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Aging Concerns Related to Sexuality and Gender: HIV Prevention and Healthy Aging

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Abstract

Healthy aging is an important area of research across many populations, but less work has focused on this area among sexual and gender diverse individuals relative to the general population. On the whole, it is known that as the U.S. population ages, increasing attention is needed to understand the intersections between aging, health, and wellbeing. One area of consideration to address in regard to healthy aging is that of HIV prevention, in particular, pre-exposure prophylaxis (PrEP) use. For the current study we assessed these factors in a cross-sectional survey designed to assess disease status and related risk factors among a sample of individuals ≥ 50 years of age ($N = 794$, $M_{age} = 58.5$, range = 50–88) who resided in a metropolitan area in Ohio, USA. Results demonstrated that as overall age increased, general aging concerns decreased. Although HIV status was not related to general aging concerns, in additional models, lifetime PrEP use and six-month PrEP use were both related to greater aging concerns. When evaluating sexual orientation-specific aging concerns, we noted the opposite direction in terms of its relationship with age; as these concerns increased so did age. Further, cisgender women, transgender women, transgender men, and those identifying with a different identity each reported greater sexual orientation related aging concerns compared with cisgender men. Based on the current findings, additional research is needed to more fully understand aging related concerns for older individuals who identify as sexual orientation diverse.

Keywords HIV · Prevention · LGBT aging · Concerns · SGM

Introduction

As the U.S. population ages, increasing attention has shifted to the intersections between aging, health, and wellbeing related outcomes. While there has been a substantial focus on facilitating healthy aging across populations and reducing age-related stigma and discrimination, considerably less attention has been given to those who identify as sexual and gender diverse, and especially those with multiple minoritized experiences [24]. In particular, aging related concerns for those living with HIV are not well understood. Indeed, despite more than 40% all of those living with HIV in the U.S. being over 55 years of age [5], perceptions persist that HIV is mostly experienced by younger people. This, coupled with misperceptions that older adults are less sexually active [21], likely contributes to the current dearth of research on experiences of aging amongst those who are living with HIV.

Over recent decades, innovations in health care have contributed to improvements in life expectancy for people living with HIV (PLWH), such that there is minimal difference in average life expectancy between PLWH and those never diagnosed with HIV [33]. Aging with HIV does, however, come with a range of additional complications, which can include higher rates of co-morbidities [8, 26]. PLWH are at heightened risk of experiencing age-health concerns including cardiovascular diseases, renal disease, osteoporosis and fracture, and neuropsychological impairment [4]. At the same time, aging with HIV interfaces with other conditions that are often experienced at greater levels among the aging population, such as loss of function, independence in

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activities of daily living, and psychosocial outcomes that may worsen in older age, such as depression and anxiety (see [9]). Living with HIV while also adjusting to losses of independence and daily function, typical challenges for many aging individuals, is of relevance to study across heterogenous groups defined by minoritized social positions. For example, those who identify with diverse sexual and gender identities can be at particular risk of poorer health outcomes, resulting from contextual factors such as poverty, discrimination, and mental health challenges [27]. Understanding and addressing aging related concerns for those with intersecting and marginalized identities is particularly important to help continue to close gaps in health equity for these groups.

Coupled with heightened risk for experiencing physical and psychosocial health concerns, older adults show increased rates of engagement with health services and supportive care facilities (including long-term care; [17]). For older adults with diverse sexual and gender identities, and particularly those living with HIV, the experience of engaging with health care and support services can be fraught [20]. Numerous qualitative studies have articulated concerns about accessing support services that are in tune with the needs of sexual and/or gender diverse individuals, including poor levels of training for staff and experiences of discrimination [3, 6]. Indeed, in a systematic review of seven studies that assessed perspectives of aged care service providers, most providers acknowledged that they had insufficient training in supporting individuals with diverse sexual identities, and higher levels of stigma towards individuals of non-heterosexual orientations were demonstrated [3]. Further compounding difficulties, those facilities and services that focus on providing care that is affirming of diverse sexual and gender identities may not sufficiently consider intersecting identities, such as racial diversity [6]. Problems with engagement with services and receiving sufficient and appropriate care can then further contribute to poorer outcomes in these already at-risk groups.

An important consideration for health care among people at heightened risk for contracting HIV is the use of pre-exposure prophylaxis (PrEP), which is effective for preventing HIV infection when taken consistently [15]. Despite older adults ≥ 50 years being one of the few age cohorts in which new HIV infections are rising, PrEP use is more commonly studied and prescribed among younger cohorts [25]. To support increased and consistent uptake of PrEP in at risk populations, it is necessary to understand factors that may be associated with PrEP use in these cohorts – this includes older adults, and in particular those older adults with sexual, gender, and racially diverse identities.

