggest that both sufficient food intake and nutrient quality (Lorenzo-Lopez et al., 2017) were important determinants of physical functioning among older adults. The results from the NHANES also suggest that poor sleep quality is associated with lower physical functioning among older adults, and the association is stronger among those with cognitive impairment and other chronic conditions (Puri et al., 2017). Previous research studies also suggest that lack of a support network might have negative impact over time on physical functioning among older adults (Hajek et al., 2021).

There has been insufficient attention to physical functioning and HRQOL among those living with cognitive impairment, particularly for disadvantaged populations including SGM older adults. This paper will address this important gap, by analyzing three-time point longitudinal data from the Aging with Pride: National Health, Aging, and Sexuality/Gender Study (NHAS). Guided by the HEPM and existing literature, this study examines the following research questions: (1) Are changes in physical functioning and HRQOL associated over time with multi-dimensional HEPM factors including SGM-specific historical and psychological adversity (i.e., SGM-related discrimination and victimization and SGM identity stigma) and behavioral (i.e., physical activity, outdoor leisure activity, optimal sleep hours, and insufficient food intake), social (i.e., living arrangement, partner/marital status, and social network size), and biological factors (i.e., the number of chronic conditions) among SGM older adults with cognitive impairment?; and (2) What factors moderate the effects of time on physical functioning and psychological and physical HRQOL?

# Methods

## Data and Study Sample

Data were drawn using a sub-sample of the NHAS from Wave 1 (2014) to Wave 3 (2018) (Fredriksen-Goldsen & Kim, 2017). The NHAS is a biennial prospective cohort study of 2450 adults aged 50 and older living in the United States who self-identify as lesbian, gay, bisexual, transgender, trans or gender non-binary, or engaged in same-sex sexual behavior, had a romantic relationship with, or attraction to, someone of the same-sex or gender. It was designed to examine predictors of health and well-being of SGM older adults focusing on historical, environmental, psychological, behavioral, biological, and social factors. Beginning in 2014 with 2450 participants, 2233 completed the survey in Wave 2 (2016) and 2011 in Wave 3 (2018). Response rates after accounting for attrition due to such factors as death were 94% and 88%, respectively.

Our study sample consisted of the 855 NHAS participants who self-reported having cognitive impairment at Wave 1. Attrition rates for the study sample (vs. those who did not have cognitive impairment at Wave 1) were 2.9% (vs. 3.0%,  $X^{2}(1) = 0.02, p = 0.88$ ) in Wave 2 and 4.5% (vs. 2.8%,  $X^{2}(1) =$ 4.5, p = 0.03) in Wave 3. Cognitive impairment was assessed with a 6-item cognitive function subscale of World Health Organization Disability Assessment Schedule (WHO-DAS) II (Üstün et al., 2010). Respondents were categorized as having cognitive impairment at Wave 1 if they self-reported having any moderate to extreme difficulties in 6 cognitive domains (concentrating, remembering, analyzing, learning, understanding, and communicating) during the past 30 days. Self-reported experience of difficulties in cognitive domains, known as subjective cognitive impairment, has been found to be a useful tool to detect early stage mild cognitive impairment, and progression to Alzheimer's disease and other types of dementia (Jessen et al., 2014). It is suggested to assess subjective cognitive impairment in both memory and non-memory domains (Jessen et al., 2014) because while the former is found to convert to Alzheimer's disease (AD; Oltra-Cucarella et al., 2018), the latter is likely to convert to non-AD dementia, such as Lewy body dementia (Ferman et al., 2013). This research was approved by the University of Washington's Institutional Review Board.

