

Association Between Subjective Age and Depressive Symptoms Among Middle-Aged and Aging HIV-Positive and HIV-Negative Men in the Multicenter AIDS Cohort Study

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Introduction

Older subjective age, or felt age, has been positively associated with being HIV-positive and having less than a high school education, depressive symptoms, diabetes, and medium and low aging satisfaction. To our knowledge, there is no literature exploring the association between subjective aging and depression among people living with HIV. Data from the Multicenter AIDS Cohort Study (MACS) was used to understand the role that subjective aging plays on depression among people who are living with and without HIV. We hypothesized that feeling older will be negatively associated with presenting symptoms of depression among men living with HIV compared to men living without HIV following an adjustment to the model to control for covariates.

Methods

The MACS is an observational cohort study that follows sexual minority men living with and without HIV in four sites within the United States: Baltimore, Maryland/Washington, DC; Chicago, Illinois; Los Angeles, California; and Pittsburgh, Pennsylvania/Columbus, Ohio. MACS participants attend semiannual visits that collect social, behavioral, medical history, and specimens using an Audio Computer-Assisted Self-Interview and standardized clinical examinations. The study design of the MACS has been described elsewhere. From 1984 to 2018, 7,352 men have been enrolled the MACS. 1,118 of these men were included in this study from the MACS substudy, *Understanding Patterns of Healthy Aging Among Men Who Have Sex With Men*, which was administered in six waves between March 2016 and September 2019. We used cross-sectional data from October 2016 to April 2017.

Odds ratios (including 95% CIs) were generated using logistic regression models to test the association of subjective age with the presence of depressive symptoms (defined as a score ≥ 16 using the Center for Epidemiological Study Depression scale). Odds ratios were adjusted for age, race/ethnicity, educational attainment, smoking status, history of hypertension, renal disease, dyslipidemia, liver disease, diabetes and HIV status.

Results

After adjusting for covariates, older age discrepancy was associated with higher odds of depressive symptoms (vs younger discrepancy; OR: 4.00; 95% CI: 2.39-6.69). Increasing age (5-year increase; OR: 0.81; 95% CI: 0.72-0.91) was

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associated with lower odds of depressive symptoms. Lower educational attainment was associated with higher odds of depressive symptoms (less than high school degree vs graduate school; OR: 5.33; 95% CI: 1.96-14.53) (high school vs graduate school: OR: 1.93; 95% CI: 1.10-3.37). There was no statistically significant association of HIV status or other covariates with risk of depressive symptoms.

Conclusion

Our findings demonstrated a statistically significant positive association between older subjective age (independent of increasing chronological age) and greater risk of depressive symptoms. We also found that having a high school or less than a high school education also increased this risk. Statistical significance was not present based on HIV status or other covariates in the adjusted model. Health care professionals should be aware of their patient's perception of aging in order to address depressive symptoms related to feeling older. Counteracting a person feeling older can be achieved through exercising regularly, prioritizing preventive care, maintaining a vibrant social life, and having an optimistic attitude on the years ahead of them.

Introduction

People surviving with HIV 50 years and older are able to live longer and healthier lives because of advancements of effective HIV treatments. Subsequently, this has led to more than half the population of people living with HIV being 50 years and older.¹ Subjective age, or felt age, is used to describe the self-perception of an individual's age in relation to their chronological age, and it is the calculation is determined by subtracting the chronological age of the person from the age they feel, or subjective age. Values representing a person's subjective age being older than their chronological age are positive, and those representing a younger subjective age in comparison to their chronological age are negative.² Understanding how people feel about their age can provide valuable insight into what they might expect for health outcomes.

The psychosocial and biological underpinnings of subjective age have been studied, and its effects have a strong association with health outcomes. Levy took a psychosocial approach to study aging and developed the theory of stereotype embodiment, which posits the beneficial effects of positive age-related stereotypes on cognition outcomes and the detrimental effects of negative stereotypes on physical outcomes.³ Here, we see the association of self-definitions of age-related stereotypes and the embodiment of these stereotypes with health outcomes. Stephan, Sutin, and Terracciano further elaborated on the psychosocial approach by coupling it with a biomedical approach, termed the *biopsychosocial approach*.⁴ In their study, Stephan et al. described how subjective age is impacted by biological characteristics of functional limitations, which contributes to health and cognition throughout the aging process.⁴ These theories outline the importance of perceptions placed on age and roles that influence cognition or mental health outcomes.