To address knowledge gaps and inform service development, attempts have been made to characterize the concerns about aging experienced by those with sexual and gender minoritized identities. Extant research has largely focused on qualitative assessments, within specific cohorts. This work has included exploring perspectives of gay, lesbian, bisexual, and transgender older adults on their experiences of aging, finding that some aging concerns were similar to other cohorts (e.g., concerns about quality of life and desire to age 'in place'; [24]). There was also, however, evidence of specific concerns, termed 'queer aging', which included desire for connection with queer communities, and specific financial concerns related to homophobic discrimination. Further, some minoritized identities noted increased concerns associated with aging that were more specific to gender and/or sexual identity. For example, older transgender women with HIV expressed concern about transphobic responses from healthcare providers, and transphobic violence, which impacted their trust in health and social care supports and willingness to access services [7]. While extant studies have consistently expressed the importance of considering intersectionality in identities when exploring aging related concerns [11], it is difficult for qualitative research to provide clarity on aging related concerns for differing sexual gender and racial identities, and in particular whether intersecting identities are associated with general aging concerns, or specific concerns related to sexual and/or gender identities. General aging concerns may be addressed by available services, but concerns that are particular to sexual and gender identity, including intersecting identities, require more nuanced and specific care.

The present study investigates aging related concerns across a large sample of older adults in Columbus, Ohio, with a focus on developing nuanced understanding of how intersectional identities, HIV status, and PrEP use are associated with aging related concerns, both general and sexual/gender identity specific. This extends previous qualitative findings to identify which intersecting minoritized identities may experience particular types of aging-related concerns—therefore enabling services to target their support accordingly—in order to reduce inequities in healthy aging.

Method

Study Population

Data for this analysis of $N = 794$ participants aged 50–88 ($M_{age} = 58.5$, $SD = 6.3$) originated from the Columbus Healthy Aging Project (CHAP), a cross-sectional survey designed to assess several domains of health (e.g., disease status) and related risk factors (e.g., substance use, stress) among adults ≥ 50 years of age who reside in the Columbus, Ohio metropolitan area. Recruitment for this study took place via Facebook and Instagram. As this study focused on assessing disparities between sexual minorities

and heterosexuals, two individual ads were run: one for the general population and a second targeted specifically towards sexual minorities. Inclusion criteria included: (1) age ≥ 50 years; (2) residence in Columbus, Ohio or surrounding suburbs; (3) access to a computer or smartphone to complete the online survey assessment; and (4) a valid email address. We also aimed to recruit equal numbers of sexual minority and heterosexual participants while maintaining a racially and ethnically diverse sample that was reflective of Columbus' own distribution. This was done by pre-defining categories of participants that matched the racial and ethnic make-up of Columbus, stratified by gender and sexual minority status (e.g. non-Hispanic Black sexual minority women, etc.). Once recruitment was completed for each category, no other participants were considered eligible. All participants provided electronic informed consent and were compensated $20 in the form of an Amazon gift card. All study protocols and procedures were approved by The Ohio State University's Institutional Review Board (2020B0394).

Demographic Measures

Demographic information was self-reported by participants and included age, sex assigned at birth, gender identity, race, ethnicity, sexual identity, and insurance status. Age was self-reported and operationalized as a continuous variable. Sex assigned at birth was reported as female or male and coded as such. Gender identity was similarly self-reported as cisgender woman or man, transgender woman or man, or a different identity and coded as such. Race and ethnicity were coded based on participant self-identification as non-Hispanic Black, non-Hispanic White, Hispanic or non-Hispanic different race or multiracial. Sexual identity was operationalized as gay, lesbian, bisexual, heterosexual, or a different identity. Insurance status was operationalized as a binary variable as no current health insurance at the time of interview and any type of health insurance (e.g., private, Medicare, Medicaid, Tricare).

HIV Status and PrEP Use

Participants self-reported whether they were ever tested for HIV in their lifetime as well as in the past six months. Those who reported being tested were subsequently prompted to report whether the test was positive or negative for HIV, with the variable dichotomized as undiagnosed with HIV or as a person living with HIV. Participants also self-reported whether they had ever used PrEP in their lifetimes alongside whether they had used PrEP in the past six months. Both variables were operationalized as binary no/yes variables.

Aging Concerns Scales

Three separate scales measured aging concerns for (1) general aging concerns; (2) sexual identity-based aging concerns; and (3) gender identity-based concerns. Concerns related to *general aging* were assessed using an eight-item measure [23]. Items included questions such as, "In general, how concerned are you about growing older?" and "How concerned are you about the possibility of needing services from a long-term care facility?" Each of the eight items were rated on a 6-point scale (1 = not at all concerned, 6 = extremely concerned) with responses summed across all items ($\alpha = 0.92$).