## Measures

*Physical Functioning*. In each wave, a self-report physical functioning scale consisting of 8 lower and upper extremity performance items (Fredriksen-Goldsen & Kim, 2017) was used to measure difficulty (0 = Extreme difficulty or cannot

do, 4 = No difficulty) performing physical activities without special equipment, including "walking a quarter of a mile," "walking up 10 stairs without resting," "sitting for about 2 hours," "reaching up over your head," "standing or bending on your feet for about 2 hours," "stooping, bending, or kneeling," "lifting or carrying something as heavy as 10 pounds," and "pushing or pulling large objects like a living room chair." The mean scores of the 8 items ranged from 0 to 4 with higher scores meaning a greater level of physical functioning. Cronbach's alphas were 0.90 in all three waves.

Physical and Psychological HRQOL. In each wave, participants rated their physical and psychological HRQOL using a brief version of World Health Organization Quality of Life (WHOQOL-BREF; Bonomi et al., 2000). The domain of physical HRQOL included 7 items assessing vitality, mobility, pain, dependence on medical treatment, sleep satisfaction, daily living activities, and work capacity. The domain of psychological HRQOL included 6 items assessing positive and negative affect, acceptance of body image, self-esteem, concentration, and personal beliefs. A summary score of each domain was computed following the recommended guidelines (World Health Organization, 2004). The possible range of summary scores was 0-100, with higher scores indicating better HRQOL. Cronbach's alphas for physical and psychological HRQOL were 0.82 and 0.84 in Wave 1, 0.84 and 0.83 in Wave 2, and 0.83 and 0.85 in Wave 3, respectively.

SGM-Specific Factors. Lifetime discrimination and victimization was assessed in Wave 1 asking participants to report lifetime frequency (never = 0; once = 1; twice = 2; 3 or more times = 3) of experiences in each of 5 types of discrimination including workplace, housing, and health care discrimination and 9 types of victimization including verbal threat and assault, physical threat and assault, sexual assault, property damage, and threat of being outed because they were or were perceived to be lesbian, gay, bisexual, or transgender (Fredriksen-Goldsen & Kim, 2017). The summed score was computed with a higher score indicating more discrimination and victimization experiences. Identity stigma, a timevarying variable, was assessed in each wave by the 4-item identity scale (Fredriksen-Goldsen & Kim, 2017) to measure the extent to which participants have negative attitudes and feelings toward their sexual or gender identity (e.g., "I feel ashamed of myself for being LGBT") ranging from strongly disagree (=1) to strongly agree (=6). Higher scores indicate higher identity stigma. Cronbach's alphas were 0.83, 0.86, and 0.86 in Waves 1, 2, and 3, respectively.

Behavioral Factors. Physical activity was a time-varying measure asking participants to report the number of minutes they spent doing each type of moderate-intensity aerobic activity (e.g., brisk walking and bicycling) and vigorous-intensity aerobic activity (e.g., running and aerobics) per week. The total amount of physical activity per week was

computed by summing the minutes of both intensity levels of aerobic activities. The minutes of vigorous-intensity aerobic activity was multiplied by 2 as 1 minute of vigorous-intensity aerobic activity is considered equivalent to 2 minutes of moderate-intensity aerobic activity (Centers for Disease Control and Prevention, 2015). Outdoor leisure activity was a time-varying measure asking participants how often they went out for enjoyment in the past month on a 5point scale ranging from never to every day. The variable was dichotomized into some days, most days, or everyday (= 1), and never or rarely (= 0). Participants' sleep hours were assessed in each wave by asking "on average, how many hours of sleep do you get in a 24-hour period?" Sleep duration was dichotomized into optimal (7-9 hours) and suboptimal ( $\leq 6$  hours or  $\geq 10$  hours) after rounding duration of sleep to the nearest hour (Hirshkowitz et al., 2015). Insufficient food intake was measured in each wave on a 5point scale by asking participants how often they have experienced insufficient food intake in the past 2 weeks due to loss of appetite, digestive problems, or chewing or swallowing difficulties. We coded quite often, very often, and always as having insufficient food intake (=1) and never and seldom as not having insufficient food intake (=0).