Younger subjective age has been associated with reducing depressive symptoms and fewer episodic events relating to major depression.⁵⁻⁷ In a systematic review, Debreczeni & Bailey found that depressive symptoms were reduced

in people with younger subjective age by mitigating the negative implications of aging (e.g., cognitive decline).⁸ A small but significant association was demonstrated between subjective age and depression in a meta-analysis of 13 independent data sets.⁸ However, the studies included in the meta-analysis focused primarily on the attributes of physical aging in the investigation of health and subjective age. They did not consider physical and mental performance, social factors, and psychological age, which may have resulted in a decreased association between subjective age and depression.⁹

Major depression is the most common psychiatric manifestation associated with HIV infection.¹⁰ Compared with the general population, people living with HIV are up to seven times more likely to be within the parameters necessary to be categorized as having major depression in accordance with international classification systems (*DSM-IV* or *ICD-10*).¹¹ Kelso-Chichetto et al. studied HIV status in two populations, the Multicenter AIDS Cohort Study (MACS) (N = 980) and Women's Interagency HIV Study (N = 1744), over 10 years to describe patterns of depressive symptoms.¹² From the MACS data, the investigators found that among men living with and without HIV, men living with HIV were associated with being 3.23 times more likely to be classified as being at moderate risk for depression.¹² Another study using MACS data described the association of stress relating to being a sexual minority (perceived stigma based on sexuality, excessive HIV bereavements) and aging (independence and fiscal anxieties) as being detrimental to mental health.¹³

Studies have shown an association between increased depression symptoms from stressful life events and diminished social support among people who are living with HIV.^{14,15} Depressive episodes are also exacerbated by numerous influences, such as feeling lonely, changes in physique, stigma surrounding HIV status, being categorized as having a disability on job-related health documentation, aging, and debilitation.¹⁶⁻¹⁸ Wight et al. showed an association between internalized gay ageism and depressive symptoms among men in the MACS.¹³ Taylor and Turner and Elliott, Kao, and Grant conceptualized the term *mattering*, which refers to how important people feel they are in relation to the world around them.^{13,19,20} This study found that mattering was overwhelmingly important to one's sense of self, and participants' sense of mattering had a negative association with depressive symptoms.¹³

Ambrosi-Randić et al. demonstrated the association younger subjective age has with aging successfully, increases in life satisfaction, and optimistic attitudes among 423 Croatian community members aged 60 to 95 years.²¹ Feeling younger has also been correlated to a decrease in depressive symptoms, the probability of major depressive episodes, and reduced symptoms of depression.⁵⁻⁷ Furthermore, feeling younger has been introduced as a contributor to cognitive performance due to its association with biological

processes (psychosocial, behavioral, and health-related processes).²² Before these findings, chronological age was considered the primary predictor for cognitive decline.²³ The association between subjective age and psychosocial conditions previously discussed provides context to the implications subjective age could play in living with HIV. Nieves-Lugo et al. found that having symptoms of depression was associated with poor age satisfaction and older subjective age with MACS participants.² Given the relationships between subjective age and depression, it seems that HIV status paired with having an older subjective age plays a central role in a person's mental health outcome of depression.

Having older subjective age has been positively associated with being HIV-positive and having less than a high school education, depressive symptoms, diabetes, and medium and low aging satisfaction.² To our knowledge, there is no literature exploring the association between subjective aging and depression among people living with HIV. Therefore, data from the MACS was used to understand the role that subjective aging plays on depression among people who are living with and without HIV. We hypothesized that feeling older will be positively associated with presenting symptoms of depression among men living with HIV compared to men living without HIV following an adjustment to the model to control for covariates.

Methods

Population

The MACS is an observational cohort study that follows sexual minority men living with and without HIV in four sites within the United States: Baltimore, Maryland/Washington, DC; Chicago, Illinois; Los Angeles, California; and Pittsburgh, Pennsylvania/Columbus, Ohio. Since 1984, 7,352 men have been enrolled over four time periods: 4,954 in 1984-1985; 668 in 1987-1991; 1,350 in 2001-2003; and 380 in 2010-2018. MACS participants attend semiannual visits that collect social, behavioral, medical history, and specimens using an Audio Computer-Assisted Self-Interview and standardized clinical examinations. The study design of the MACS has been described elsewhere.^{24, 25}

In this analysis, data was used from the MACS substudy, *'Understanding Patterns of Healthy Aging Among Men Who Have Sex With Men'*, which was administered in six waves between March 2016 and September 2019. We used cross-sectional data from October 2016 to April 2017 (visit 66).