Sexual identity-based and gender-based aging discrimination was assessed by asking participants, "Aging may be of greater concern to individuals who are [sexual minorities or transgender and gender non-conforming individuals], answer the following questions thinking how they may apply directly as a result of your [sexual orientation or gender identity]." The four questions included were: (1) "Because of my [sexual orientation/gender identity], I worry that my family will not care for me when I am older"; (2) "Because of my [sexual orientation/gender identity], I worry that I will not receive government aid when I am older"; (3) "I am concerned that getting the support I need as I age will influence my openness about my [sexual orientation/gender identity]"; and (4) "I am concerned that doctors, nurses, or other health care providers make assumptions about my health (e.g., HIV status) based on my [sexual orientation/gender identity]." In both instances, participants responded to four-items in each measure on a 5-point scale (1 = strongly disagree, 5 = strongly agree). The sexual identity-based aging discrimination scale has been used in previous research [23], whereas the gender identity-based aging discrimination scale was newly created by the research team, using equivalent wording to the sexual-identity based scale. Cronbach's alpha was acceptable for the sexual identity-based aging discrimination scale ($\alpha = 0.78$) but not for the gender identity-based aging discrimination scale ($\alpha = 0.46$).

Statistical Analyses

Univariate participant characteristics were described using means, standard deviations, and proportions, as appropriate. Multivariable hierarchical linear regression models were then utilized to assess the relationship between each of the aging concerns variables and: (1) demographic variables only; (2) demographic variables and HIV status; (3) demographic variables and lifetime PrEP use; and (4) demographic variables and past six-month PrEP use. All models were selected based on a mixture of statistical testing (those variables significant at the $p < 0.05$ level), confounding

assessment, and a priori knowledge regarding risk factors for aging concerns. All models were tested for violation of standard assumptions with no issues noted. Statistical significance was established at alpha = 0.05. All analyses were performed in StataSE 18.0.

Results

Table 1 presents the demographic characteristics of the sample ($N = 794$). Mean age across participants was 58.5 years (standard deviation [SD] = 6.3, range = 50–88). The sample was nearly evenly split between those assigned female at birth ($n = 371$, 49.7%) and those assigned male at birth ($n = 375$, 50.3%). A plurality of the sample self-reported as non-Hispanic White ($n = 411$, 51.8%), heterosexual ($n = 317$, 39.9%), cisgender ($n = 690$, 86.9%), and possessed insurance at the time of the survey ($n = 610$, 77.7%). Mean sum score on the general aging concerns scale was 45.3 ($SD = 8.1$, range: 16–72). Meanwhile mean scores on the sexual identity aging concerns and gender identity aging concerns scales were 12.4 ($SD = 3.9$, range: 4–20) and 13.0 ($SD = 3.9$, range: 6–19), respectively.

Table 1 Demographics of sample (N = 794)

Age, mean SD (range = 50–88)	58.5	6.3
Sex, n %		
Female	371	49.7
Male	375	50.3
Race and ethnicity, n %		
Non-Hispanic Black	297	37.4
Non-Hispanic White	411	51.8
Hispanic	49	6.2
Different identity	37	4.7
Sexual identity, n %		
Gay	214	27.0
Lesbian	180	22.7
Bisexual	52	6.6
Heterosexual	317	39.9
Different identity	31	3.9
Gender identity, n %		
Cisgender Women	330	41.6
Cisgender Men	360	45.3
Transgender Women	25	3.2
Transgender Men	27	3.4
Different Identity	52	6.6
Insured, n %	610	77.7
Aging concerns scales, mean SD		
General aging	45.3	8.1
Sexual orientation aging	12.4	3.9
Gender identity aging	13.0	3.9
HIV diagnosed, n %	32	7.4
PrEP use		
Lifetime	116	14.5
Past 6 months	93	11.6

Table 2 presents the multivariable linear regression results assessing the association between general aging concern scale items, demographic characteristics, and risk factors. The first model assessed only demographic characteristics. Here, we observed that as age increased, general aging concerns decreased ($B = -0.19$; 95% confidence interval [CI]: − 0.29, 0.09). Compared to non-Hispanic White participants, those who self-report as non-Hispanic Black (B = 1.53; 95% CI: 0.17, 2.89) and Hispanic ($B = 2.56$; 95% CI: 0.01, 5.12) each reported greater general aging concerns. Transgender women, compared to cisgender men, also reported greater general aging concerns ($B = 6.75$; 95% CI: 2.58, 10.92). Those without any form of insurance, compared to those with any form of insurance, reported lower general aging concerns ($B = -1.60$; 95% CI: 0.13, 3.06). The next model added HIV status alongside the demographic variables, although no significant relationship was observed between HIV status and general aging concerns. The third and fourth models each added lifetime PrEP use and past 6-month PrEP use, respectively. In the former model, lifetime PrEP use, compared to those who never used PrEP was associated with greater aging concerns ($B = 3.73$; 95% CI: 2.02, 5.45). In the latter model, those who reported PrEP use in the past six months, compared to those who did not, similarly reported greater aging concerns ($B = 4.99$; 95% CI: 3.08, 6.90).