Social Factors. Relationship status was measured in each wave. Participants reported whether they were single (=0) or partnered/married (=1). Living arrangement was assessed in each wave by asking whether participants were living alone. Social network was also assessed in each wave by asking the number of close ties with living children, other immediate family members (e.g., brothers or sisters, parents, cousins, or grandchildren), and other relationships including ex-partners, friends, and neighbors. We summed the number of close ties (range: 0-51), and the variable ranges from 0 to 10 with 10 indicating 10 or more ties.

Biological Factors. The number of chronic health conditions potentially leading to disability (Brault et al., 2007; Freedman et al., 2007) was computed in each wave. Participants were asked whether they had been told by a doctor that they had any of the following chronic health conditions known to lead to functional limitations and disability, including heart attack, heart disease including angina or congestive heart failure, stroke, high blood pressure, arthritis, osteoporosis, diabetes, lung disease, chronic back pain, cancer, HIV/AIDS, and dementia. Dementia was included because medically diagnosed dementia is a distinct health condition associated with functional limitations even among individuals experiencing subjective cognitive impairment. Very small fractions of the study sample reported diagnosed dementia: 2.2% (n =19), 3.3% (n = 28), and 4.1% (n = 35) in Waves 1, 2, and 3, respectively. The possible range of the number of chronic conditions was from 0 to 12. Additional analysis with dementia excluded from calculating chronic conditions found no changes in the study findings.

Sociodemographic Characteristics. Sociodemographic characteristics included age, gender (women, men, and gender non-binary/diverse), race and ethnicity (Hispanic, Black or African American, non-Hispanic White, and other), and education (high school or less, some college or college graduate, and graduate school) that were measured at Wave 1. Household income was measured in each wave and dichotomized into greater than 200% of the federal poverty guideline [FPG] (=0) and at or below 200% of the FPG (=1) (U.S. Department of Health & Human Services, 2021), which is widely used to determine low family income in health disparity studies (Okoro et al., 2018).

## Data Analysis

All analyses were conducted using Stata/MP 16.1 (StataCorp, 2019). Preliminary analyses were conducted to describe the sample at the baseline wave (Wave 1). To investigate the effects of risk and protective factors on the overall levels of physical functioning and its longitudinal changes, we employed multilevel modeling using the following stepwise approach with random intercepts and random slopes for time estimated. First, time was coded as 0 for Wave 1, 1 for Wave 2, and 2 for Wave 3 and was entered as the only predictor (Level-1) to examine the linear change in physical functioning over time while controlling for Level-2 sociodemographic characteristics (Model 1). Second, lifetime discrimination and victimization at baseline (Level-2) were added to Model 1 to examine its effect on physical functioning controlling for the sociodemographic characteristics (Model 2). Next, identity stigma and behavioral, social, and biological factors were added as Level-1 predictors to Model 2 to examine their main effects on the overall levels of physical functioning (Model 3). Lastly, the effects of behavioral factors on the linear time slope of physical functioning were tested by adding interaction terms of time and each predictor. The interaction effects of time and the other predictors were also tested, but they were not significant and excluded from the final model. The results of interaction effects were plotted using the margins command. The same analytical approach was applied to the tests of multilevel modeling predicting physical and psychological HRQOL. As physical functioning closely relates to HRQOL (Jing et al., 2016), we controlled for physical functioning in Model 3.

# Results

#### Sample Characteristics

Descriptive statistics of study variables at the baseline wave are presented in Table 1. The average age at baseline was 66 years old, ranging from 50 to 97. More than 60% of the sample were men (61.8%); 34.6% were women; and 3.6% were gender diverse. Over eight in 10 were lesbian or gay, 12% bisexuals, and 7% sexually diverse individuals. Approximately 11% were identified as transgender. While 73%

 Table I. Descriptive statistics of study variables at Wave I:

 national health, aging, and sexuality/gender study (N = 855).