Measures

OUTCOME

The Center for Epidemiologic Studies Depression Scale (CES-D) was used to define symptoms of depression.²⁶ CES-D scores greater than or equal to 16 were categorized as presenting with symptoms of depression; scores less than 16 were classified as not having depressive symptoms.

PRIMARY PREDICTOR

The assessment of age discrepancy was based on responses to “What age (years) do you feel most of the time?”. Subsequently, the calculations were obtained by taking the difference of the response in years (subjective age) and chronological age (subjective age – chronological age = age discrepancy). Positive values (subjective age > chronological age) were categorized as older age discrepancy, values of zero (where subjective age was the same as chronological age) as no age discrepancy, and negative values (subjective age < chronological age) as younger age discrepancy.

COVARIATES

Self-reporting allowed the participants to divulge their date of birth and the survey administration date. Race and ethnicity were categorized as non-Hispanic White (hereafter, White), non-Hispanic Black (hereafter, Black), Hispanic, and other. Education was categorized as less than a high school diploma, obtained a high school diploma, obtained some college education or a college degree, and obtained some graduate education or a postgraduate degree. Whether someone was living with or without HIV was assessed using assays outlined in the MACS protocol for all participants for their baseline MACS visit. Additionally, for men living without HIV at baseline, they were assessed using the MACS protocols at every subsequent visit. The smoking status of participants was categorized as never, current or former. Comorbidities included high blood pressure (systolic blood pressure ≥ 140 mm Hg, diastolic blood pressure ≥ 90 mm Hg or diagnosis of hypertension and use of medication), diabetes (fasting glucose level ≥ 126 mg/dL or a diagnosis of diabetes and use of medication), liver disease (serum glutamic pyruvic transaminase or serum glutamic oxaloacetic transaminase > 150 U/L), kidney disease (estimated glomerular filtration rate < 60 mL/min/1.73 m² or urine protein to creatinine ratio ≥ 200), and dyslipidemia (total cholesterol level ≥ 200 mg/dL, low-density lipoprotein cholesterol level ≥ 130 mg/dL, high-density lipoprotein cholesterol level < 40 mg/dL, or triglyceride level ≥ 150 mg/dL).²⁷

Statistical Analysis

Descriptive statistics were generated on the outcome measure, primary predictors, and covariates, stratified by HIV status, using median/interquartile range and frequencies/percentages where appropriate. We used logistic regression to assess the association between age discrepancy and depressive symptoms. Odds ratios (ORs) and 95% CIs adjusted for all the covariates. Statistical significance was set at $P < .05$. All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

Results

Descriptive Statistics

The analytic sample included 1,118 MACS participants (49.8% HIV positive/50.2% HIV negative). Overall, the median age was 60 years (interquartile range, 54-66) and most participants were White (68.8%), college-educated (85.6%), and former smokers (48.4%). Participants reported high blood pressure (58.2%), kidney disease (17.4%), dyslipidemia (73.5%), liver disease (0.2%), and diabetes (12.5%). Most participants also reported a younger age discrepancy (81.8%). Depressive symptoms were reported in 23.7% of participants (see [Table 1](#)).

Association of Age Discrepancy and Depressive Symptoms

After adjusting for covariates, older age discrepancy was associated with higher odds of depressive symptoms (vs younger discrepancy; OR: 4.00; 95% CI: 2.39-6.69). Increasing age (5-year increase; OR: 0.81; 95% CI: 0.72-0.91) was associated with lower odds of depressive symptoms. Lower educational attainment was associated with higher odds of depressive symptoms (less than high school degree vs graduate school; OR: 5.33; 95% CI: 1.96-14.53) (high school vs graduate school: OR: 1.93; 95% CI: 1.10-3.37). ([Table 2](#)). There was no statistically significant association of HIV status or other covariates with risk of depressive symptoms (see [Table 2](#)).

Discussion

These findings demonstrated statistically significant positive association between older subjective age (independent of increasing chronological age) and greater risk of depressive symptoms. We also found that having a high school or less than a high school education also increased this risk. Statistical significance was not present based on HIV status or other covariates in the adjusted model.

