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The impact of life stress, psychological resources, and proactive behaviors on quality of life among people living with HIV

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ABSTRACT

Objectives: Quality of life (QoL) is an important consideration for people living with HIV (PWH). We investigated the relationship between stress, psychological resources, and proactive behaviors, on QoL (conceptualized as life satisfaction, successful aging, and depressive symptoms) by testing the hypotheses: (1) greater life stress (stress and functional impairment) is associated with poorer QoL; (2) resources (mastery, resilience, and social support) are associated with better QoL, beyond the influence of stress; and (3) proactive behaviors (medication management and leisure activities) mediate the relationship between resources and QoL.

Methods: Secondary analyses were performed ($N = 128$ PWH). Participants' mean age was 52.3, 83.6% were male, and 53.9 identified as white. Multivariate regressions were performed within the context of path analyses.

Results: In series 1, greater stress was associated with poorer life satisfaction ($p < 0.001$), lower self-rated successful aging ($p < 0.001$), and greater depression ($p < 0.001$). Functional impairment was associated with lower successful aging ($p = 0.017$) and greater depression ($p = 0.001$). In series 2, which accounted for mastery, resilience, social support, as well as demographic covariates, mastery was associated with greater life satisfaction ($p = 0.038$). In series 3, stress, functional impairment, leisure activities, and ART management were added to the model and social support was associated with engagement in leisure activities ($p < 0.001$), which was associated with better successful aging ($p = 0.006$). Fit indices suggested adequate relative fit. In bootstrapped analyses of indirect effects, social support was indirectly associated with successful aging through leisure activities ($p = 0.020$).

Conclusions: QoL, as captured by self-rated successful aging, is threatened by stress but positively influenced by social support and engaging in leisure activities. Findings support a model of proactive successful aging for PWH.

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Introduction

Quality of life (QoL) is a broad and holistic assessment of an individual's overall well-being. Health burdens associated with illness or disease may threaten QoL and the impact can last a lifetime, especially for people living with chronic conditions. HIV is now largely considered a chronic condition in the many parts of the world and the health burdens associated with living with HIV can be long lasting. Half of all people living with HIV (PWH) in the United States are ages 50 or older (CDC, 2019), representing an aging population. This is a reflection of the success of antiretroviral treatments (ART) in decreasing mortality rates and increasing long-term survival (Cahill & Valadez, 2013; Neuhaus et al., 2010).

Many PWH experience psychosocial stress to varying degrees throughout their lifetime. Stressors such as isolation, diminishing social support with increasing age (Shippy & Karpiak, 2005), stigma and discrimination (Emlet et al., 2013; Hutton et al., 2013; Slater et al., 2013), and overall feelings of stress (Fang et al., 2015) can threaten personal sense of well-being and QoL. Furthermore, HIV is associated with other chronic comorbidities such as cardiovascular disease, diabetes, and liver disease (High et al., 2012; Warriner et al., 2014) that require constant medical management. The early onset among PWH of age-associated physical and cognitive conditions, such as osteoporosis, frailty, and cognitive impairment (Balderson et al., 2013; R. C. Moore et al., 2014; Paul et al., 2018), may adversely impact QoL.

Despite facing adversities associated with HIV, research in this area has also brought attention to the ability of PWH to adapt and maintain a positive sense of well-being as they age (Emlet et al., 2011; Vance et al., 2008). Drawing from constructs of positive psychology, factors such as resilience (Fang et al., 2015; McGowan et al., 2018), self-efficacy, social and emotional support (Emlet et al., 2013; Slater et al., 2013) are considered positive psychological resources. These resources enable individuals to engage in mechanisms that promote and enhance health and QoL. This perspective acknowledges the strengths, and not only the health burdens or deficits, of PWH (Halkitis et al., 2017; D. J. Moore et al., 2018).