	Mean (SD) or %
Age, in year	66.2 (9.6)
Gender	
Women	34.6
Men	61.8
Gender diverse	3.6
Sexual orientation	
Lesbian or gay	81.1
Bisexual	11.6
Sexual diverse	7.3
Transgender	10.6
Race/ethnicity	
Non-Hispanic White	73.0
Hispanic	9.9
Black	10.7
Other	6.4
Education	
High school or less	15.4
Some college/4 year college degree	48.9
Graduate or professional degree	35.7
Household Income, $\leq$ 200% FPG	50.4
Lifetime discrimination and victimization	8.1 (8.5)
Identity stigma	I.7 (0.9)
Number of chronic conditions	2.5 (1.7)
Physical activity per week, in hours	8.4 (7.8)
Outdoor leisure activity	71.8
Optimal sleep hours (7–9 hours)	53.6
Insufficient food intake	17.6
Social network size	7.1 (5.7)
Partnered/married	37.2
Living alone	57.0

Note. SD = standard deviation; FPG = federal poverty guideline

were non-Hispanic Whites, 10%, 11%, and 6% were Hispanics, Blacks, and other race/ethnicities, respectively. While 84.6% had more than a high school education, more than half (50.4%) were living at or below 200% federal poverty guideline. The average frequency of lifetime discrimination and victimization was 8.1. The mean score of identity stigma was 1.7. The average number of chronic conditions was 2.5. The average hour per week spent on physical activity was 8.4. More than 70% were involved in outdoor leisure activity (71.8%). About 54% reported having an optimal amount of sleep hours. Nearly one fifth reported insufficient food intake (17.6%). Thirty seven percent were married or partnered, and more than half were living alone (57.0%). The average social network size was 7.

## Predictors of Physical Functioning

Table 2 presents the results of the multilevel modeling with physical functioning as an outcome variable. As shown in

Model 1 of Table 2, physical functioning significantly declined over time for SGM older adults with cognitive imafter pairment controlling for sociodemographic characteristics, including age, gender, race/ethnicity, education, and income. In Model 2, when lifetime discrimination and victimization was added to Model 1, the time effect remained significant, and lifetime discrimination and victimization was significantly associated with a lower level of physical functioning. Next, we tested the effect of the other correlates independent of time, lifetime discrimination and victimization, and sociodemographic characteristics by adding them to Model 2. As shown in Model 3 of Table 2, both time effect and the effect of lifetime discrimination and victimization on physical functioning were no longer statistically significant when the other predictors were added to the model. Of behavioral factors, physical activity, outdoor leisure activity, and optimal sleep hours were positively associated with physical functioning. Insufficient food intake was negatively associated with physical functioning. None of the social factors or identity stigma was significantly associated with physical functioning while a higher number of chronic conditions were associated with a lower level of functioning.

# Differences in Physical Functioning Trajectories by Behavioral Factors

As the last step, we examined interactions between time and behavioral factors, and the results are presented in Model 4 of Table 2. The significant interaction terms suggest that the time slopes of physical functioning varied by the hours spent on physical activity and whether participants were engaged in frequent outdoor leisure activity. Every point increase in the hours of physical activity was associated with estimated increase in time slope of physical functioning by 0.005. As shown in Figure 1, degree of physical functioning significantly increased over time for those who were engaged in 15.4 hours per week (=one SD above the mean) of physical activity while it did not change for those whose physical activity per week was one SD below the mean (=0.3 hours). As shown in Figure 2, those who had been engaged in frequent outdoor leisure activities showed a marginally significant over-time increase in degree of physical functioning whereas the time slope of physical functioning was not statistically different from 0 for those who had not been engaged in outdoor leisure activities.