Table 3 presents the next set of models assessing the multivariable linear regressions assessing the association between sexual orientation-related aging concern scale items, demographic characteristics, and risk factors. The first model again assessed only demographic characteristics. Here, we noted opposite results with regards to age, namely, that as age increases so too does sexual orientation-specific aging concerns ($B = 0.12$; 95% CI: 0.07, 0.18). We continued to observe that compared to non-Hispanic White participants, those who self-report as non-Hispanic Black ($B = 2.13$; 95% CI: 1.33, 2.92) and Hispanic ($B = 2.76$; 95% CI: 1.42, 4.11) each reported greater sexual orientation-specific aging concerns. Conversely, compared to non-Hispanic White participants, those identifying as a different race or ethnicity reported lower sexual orientation-specific aging concerns ($B = -2.16$; 95% CI: − 3.72, − 0.61). Compared to gay participants, those who identified as a different sexual identity also reported lower sexual orientation-specific aging concerns ($B = -3.17$; 95% CI: − 5.53, − 0.81). Compared to cisgender men, cisgender women ($B = 2.53$; 95% CI: 0.92, 4.14), transgender women ($B = 2.34$; 95% CI: 0.29, 4.40), transgender men ($B = 2.91$; 95% CI: 0.73, 5.09), and those identifying as a different gender identity ($B = 3.14$; 95% CI:

Table 2 Multivariable linear regressions assessing the association between *general aging concern* scale items, demographic characteristics, and risk factors

	Demographics		HIV Status		Lifetime PrEP Use		Past 6-Month PrEP use	
	(n = 677)		(n = 379)		(n = 677)		(n = 677)	
Variable	B	95% CI	B	95% CI	B	95% CI	B	95% CI
Age	− 0.19***	− 0.29, − 0.09	− 0.25***	− 0.39, − 0.11	− 0.19***	− 0.29, − 0.10	− 0.20***	− 0.30, − 0.10
Sex								
Female	Ref	–	Ref	–	Ref	–	Ref	–
Male	− 2.48	− 5.93, − 0.09	− 3.02	− 8.69, 2.63	− 1.36	− 4.81, 2.10	− 0.50	− 3.98, 2.99
Race and Ethnicity								
Non− Hispanic Black	1.53*	0.17, 2.89	0.24	− 1.52, 2.00	1.72*	0.38, 3.07	1.71*	− 0.38, 3.05
Non− Hispanic White	Ref	–	Ref	–	Ref	–	Ref	–
Hispanic	2.56*	0.01, 5.12	0.47	− 2.60, .3.53	3.02*	0.48, 5.55	2.92*	0.41, 5.44
Different Identity	− 1.44	− 4.41, 1.52	− 1.33	− 5.61, 2.94	− 1.59	− 4.51, 1.34	− 1.69	− 4.60, 1.22
Sexual Identity								
Gay	− 0.55	− 2.27, 1.17	− 2.07	− 4.35, 0.21	− 1.04	− 2.75, 0.67	− 1.34	− 3.06, 0.37
Lesbian	− 1.21	− 3.14, 0.71	− 3.48**	− 6.08, − 0.88	− 1.33	− 3.23, 0.58	− 1.14	− 3.03, 0.75
Bisexual	− 2.11	− 5.02, 0.79	− 3.14	− 7.15, 0.87	− 2.16	− 5.03, 0.71	− 2.03	− 4.88, 0.82
Heterosexual	Ref	–	Ref	–	Ref	–	Ref	–
Different Identity	0.62	− 3.22, 4.45	− 1.56	− 6.03, 2.90	0.18	− 3.62, 3.97	0.32	− 3.44, 4.09
Gender Identity								
Cisgender Women	− 1.71	− 5.01, 1.57	− 0.65	− 6.21, 4.91	− 0.80	− 4.08, 2.47	− 0.27	− 3.55, 3.00
Cisgender Men	Ref	–	Ref	–	Ref	–	Ref	–
Transgender Women	6.75***	2.58, 10.92	7.14*	0.62, 13.66	5.65**	1.50, 9.80	5.09*	0.95, 9.24
Transgender Men	1.24	− 3.31, 5.78	2.80	− 6.88, 12.48	2.53	− 1.98, 7.06	2.93	− 1.56, 7.44
Different Identity	− 0.84	− 3.95, 2.27	0.86	− 4.75, 6.48	− 0.67	− 3.74, 2.41	− 0.72	− 3.77, 2.34
Insured								
Yes	Ref	–	Ref	–	Ref	–	Ref	–
No	1.60*	0.13, 3.06	1.45	− 1.11, 4.01	− 1.04	− 2.51, 0.43	− 0.94	− 2.40, 0.52
HIV Status								
HIV Negative	–	–	Ref	–	–	–	–	–
HIV Diagnosed	–	–	0.67	− 2.70, 4.04	–	–	–	–
PrEP Use								
Lifetime								
No	–	–	–	–	Ref	–	–	–
Yes	–	–	–	–	3.73***	2.02, 5.45	–	–
Past 6-Months								
No	–	–	–	–	–	–	Ref	–
Yes	–	–	–	–	–	–	4.99***	3.08, 6.90