Drawing from the gerontology literature, the Proactivity Model of Successful Aging similarly emphasizes the strengths and resiliencies of individuals by delineating the adaptive processes through which individuals maintain a positive outlook despite facing various health and social stresses as they move through the lifecourse (Kahana & Kahana, 2001). Life stress occurs at any

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point in the lifecourse and the impact of these experiences can be cumulative in nature as an individual ages. Changes in health status and social circumstances such as illness, death of a romantic partner, and death of friends are more likely to occur with increasing age. The adaptive processes are referred to as 'proactive behavioral adaptations' in the Proactivity Model (Kahana et al., 2014). Health promotion behaviors like adherence to medications are considered proactive behaviors. Marshaling support through engaging in social interactions are also considered proactive behaviors. According to the model, internal and external resources (like psychological resilience, mastery, and social support) can motivate proactive behavioral adaptations. This theoretical pathway suggests positive resources influence QoL through proactive behaviors. Specifically, the pathway suggests that people with higher levels of resilience, mastery, and social support are more likely to adhere to positive, proactive behaviors and that these behaviors promote QoL. For example, an individual who has many close social contacts and high levels of perceived social support may be more likely to engage in social activities that promote health such as walking groups and social clubs.

Applied to the context of living HIV, the Proactivity Model serves as a practical framework for QoL considerations because many of the adaptive factors considered in the model are potentially modifiable. Proactive behaviors such as social engagement and medication adherence have broad implications for QoL in the context of living with HIV. One of the challenges that PWH face as they age is the parallel increase in risk of isolation and diminished social support (Shippy & Karpiak, 2005). These social challenges can influence engagement in social activities. Social engagement can take various forms but generally refers to activities that involve interaction with other people around a practice that has shared meaning, (Arai & Pedlar, 2003). Leisure activities such as participating in social clubs, religious activities, and travel are forms of social engagement. Social engagement is associated with overall well-being including QoL, psychological well-being, and mortality (Gerritsen et al., 2004; Jansen & von Sadovszky, 2004; Kawachi & Berkman, 2001; Kiely & Flacker, 2003).

Proper medication management is a critical component of chronic disease management. For PWH, proper adherence to ART is key for maintaining suppressed viral loads, high CD4 cell counts, and curbing progression to AIDS (Center for Disease Control and Prevention, 2019). Long-term survivors may have developed a medication routine over time that supports adherence but may still face challenges with ART persistence, or the continuous adherence to ART over time. Skipping ART for even two consecutive days can have negative impacts on clinical indicators. Even for long-term survivors, it is possible to be adherent to an ART regimen but have patterns of nonpersistence.(Gwadz et al., 2021; Nyaku et al., 2019)

In this study, we draw on the Proactivity Model of Successful Aging to guide analyses using a secondary dataset of PWH. Specifically, in our analyses, we examined the suppositions that (1) individuals with more life stress would experience poorer QoL (life satisfaction, self-rated successful aging, and depressive symptoms); (2) higher levels of resources (mastery, resilience, and social support) would be associated with better QoL beyond the influence of stress; and (3) engagement in proactive behaviors (ART management and leisure activities) would be associated with better QoL and would mediate the relationship between resources and QoL. A diagram of the hypothesized relationships is presented in Figure 1.

Materials and methods

Data source

De-identified data were obtained from the Multi-Dimensional Successful Aging Among HIV-Infected Adults study conducted at the University of California, San Diego. The study was active from 2013 to 2017 and study procedures have been published in detail elsewhere (R. C. Moore et al., 2017; Rooney et al., 2019). HIV status of the participants was confirmed by enzyme-linked immunosorbent assays with Western Blot. All participants in the parent study provided written informed consent and exclusion criteria included: (a) diagnosis of a psychotic disorder or a mood disorder with psychotic features; (b) presence of a neurological condition not related to HIV infection and known to affect cognitive functioning, such as Alzheimer's disease, stroke, traumatic brain injury, and severe learning disability; and (c) having a positive urine toxicology for illicit substances of abuse (except for marijuana) conducted prior to the baseline visit. The original study recruited both PWH and individual without, but we included only PWH in our analyses. The final dataset had a sample of 128 people.