# Predictors of Physical and Psychological HRQOL

The results of the multilevel modeling predicting physical and psychological HRQOL are presented in Table 3. As shown in Model 1 for each outcome variable, both physical and psychological HRQOL significantly declined over time for SGM older adults with cognitive impairment after

	Model	I	Model	2	Model 3	1	Model 4	
Fixed effects	b (SE)	Þ	b (SE)	Þ	b (SE)	Þ	b (SE)	Þ
Time since baseline	-0.06 (0.01)	< .001	-0.06 (0.01)	< .001	0.01 (0.01)	.456	-0.08 (0.03)	.018
Lifetime discrimination and victimization	_		-0.01 (0.003)	.003	-0.01 (0.003)	.092	-0.01 (0.003)	.094
Identity stigma	_				0.02 (0.02)	.324	0.02 (0.02)	.295
Physical activity	_		_		0.02 (0.002)	< .001	0.01 (0.002)	< .001
Outdoor leisure activity	_				0.07 (0.03)	.023	0.01 (0.04)	.772
Optimal sleep hours	_				0.06 (0.03)	.029	0.07 (0.04)	.060
Insufficient food intake					-0.17 (0.04)	< .00 I	-0.22 (0.05)	< .001
Partnered/married					-0.01 (0.04)	.785	-0.01 (0.04)	.747
Social network size	_				-0.000 (0.003)	.958	0.000 (0.003)	.979
Living alone	_				-0.000 (0.04)	1.00	-0.004 (0.04)	.930
Number of chronic conditions	—		—		-0.16 (0.01)	< .00 I	-0.16 (0.01)	< .001
Physical activity × Time	_				_		0.005 (0.002)	.018
Outdoor leisure activity × Time	—		—		—		0.07 (0.03)	.035
Optimal sleep hour × Time					—		-0.01 (0.03)	.740
Insufficient food intake × Time	_				_		0.06 (0.04)	.137
Intercept (Initial status)	3.59 (0.22)	< .00 I	3.76 (0.23)	< .001	3.63 (0.21)	< .00 I	3.70 (0.21)	< .001
Random effects	Estimate (SE)		Estimate (SE)		Estimate (SE)		Estimate (SE)	
Residual	0.40 (0.01)		0.40 (0.01)		0.39 (0.01)		0.39 (0.01)	
Time	0.18 (0.02)		0.18 (0.02)		0.16 (0.02)		0.15 (0.02)	
Intercept	0.76 (0.02)		0.75 (0.02)		0.63 (0.02)		0.64 (0.02)	

**Table 2.** Multilevel models predicting physical functioning among SGM older adults with cognitive impairment: NHAS (2014-2018; N = 855).

Note. The mixed models controlled for baseline age, education, gender, race/ethnicity, and income. Some numeric expressions are in three decimal places for precision.



Figure 1. Hours per week spent for physical activity and the level and change of physical functioning.

controlling for sociodemographic characteristics. When lifetime discrimination and victimization was added to Model 1, the time effect remained significant for both physical and psychological HRQOL. More frequent experiences of lifetime discrimination and victimization were significantly associated with lower levels of physical and psychological HRQOL. Next, we tested the effects of the time-varying correlates on the outcome variables independent of lifetime

Figure 2. Outdoor leisure activity and the level and change of physical functioning.

discrimination and victimization and sociodemographic characteristics as well as physical functioning by adding them to Model 2, and the results are shown in Model 3 of Table 3. While lifetime discrimination and victimization remained associated with physical and psychological HRQOL, identity stigma was also negatively associated with the outcome variables. Of the behavioral factors, physical activity, outdoor leisure activity, and optimal sleep hours were positively associated with physical and psychological HRQOL. Insufficient food intake was negatively associated with physical and psychological HRQOL. Of social factors, social network size was positively associated with physical and psychological HROOL. Being partnered or married was associated with higher level of psychological HRQOL whereas it was not associated with physical HROOL. Living arrangement was associated with neither of the HRQOL domains. A higher number of chronic conditions were significantly associated with lower physical HRQOL. A higher level of physical functioning was associated with higher levels of physical and psychological HRQOL. As the last step, we considered whether the time slope of physical and psychological HRQOL differed by behavioral and social factors, but no significant interactions were observed (not shown in Table 3).