*p-value < 0.05; **p-value < 0.01; ***p-value < 0.001

1.77, 4.52) each reported greater sexual orientation-specific aging concerns. Similar to the models in Table 2, those with no insurance ($B = -1.55$; 95% CI: − 2.39, − 0.71) reported lower sexual orientation-specific aging concerns relative to those with any form of insurance. The next model added HIV status alongside the demographic variables, finding that those diagnosed with HIV reported greater sexual orientation-specific aging concerns relative to HIV-negative participants ($B = 2.09$; 95% CI: 0.58, 3.60). The third and fourth models again each added lifetime PrEP use and past 6-month PrEP use, respectively, although in neither of these models was there a significant association between either PrEP use variable and sexual orientation-specific aging concerns.

Table 4 presents the results of the multivariable linear regression models assessing the association between gender identity-related aging concern scale items, demographic characteristics, and risk factors. The first model examining demographic characteristics this time found no association between age and gender identity-related aging concerns. Compared to those assigned female at

Table 3 Multivariable linear regressions assessing the association between *sexual orientation-related aging concern* scale items, demographic characteristics, and risk factors

	Demographics		HIV Status		Lifetime PrEP Use		Past 6-Month Prep Use	
	(n = 451)		(n = 258)		(n = 451)		(n = 451)	
Variable	B	95% CI	B	95% CI	B	95% CI	B	95% CI
Age	0.12***	0.07, 0.18	0.12**	0.04, 0.20	0.12***		0.12***	0.06, 0.18
Sex								
Female	Ref	–	Ref	–	Ref	–	Ref	–
Male	0.46	− 1.75, 2.66	0.63	− 2.34, 3.61	0.48	− 1.74, 0.18	0.64	− 1.61, 2.89
Race and Ethnicity								
Non-Hispanic Black	2.13***	1.33, 2.92	2.33***	1.28, 3.38	2.13***	1.34, 2.93	2.15***	1.36, 2.95
Non-Hispanic White	Ref	–	Ref	–	Ref	–	Ref	–
Hispanic	2.76***	1.42, 4.11	3.64***	1.92, 5.36	2.78***	1.42, 4.13	2.80***	1.45, 4.15
Different Identity	− 2.16**	− 3.72, − 0.61	1.00	− 1.19, 3.18	− 2.16**	− 3.72, − 0.61	− 2.16**	− 3.72, − 0.61
Sexual Identity								
Gay	Ref	–	Ref	–	Ref	–	Ref	–
Lesbian	− 1.97	− 4.29, 0.36	− 1.71	− 4.44, 1.01	− 1.96	− 4.29, 0.36	− 1.90	− 4.23, 0.44
Bisexual	− 1.04	− 3.06, 0.97	− 0.83	− 3.46, 1.80	− 1.04	− 3.05, 0.98	− 0.97	− 2.99, 1.05
Different Identity	− 3.17**	− 5.53, − 0.81	− 3.58*	− 6.34, − 0.83	− 3.17**	− 5.53, − 0.80	− 3.11*	− 5.48, − 0.74
Gender Identity								
Cisgender Women	2.53**	0.92, 4.14	3.75**	1.22, 6.29	2.56**	0.92, 4.20	2.67**	1.03, 4.32
Cisgender Men	Ref	–	Ref	–	Ref	–	Ref	–
Transgender Women	2.34*	0.29, 4.40	3.72*	0.83, 6.60	2.33*	0.26, 4.39	2.23*	0.16, 4.30
Transgender Men	2.91**	0.73, 5.09	5.40*	0.81, 10.00	2.95**	0.73, 5.16	3.08**	0.86, 5.30
Different Identity	3.14***	1.77, 4.52	4.27***	2.00, 6.54	3.15***	1.77, 4.54	3.17***	1.79, 4.55
Insured								
Yes	Ref	–	Ref	–	Ref	–	Ref	–
No	− 1.55***	− 2.39, − 0.71	− 1.91	− 3.86, 0.04	− 1.53***	− 2.38, − 0.68	− 1.49***	− 2.34, 0.65
HIV Status								
HIV Negative	–	–	Ref	–	–	–	–	–
HIV Diagnosed	–	–	2.09**	0.58, 3.60	–	–	–	–
PrEP Use								
Lifetime								
No	–	–	–	–	Ref	–	–	–
Yes	–	–	–	–	0.09	− 0.85, 1.03	–	–
Past 6− Months								
No	–	–	–	–	–	–	Ref	–
Yes	–	–	–	–	–	–	0.41	− 0.61, 1.43