These findings are consistent with other studies that explored the association of age discrepancy and depression (see [Figure 1](#)). The studies included various approaches such as using a different depression scale or calculating age discrepancy in the reverse; however, they all resulted in correlating feeling older with increased depressive symptoms.²⁸⁻³³

Xiao et al. found that perceived control of the participant's outlook on aging has an important contribution to the association of younger subjective age and symptoms of depression.³³ The authors related this conclusion with the findings of Liang, whose study found that the development of younger subjective age could be a self-protection strategy to counteract negative stereotypes of aging.³⁴ We speculate that biological illnesses (e.g., heart disease, cancer, diabetes), which ultimately contribute to mortality, are some of the primary factors that can lead to depression among aging individuals. Subjective age plays a role in how the physical and emotional effects of aging are perceived. Feeling younger has been associated with reducing stress, being more physically

Table 1. Population Characteristics by HIV Status

	HIV-negative (n=561)	HIV-positive (n=557)	Overall (N=1118)
Age, median (IQR), years	57 (52-63)	62 (56-68)	60 (54-66)
Race/ethnicity, n (%)			
Non-Hispanic White	452 (80.6%)	317 (56.9%)	769 (68.8%)
Non-Hispanic Black	69 (12.3%)	162 (29.1%)	231 (20.7%)
Hispanic	28 (5.0%)	66 (11.9%)	94 (8.4%)
Other	12 (2.1%)	12 (2.1%)	24 (2.1%)
Education, n (%)			
Less than high school	10 (1.8%)	19 (3.4%)	29 (2.6%)
High school	42 (7.5%)	70 (12.6%)	112 (10.0%)
College	232 (41.4%)	270 (48.8%)	504 (45.1%)
Graduate school	268 (47.8%)	185 (33.2%)	453 (40.5%)
Missing	8 (1.6%)	11 (2.0%)	20 (1.8%)
Age discrepancy, n (%)			
Older age discrepancy	28 (5.0%)	59 (10.6%)	87 (7.8%)
No age discrepancy	60 (10.7%)	50 (9.0%)	110 (9.8%)
Younger age discrepancy	471 (84.0%)	443 (79.5%)	914 (81.8%)
Missing	2 (0.3%)	5 (0.9%)	7 (0.6%)
Smoking, n (%)			
Never smoker	196 (34.9%)	168 (30.2%)	364 (32.6%)
Former smoker	298 (53.1%)	243 (43.6%)	541 (48.4%)
Current smoker	61 (10.7%)	137 (24.6%)	197 (17.6%)
Missing	7 (1.3%)	9 (1.6%)	16 (1.4%)
High blood pressure, n (%)			
Normal blood pressure	214 (38.2%)	225 (40.4%)	439 (39.3%)
High blood pressure	337 (60.1%)	314 (56.4%)	651 (58.2%)
Missing	10 (1.7%)	18 (3.2%)	28 (2.5%)
Kidney disease, n (%)			
No kidney disease	470 (83.8%)	397 (71.3%)	867 (77.5%)
Kidney disease	58 (10.3%)	136 (24.4%)	194 (17.4%)
Missing	33 (5.9%)	24 (4.3%)	57 (5.1%)
Dyslipidemia, n (%)			
No dyslipidemia	120 (21.4%)	100 (18.0%)	220 (19.7%)
Dyslipidemia	410 (73.1%)	412 (74.0%)	822 (73.5%)
Missing	31 (5.5%)	45 (8.0%)	76 (6.8%)
Liver disease, n (%)			
No liver disease	533 (95.0%)	527 (94.6%)	1060 (94.8%)
Liver disease	1 (0.2%)	1 (0.2%)	2 (0.2%)
Missing	24 (4.8%)	29 (5.2%)	56 (5.0%)
Diabetes, n (%)			
No diabetes	447 (85.0%)	450 (80.8%)	927 (82.9%)
Diabetes (any)	60 (10.7%)	80 (14.3%)	140 (12.5%)
Missing	24 (4.3%)	27 (4.9%)	51 (4.6%)
Depression, n (%)			
No depression	434 (77.4%)	386 (69.3%)	820 (73.3%)
Depression	109 (19.4%)	156 (28.0%)	265 (23.7%)
Missing	18 (3.2%)	15 (2.7%)	33 (3.0%)

Table 2. Association of Age Discrepancy and Depressive Symptoms (Adjusted Model)