# Discussion

Research has found that SGM older adults are at elevated risks of cognitive impairment (Fredriksen-Goldsen et al., 2021). Deterioration of physical functioning and HRQOL with the progression of cognitive impairment is of major concern particularly in this historically and socially marginalized population given the disparities in limited activities and poor physical and mental health among SGM older adults compared to their heterosexual and cisgender counterparts (Fredriksen-Goldsen et al., 2022; Fredriksen-Goldsen, Kim, Shui et al., 2017). To our knowledge, this is the first empirical study that examines correlates of changes in physical functioning and HRQOL over time among SGM older adults living with cognitive impairment.

This study revealed over-time declining of physical functioning and physical and psychological HRQOL among SGM older adults with cognitive impairment and showed that the decline in physical functioning and physical and psychological HROQL over time was associated with lower levels of physical activity, outdoor leisure activity, and optimal sleep, and a higher level of insufficient food intake. Furthermore, the decreases in physical and psychological HRQOL were associated over time with lifetime SGMrelated discrimination and victimization, identity stigma, and limited social network. Consistent with the HEPM, these findings shed light on the importance of addressing both health-promoting and risk factors as well as SGM-specific factors in efforts for delaying deterioration of HRQOL among SGM older adults living with cognitive impairment.

The findings on the associations between physical and outdoor leisure activities and physical and psychological HRQOL echo the results from previous studies for SGM older adults in general (Fredriksen-Goldsen et al., 2015; Fredriksen-Goldsen, Kim et al., 2013). This study extends earlier work by revealing that engagement in regular exercise and frequent outdoor leisure activities over time could alleviate longitudinal decline in physical functioning among SGM older adults with cognitive impairment. Our findings underscore the value of health professionals assessing activity engagement of SGM individuals experiencing cognitive impairment and the importance of helping SGM individuals



			Physical HR	QOL					Psychological H	HRQOL		
	Model I		Model 2		Model 3		Model		Model 2		Model 3	
Fixed effects	b (SE)	đ	b (SE)	¢	b (SE)	¢	b (SE)	Ф	b (SE)	þ	b (SE)	ф
Time since baseline	-1.27 (0.30)	- 100. -	-1.29 (0.30)	100. >	0.27 (0.29)	.357	-0.83 (0.28)	.003	-0.84 (0.28)	.003	-0.26 (0.31)	.398
Lifetime	I		-0.38 (0.07)	100. >	-0.17 (0.05)	100.	I		-0.34 (0.07)	100 <sup>.</sup> >	-0.22 (0.06)	100. >
discrimination and victimization												
ldentity stigma	I				-0.87 (0.35)	.014			I		-3.05 (0.40)	<ul><li>100. &gt;</li></ul>
Physical activity			I		0.13 (0.04)	.003					0.18 (0.05)	<ul><li>100. &gt;</li></ul>
Outdoor leisure			I		3.64 (0.66)	<ul><li>100. &gt;</li></ul>					5.56 (0.71)	100. >
activity												
Optimal sleep			I		3.57 (0.59)	<ul><li>100. &gt;</li></ul>					2.49 (0.65)	100 <sup>.</sup> >
hours												
Insufficient food intake	I		I		-2.55 (0.77)	100.			I		-3.65 (0.83)	100. >
Partnered/married					0.44 (0.84)	.599					2.21 (0.94)	.018
Social network					0.17 (0.06)	.007					0.63 (0.07)	100. >
size												
Living alone					0.15 (0.78)	.842					1.30 (0.86)	.130
Physical functioning			I		10.48 (0.42)	100 <sup>.</sup> >					1.98 (0.48)	100. >
Number of	I		I		-1.50 (0.23)	<ul><li>100. &gt;</li></ul>			I		0.01 (0.27)	.974
chronic												
conditions												
Intercept (Initial status)	49.70 (4.64)	100 <sup>.</sup> >	56.01 (4.72)	100 <sup>.</sup> >	13.35 (3.80)	100. >	32.04 (4.55)	100. >	37.28 (4.64)	100. >	24.31 (4.56)	<ul><li>100. &gt;</li></ul>
Random effects	Estimate (SE)		Estimate (SE)		Estimate (SE)		Estimate (SE)		Estimate (SE)		Estimate (SE)	
Residual	9.52 (0.24)		9.50 (0.24)		8.86 (0.22)		9.26 (0.24)		9.23 (0.24)		9.00 (0.26)	
Time	3.70 (0.48)		3.75 (0.47)		2.03 (0.61)		2.88 (0.55)		2.99 (0.53)		2.42 (0.65)	
Intercept	15.27 (0.45)		15.96 (0.45)		9.52 (0.35)		14.96 (0.44)		14.76 (0.43)		12.31 (0.41)	
Note. The mixed models	controlled for bas	ieline age, e	ducation, gender, an	d income. Ir	iteractions betweel	n time and b	ehavior and social	actors were	e tested but not sho	own due to l	ack of statistical sig	gnificance.