*p-value < 0.05; **p-value < 0.01; ***p-value < 0.001

birth, those assigned male at birth reported greater gender identity-related aging concerns ($B = 4.57$; 95% CI: 1.66, 7.49). Compared to non-Hispanic White participants, non-Hispanic Black participants continued to report gender identity-related aging concerns ($B = 4.09$; 95% CI: 2.64, 5.54). Relative to transgender men, transgender women ($B = -3.14$; 95% CI: − 5.52, − 0.76) and those identifying as a different gender identity ($B = -2.08$; 95% CI: − 4.04, − 0.12) each reported lower gender identity-related aging concerns. The next model added HIV status alongside the demographic variables, although no significant relationship was observed between HIV status and gender identity-related aging concerns. The third and fourth models, as in other tables, each added lifetime PrEP use and past 6-month PrEP use, respectively. It is pertinent to note here that results in these two models are identical as all transgender participants initiated PrEP within the past six months, meaning they are identical to lifetime PrEP use. We did note, however, that past six-month PrEP use was associated with lower gender identity-related aging concerns relative to those who did not report PrEP use in the past six months ($B = -3.61$; 95% CI: − 5.20, − 2.02).

Table 4 Multivariable linear regressions assessing the association between *gender identity-related aging concern* scale items, demographic characteristics, and risk factors

	Demographics		HIV Status		Lifetime PrEP Use		Past 6-Month Prep Use	
	(n = 100)		(n = 51)		(n = 100)		(n = 100)	
Variable	B	95% CI	B	95% CI	B	95% CI	B	95% CI
Age	− 0.06	− 0.16, 0.03	− 0.06	− 0.21, 0.10	0.01	− 0.08, 0.10	0.01	− 0.08, 0.10
Sex								
Female	Ref	–	Ref	–	Ref	–	Ref	–
Male	4.57**	1.66, 7.49	4.65	− 0.95, 10.24	1.39	− 1.60, 4.37	1.39	− 1.60, 4.37
Race and Ethnicity								
Non-Hispanic Black	4.09***	2.64, 5.54	4.18***	2.07, 6.29	3.57***	2.24, 4.90	3.57***	2.24, 4.90
Non-Hispanic White	Ref	–	Ref	–	Ref	–	Ref	–
Hispanic	0.54	− 2.31, 3.40	2.71	− 3.05, 8.47	− 0.18	− 2.78, 2.42	− 0.18	− 2.78, 2.42
Different Identity	− 0.75	− 6.14, 4.65	− 2.33	− 10.38, 5.71	− 2.07	− 6.98, 2.85	− 2.07	− 6.98, 2.85
Sexual Identity								
Gay	1.07	− 4.05, 6.20	− 4.29	− 10.67, 2.08	1.23	− 3.40, 5.87	1.23	− 3.40, 5.87
Lesbian	5.03	− 1.55, 11.62	− 1.06	− 4.20, 2.08	2.72	− 3.32, 8.77	2.72	− 3.32, 8.77
Bisexual	3.07	− 2.40, 8.54	1.13	− 9.61, 11.88	0.61	− 4.46, 5.68	0.61	− 4.46, 5.68
Heterosexual	Ref	–	Ref	–	Ref	–	Ref	–
Different Identity	4.63	− 1.53, 10.79	empty	–	3.11	− 2.51, 8.72	3.11	− 2.51, 8.72
Gender Identity								
Transgender Women	− 3.14**	− 5.52, − 0.76	− 1.38	− 6.15, 3.38	− 0.005	− 2.56, 2.55	− 0.005	− 2.56, 2.55
Transgender Men	Ref	–	Ref	–	Ref	–	Ref	–
Different Identity	− 2.08*	− 4.04, − 0.12	− 1.47	− 5.93, 2.99	− 0.69	− 2.56, 1.19	− 0.69	− 2.56, 1.19
Insured								
Yes	Ref	–	Ref	–	Ref	–	Ref	–
No	− 0.12	− 1.47, 1.24	− 2.03	− 10.19, 6.12	− 0.45	− 1.68, 0.79	− 0.45	− 1.68, 0.79
HIV Status								
HIV Negative	–	–	Ref	–	–	–	–	–
HIV Diagnosed	–	–	4.96	− 0.65, 10.56	–	–	–	–
PrEP Use								
Lifetime								
No	–	–	–	–	Ref	–	–	–
Yes	–	–	–	–	− 3.61***	− 5.20, − 2.02	–	–
Past 6-Months								
No	–	–	–	–	–	–	Ref	–
Yes	–	–	–	–	–	–	− 3.61***	− 5.20, − 2.02