	Adjusted odds ratio (95%)
Age discrepancy	
Older age discrepancy	4.00 (2.39-6.69)*
No age discrepancy	1.15 (0.67-1.98)
Younger age discrepancy	1 [Reference]
Age (per 5-year increase)	0.81 (0.72-0.91)*
Race/ethnicity	
Non-Hispanic Black	1.15 (0.74-1.79)
Hispanic	1.04 (0.56-1.91)
Other	1.13 (0.41-3.06)
Non-Hispanic White	1 [Reference]
Education	
Less than high school	5.33 (1.96-14.53)*
High school	1.93 (1.10-3.37)*
College	1.40 (0.96-2.03)
Graduate school	1 [Reference]
HIV status	
Positive	1.05 (0.74-1.48)
Negative	1 [Reference]
Smoking	
Never smoker	0.97 (0.67-1.41)
Former smoker	1.16 (0.72-1.89)
Current smoker	1 [Reference]
High blood pressure	
Normal blood pressure	1.13 (0.80-1.60)
High blood pressure	1 [Reference]
Kidney disease	
No kidney disease	0.72 (0.44-1.20)
Kidney disease	1 [Reference]
Dyslipidemia	
No dyslipidemia	1.11 (0.75-1.64)
Dyslipidemia	1 [Reference]
Liver disease	
No liver disease	0.53 (0.03-8.93)
Liver disease	1 [Reference]
Diabetes	
No diabetes	0.88 (0.54-1.44)
Diabetes	1 [Reference]

* = Statistical Significance ($P < .05$)

resilient, and having larger grey matter volumes, which impact cognitive impairment.³⁵⁻³⁷ Subsequently, negative perceptions due to feeling older influence age-related stress that contributes to depression.

One perspective to address feeling older can be found in the work of Nieves-Lugo et al. when they described how physical health and lifestyle factors influence self-perceptions of aging.² The perception of the importance someone internally holds regarding their contribution to their external

Figure 1. Correlations of Subjective Age and Depression from the Scientific Literature

	<i>Depression Scale Used</i>	<i>Age Discrepancy Calculation Method</i>	<i>Do Their Findings Support or Refute Our Findings?</i>	<i>Does Feeling Younger Increase (↑) or Decrease (↓) Depressive Symptoms?</i>	<i>Positive (↑) or Negative (↓) Relationship Between Age Discrepancy and Depression</i>
<i>Choi et al. (2017)</i>	CES-D	CA-SA	Support	↓	↓
<i>Hwang & Hong (2019)</i>	S-GDS	CA-SA	Support	↓	↓
<i>Notthoff et al. (2018)</i>	CES-D	CA-SA	Support	↓	↓
<i>Rippon & Steptoe (2018)</i>	CES-D	CA-SA	Support	↓	↓
<i>Takatori et al. (2019)</i>	GDS-5	SA-CA	Support	↓	↑
<i>Xiao et al. (2019)</i>	CES-D	CA-SA	Support	↓	↓

Abbreviations: CA, chronological age; CES-D, Center for Epidemiological Studies Depression Scale; GDS, Geriatric Depression Scale; SA, subjective age; S-GDS, Short-Form of the Geriatric Depression Scale.

environment is called mattering.^{19,20,38} We postulate that aging could result in decreasing a person's outlook on mattering and could subsequently stimulate depressive symptoms. Feeling lonely, losing one's sense of self, and lack of social interactions are all factors that are prevalent as individuals age and impact a person's perspective on mattering. Wight et al. used the concept of mattering in conjunction with feeling denigrated due to gradual aging in conjunction with the characteristics attributed to the identities of gay men.¹³ This was termed internalized gay ageism and was established to understand depressive outcomes attributable to gay men specifically. Aging, having internal gay ageism, and holding a lower sense of mattering should be considered by clinicians when evaluating men who have sex with men for depressive symptoms. Additionally, preventive measures can combat these negative perceptions of aging, such as those presented by Stephan et al. (2014).²² They were able to successfully induce a younger subjective age among older adults through redirecting their thoughts to downward social comparison with their peers who had the same chronological age. This does introduce ethical concerns that would require refinement of this approach to keep the patient's well-being a priority.

This study has several limitations. First, the MACS participants are predominantly White, college-educated, and a survivor cohort; therefore, the results of this study may not be generalizable to other groups of aging men who have sex with men living with and without HIV. Second, most of the participants had a younger age discrepancy, which translates into the variability of age discrepancy not being high enough to find a statistically significant relationship between it and risk of depressive symptoms. Our study examined the relationship of subjective age and risk of depression cross-sectionally. Therefore, we were not able to examine the temporality of this relationship. Despite these limitations, the findings aid in understanding subjective aging and its association with depressive outcomes among middle-aged and aging men living with or without HIV.

Conclusions

We found that feeling older puts individuals at risk for depressive symptoms. Addressing comorbidities and implementing interventions for lifestyle changes, subjective age can be impacted positively and subsequently foster a sense of feeling younger.⁹ Therefore, health care practitioners can assist in counteracting a person feeling older by recommending the individual exercises regularly, makes preventive care a priority, maintains a vibrant social life, and has an optimistic attitude on the years ahead of them.

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Disclaimers

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Conflicts of Interests

None.

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