impairment: NHAS (2014-2018; N = 855). thin the second one SGM older adults with 2 nhvsical and nsvchological HROOI Table 3. Multilevel models predicting to understand the benefits of physical activity and outdoor leisure activities and identify preferred activities that they can participate in on a regular basis. Optimal sleep and food intake have rarely been examined in SGM health research, and this study suggests that they need to be paid more attention as more than a half of the study participants reported experiencing difficulties in having optimal sleep hours or sufficient food intake. Sleep quality and nutritional assessments are recommended, even at an early stage of cognitive impairment, so that health professionals can implement prevention treatment to help delay functional decline and improve HRQOL. Furthermore, as physical activities and increased exposure to daytime light can improve sleep quality (Ancoli-Israel et al., 1997; Bademli et al., 2019) for individuals with cognitive impairment, future research is needed to examine if such multi-component behavioral interventions addressing regular exercise, outdoor leisure activities, and sleep quality can effectively support SGM individuals with cognitive impairment toward an improvement of their physical functioning and HRQOL.

An unexpected finding was that the association with physical functioning of lifetime SGM-related discrimination and victimization and identity stigma did not remain significant when chronic conditions and other covariates were added to the model. It is critical to explore other potential mechanisms that might underlie this relationship. For example, the accumulation of stressful life experiences might cause chronic conditions and deterioration of cognitive and physical functioning via increased allostatic load (Gruenewald et al., 2009; Guidi et al., 2021; Juster et al., 2010). Still, lifetime SGM-related discrimination and victimization and identity stigma, as hypothesized, were risk factors associated with lower levels of physical and psychological HROOL even after controlling for other health risk and health-promoting factors. This finding is consistent with previous evidence among SGM older adults in general (Fredriksen-Goldsen, Cook-Daniels et al., 2014; Fredriksen-Goldsen, Emlet et al., 2013). High levels of perceived and enacted adverse experiences and identity stigma may be barriers to accessing health care and obtaining social resources that contribute to HRQOL. To date, there has been insufficient attention to the role of structural adversities based on social identities such as SGM-related discrimination and victimization in the health of adults living with cognitive impairment. SGM older adults living with cognitive impairment might also face stigma based on dementia and aging (McParland & Camic, 2018); and racial and ethnic minorities within this population might also experience additional disadvantages (Zhang et al., 2016). Further research is needed to understand the impact of intersections of marginalization on health outcomes in this demographically diverse population.

When considering social factors, relationship status was associated with psychological HRQOL. Our findings suggest that care support from a spouse or an intimate relationship may be beneficial for the psychological well-being and quality of life of SGM older adults who are facing challenges in daily activities due to cognitive impairment. Yet, a low rate of being partnered or married among SGM older adults are well-documented (Fredriksen-Goldsen, Kim, Shui et al., 2017), which imposes increased risks of loneliness and social isolation (Kim & Fredriksen-Goldsen, 2016). This study illustrates the need to identify those with cognitive impairment who do not have a spouse or partner and further evaluate whether and how they are connected to other sources of support and what types of support mostly contribute to enhancing their independence and HRQOL.