Parameter estimates for "Lifetime PrEP use" and "Past 6-month PrEP use" are identical because all transgender participants initiated PrEP in the past 6 months

*p-value < 0.05; **p-value < 0.01; ***p-value < 0.001

Discussion

Older adults make up almost half of all individuals living with HIV in the U.S. [5]. Extant research has not, however, sufficiently explored the related aging concerns among individuals living with HIV. Further, no research has examined how older adults' engagement in HIV preventive measures, such as PrEP, may contribute to aging concerns. The current study extends the literature in two primary ways: First, by exploring how HIV status, lifetime PrEP use, and past six-month PrEP use were associated with aging concerns among a large sample of older adults—an area of research that often only focuses on the experiences of younger adults—and second, by exploring patterns across general, sexuality, and gender-specific related aging concerns. Overall, we found that older adults with sexual minoritized identities who reported living with HIV reported greater *sexuality-related* aging concerns. Additionally, we found that lifetime and recent PrEP use were associated with elevated *general* aging concerns in the full sample; in comparison,

PrEP use was associated with lower *gender-related* aging concerns among gender diverse older adults. Collectively, these findings highlight the unique and nuanced ways HIV status and PrEP engagement contribute to aging concerns across sexual and gender identities.

Our findings highlight unique demographic differences that suggest the burden of aging concerns is disproportionately felt by older adults across racial-ethnic, gender, and sexual identities. Non-Hispanic Black and Hispanic older adults, for example, consistently reported elevated general, sexuality, and gender related (e.g., results for Hispanic older adults were null for gender related concerns) aging concerns compared to non-Hispanic white older adults. This finding corroborates other evidence that has documented Black individuals, for example, face specific challenges across the aging process as compared to their White counterparts [31]. Additionally, among older adults holding a sexual minoritized identity, cisgender women, transgender women, and transgender men reported elevated sexuality aging concerns compared to cisgender men. Interestingly, among gender diverse older adults, transgender men reported higher levels of gender related aging concerns compared to transgender women. These findings indicate that aging concerns are especially elevated among older adults holding multiple marginalized identities. Unique experiences with stigma experienced at the intersection of identities may be a contributing factor [6, 10]. It is concerning that racial-ethnic identity was a persistent distinguishing factor in aging concerns across all three models and highlights the importance of future research to further understand how to cultivate positive aging experiences in older adults with marginalized racial-ethnic identities. Beyond differences across social positions, we documented relations between aging concerns and health insurance status, such that individuals without health insurance also reported lower aging concerns. This finding may be related to our sample of participants who, while older, were on average 58.5 years of age. Individuals experience chronic conditions more frequently with increasing age, and our participants who did not yet qualify for Medicare (i.e. at age 65), but did not have health insurance, may have not yet needed to interact with the health care system in ways that the oldest participants in our sample (who qualified for Medicare and were therefore categorized as having 'current health insurance') may have needed to.

We also documented nuanced patterns of general and sexuality-related aging concerns across age. Specifically, in the full sample, adults who were older reported lower levels of *general* aging concerns. This finding aligns with previous research that documents as individuals age, they do not describe themselves as "old", [29] and actively report living in the moment with fewer past and future worries [16], which could reflect adaptations to maintain life satisfaction [22, 30]. A different pattern was observed for sexual diverse individuals, such that older age was associated with elevated *sexual identity* related aging concerns. Distinct patterns between age and general and sexual identity-related aging concerns may highlight the unique lived experiences of heterosexual and sexual minority older adults. For example, older adults with sexual minoritized identities who lived through the height of the HIV epidemic may have experienced severe losses in social networks/ties and persistent exposure to stigma related to their sexual identity, thereby reducing the availably of role models that portray *how* to age as a person with a sexual minoritized identity [7]. Sexual minority older adults' chronic exposure to stigma across various developmental periods, as suggested by time and stigma perspectives [12], implicates older adulthood as a sensitive period of coping with stigma (e.g., weathering hypothesis). As such, future investigations should explore how sexual identity related aging concerns and chronic life exposure to stigma intersect to shape aging experiences, and the resulting adjustment, among older adults with sexual minoritized identities.

Interestingly, we found that HIV status was associated with *sexuality-related* aging concerns. That is, general and gender-specific aging concerns did not vary across HIV status among the general sample and older adults with minoritized gender identities; in comparison, living with HIV was associated with elevated sexuality-specific aging concerns among participants with sexual minoritized identities. Exposure to stigma based on age, sexual identity, and HIV could be compounded [18, 32] and, thus, may contribute more to sexuality specific aging concerns. Some qualitative research has deemed this compounded exposure to stigma as a "gay dilemma", which details the loss in social ties and role models older adults experienced throughout the height of the HIV epidemic alongside coping with stigma based on their sexual identities and HIV [7]. The resulting uncertainty around aging, reductions in perceived social support, and heightened experiences of loneliness partially driven by age, sexual identity, and HIV stigma [13, 14, 28, 32] could amount to greater stress and sexuality specific aging concerns. Put succinctly, these findings may suggest that HIV status is a particularly salient factor among older adults reflecting on future sexuality-specific aging concerns rather than more general or gender-specific aging concerns. Importantly, this finding underscores the need for future research to understand the impacts of sexuality-related aging concerns among older adults living with HIV.

Perhaps our most novel contributions are the findings that demonstrate PrEP use could be a unique factor related to aging concerns among older adults. Specifically, older adults in the general sample who reported lifetime and recent PrEP use also tended to report elevated *general* aging concerns. This finding could reflect older adults' experiences with age stigma across medical environments and interpersonal

relationships [2]. As one example, some medical providers may believe that older patients are less/not sexually active, which may lead them to stigmatize, discount, or be dismissive of older patients' desire to access and use HIV preventative services [1]. These interactions may shape older adults' future aging concerns, such as the potential utilization of longer-term living facilities and disclosing their use of HIV prevention services. Similarly, older adults who have used PrEP may experience enacted and anticipated forms of stigma tied to their PrEP use as a result of accessing and disclosing their use of PrEP to others, which may be compounded with age stigma in ways that amplify general aging concerns. This finding underscores the need for future research to explore the mechanisms that link PrEP use to general aging concerns and the subsequent impacts on positive aging experiences.

An opposite pattern was documented among gender diverse older adults when the association between PrEP use and gender-related aging concerns was examined. That is, PrEP use was associated with lower *gender-related* aging concerns among gender diverse older adults. It remains unclear why PrEP use contributed to lower levels of *gender-related* aging concerns yet higher levels of *general* aging concerns. A potential explanation could be the potential of PrEP access to connect transgender adults to positive and affirming sources of health care—a salient aging concern reported by transgender older adults [19]. Such positive interactions in the healthcare system may boost gender diverse older adults' access to HIV prevention services that may, in turn, weaken their concerns about gender-related aging (e.g., interactions with the healthcare system); however, this may not be enough to generalize and spill-over to reduce general aging concerns. These explanations can only be speculated but highlight critical directions for future research to identify how gender diverse older adults potentially view HIV prevention measures as resources that can facilitate positive aging experiences.

Limitations

Despite this study's novel contributions, several limitations should be noted. First, the study was cross-sectional and, thus, temporal causality could not be determined. For instance, PrEP use contributed to higher levels of aging concerns in the full sample; however, it is equally possible that older adults who were more concerned about aging sought out PrEP to reduce these concerns and foster a sense of agency in their future health. Future studies should take a longitudinal approach to understanding the complex nature of aging concerns among older adults' engagement in HIV prevention strategies. Additionally, this study used a self-report measure of HIV status, and it was unclear *when* individuals seroconverted. As such, it is unclear the extent to which HIV status contributes to sexual identity related aging concerns when considering the length of time someone has lived with HIV. Future studies should determine how the length of time one has lived with HIV shapes their future aging concerns. Such investigations could highlight sensitive periods that undermine positive aging experiences among older adults living with HIV and inform the optimal time to intervene. Next, given we recruited our sample from online spaces such as Facebook and Instagram, we may have unintentionally excluded aging individuals who do not use the internet, or who do not regularly engage with social media while on the internet. Relatedly, though we focus on the broad spectrum of aging adults, our participants were on average 58.5 years of age (with the oldest participant 88 years of age) – the aging concerns of participants in their 70s and 80s may certainly differ from participants in their 50s and 60s. Future investigations into aging and HIV care should recruit participants from multiple spaces that move beyond only Internet-based recruitment. Last, despite the research team adapting the sexual identity-based aging discrimination scale for gender-based discrimination, the newly created scale demonstrated poor internal reliability. Though the two scales were exactly the same except for the changed term of "sexual identity" vs. "gender identity" across each of the four items in each scale, the gender identity-based aging discrimination findings should be interpreted with caution.

Conclusion

Among a diverse sample of older adults, the current study explored how three forms of aging concerns varied across socio-demographic characteristics, HIV status, and PrEP use. Overall, we found that aging concerns were disproportionately felt across racial-ethnic, sexual, and gender identities. Additionally, the findings underscore that HIV status may be a particularly salient factor to consider alongside sexuality-related aging concerns. Whereas gender diverse older adults' engagement in PrEP use was associated with lower gender-related aging concerns, PrEP use was associated with elevated general aging concerns in the full sample. We hope scholars leverage our findings for future research on the specific mechanisms that drive these associations to inform interventions focused on promoting positive aging experiences for all.

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Declarations

Competing Interests The authors declare no competing interests.

Ethical Approval Ethical All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by The Ohio State University IRB. Informed consent was obtained from all individual participants included in the study.

Consent for Publication Not applicable.

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