The positive benefits of a large social network, extending beyond a partner and immediate family, are consistent with previous studies of SGM older adults in general (Fredriksen-Goldsen et al., 2015; Kim et al., 2017). Such findings provide important insight to researchers regarding potential interventions that could improve both physical and psychological HRQOL of SGM older adults with cognitive impairment. However, sustaining support network ties in the face of cognitive impairment is challenging. Studies have documented a reduction of support network size with the onset of functional health declines among older adults (Cornwell & Waite, 2009). In future research, increased attention needs to be paid to those with restricted support networks and experiencing social isolation, which may cause accelerated decline in cognitive function and limited access to health care services (Cacioppo et al., 2015). Many SGM older adults have built friend-focused networks. As cognitive impairment progresses, the nature of friendships in terms of function and quality can change. Health professionals and service providers should be trained to counsel SGM adults with cognitive impairment while being culturally responsive to changes in their support networks and helping them identify and maintain the support they need (Fredriksen-Goldsen et al., 2018). Interestingly, it was found that none of the evaluated social factors (i.e., the structure of social relations) were associated with physical functioning. Further research is needed to explore whether other dimensions of social relations, particularly perceived social disconnectedness or loneliness are associated with physical functioning. For example, continuous experience of loneliness over time may cause functional decline and limited activities (Cacioppo et al., 2015) via impaired executive control leading to risky health behaviors as well as increased risks of disabling chronic conditions (Hawkley & Cacioppo, 2010).

There are limitations to the present study that should be noted. First, all study variables, including cognitive impairment, health behaviors, and physical functioning, were assessed using self-report, and social desirability effects may be a factor at play. Future studies should also incorporate objective and clinical measures to validate the present findings. Second, SGM older adults with advanced dementia are likely underrepresented. It is also plausible that a small number of baseline study participants might have dropped out of the study due to progression of cognitive impairment as suggested by higher attrition and lower response rates found in the study sample as compared with those not in this study without cognitive impairment at baseline. Third, the results of this study based on self-report data may be biased because those with cognitive impairment may not be able to report their experiences accurately. Fourth, only SGM-related lifetime discrimination and victimization were measured while demographically diverse SGM older adults with cognitive impairment might also experience unfair treatment due to race, ethnicity, gender, and age as well as their cognitive impairment status. Fifth, types and functions of social networks were not evaluated, which may have influenced the study findings. Lastly, the observational study design precludes us from testing causal relationships between variables. A controlled experimental study is warranted to go one step further to establish the causal role of behavioral and social factors for physical functioning and HRQOL among SGM older adults living with cognitive impairment.

Despite the limitations, the results of this study have important implications for further research. Most research studies on cognitive impairment have previously adopted a disease and deficit-focused model rather than investigating the resilience and quality of life among people living with cognitive impairment. The HEPM model, highlighting health equity and resilience, sheds new light on the significance of identifying modifiable factors to promote health and advance the quality of life among SGM older adults with cognitive impairment. Also, it will be important to utilize additional waves of longitudinal data to examine how and to what extent the health promoting effects are sustained over time as cognitive impairment progresses.

Promoting independence in daily living activities and HROQL for SGM older adults with cognitive impairment may reduce the costs associated with caregiving, hospitalization, and institutionalization. Our results suggest the need for policies that address the higher risk of cognitive impairment among SGM older adults, eliminate systemic stigma related to SGM identity, reduce social isolation, and enhance access to programs that help adhere to health-promoting behaviors and foster and maintain social resources. Programs for individuals with cognitive impairment and their caregivers have documented effectiveness in enhancing health-promoting behaviors such as exercise and outdoor activities and improving physical functioning and HRQOL (Teri et al., 2012). Yet, they may not adequately address SGM-specific needs including discrimination and stigma across the life course, distinct characteristics of caregiving relationships and social networks, and barriers to programs due to lack of cultural competence (Fredriksen-Goldsen et al., 2018). It will be imperative to develop and test culturally tailored programs incorporating such SGM-specific concerns and resources.

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