Measures

We conceptualized QoL as separate outcome measures of life satisfaction, successful aging, and depressive symptoms. Life satisfaction was assessed using the 5-item, Satisfaction with Life Scale (Diener et al., 1985), where higher sum scores indicate greater life satisfaction. In this sample, there was good measure reliability at

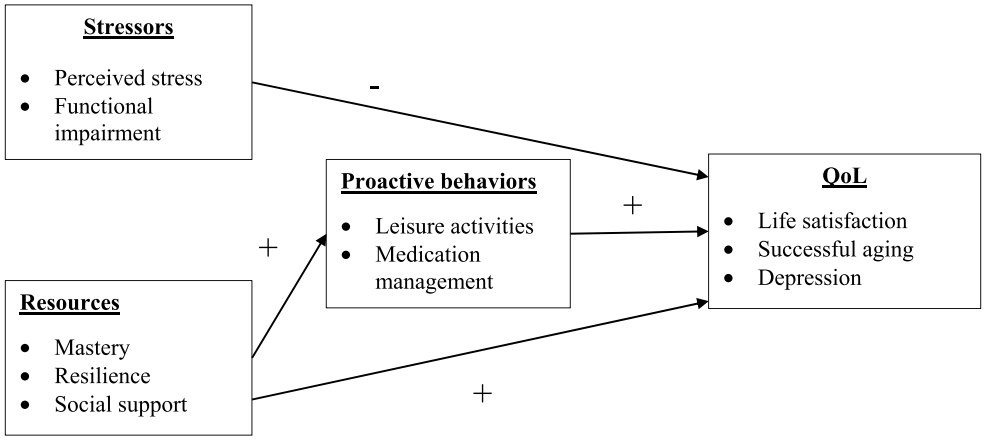

Figure 1. Hypothesized relationships tested in hypotheses.

$\alpha = 0.93$. For successful aging, we used a single, visual analog scale, with values ranging from 1 to 10. Participants indicated their self-rated successful aging with greater values indicating greater successful aging. This scale has established validity in other studies (Montross et al., 2006; R. C. Moore et al., 2013). Finally, depressive symptoms were measured using the Center for Epidemiological Studies Depression Scale-Revised (CESD-R; Radloff, 1991). Higher scores indicate greater severity of depressive symptoms. The reliability of the CESD-R in the sample was $\alpha = 0.93$.

Overall stress and functional impairment were used as indicators of stress. Overall stress was measured using the 10-item, Perceived Stress Scale (Cohen et al., 1983), with higher scores indicated greater levels of perceived stress. In this sample, reliability of the measure was $\alpha = 0.92$. Functional impairment was measured using a modified version of the Lawton and Brody (1969) questionnaire of activities of daily living (R. K. Heaton et al., 2004) which asks participants to assess their ability to independently perform certain everyday tasks. For analyses, a dichotomized variable was used to delineate between functional impaired and not impaired.

We included three measures of internal and external resources. Mastery captures the degree to which individuals feel they have control over the factors that influence their lives. This was measured using the 7-item, Pearlin Mastery Scale (Pearlin & Schooler, 1978). The original scale is coded such that lower sum scores indicate greater mastery but for consistency and ease of interpretation, we recoded the items so that higher scores indicated greater levels of mastery. Reliability of the measure was $\alpha = 0.85$. The 10-item Connor-Davidson Resilience Scale (Campbell-Sills & Stein, 2007; Connor & Davidson, 2003) was used to measure resilience. Greater summed scores indicate greater levels of resilience. There was good reliability of the measure in this study population with $\alpha = 0.92$. Social support was measured using the Social Interaction subscale from the Duke Social Support Index (DSSI; Koenig et al., 1993). The four items on this subscale were summed with higher scores indicating greater social support. The reliability of the measure in this population was $\alpha = 0.63$.

For proactive behaviors, ART management over the past 30 days was assessed (Wilson et al., 2016). This included two items—perceptions of 'how good a job' and how often participants took their ART as prescribed. These items were treated as a single variable for analyses by averaging responses across both questions. Higher scores indicate better ART management. Participants also reported on their weekly engagement in leisure activities that cover social, cognitive, and physical leisure domains (Campbell et al., 2020). A checklist of 30 activities is presented (e.g. playing cards, watching movies, going to church, synagogue or temple, etc.) Each activity endorsed on this measure was counted as '1' and all activities endorsed were summed to yield a count of the extent of engagement in activities on a weekly basis. The possible number of activities ranged from 0 to 30 for a continuous score.

Variables that were controlled in analyses included participant age, gender, race/ethnicity, and cognitive impairment. Cognitive impairment was determined based on performance on a standard neuropsychological battery and the raw scores were transformed into age-, education-, sex-, and race/ethnicity-adjusted T-scores based on normative samples of HIV-seronegative participants (R.K. Heaton et al., 2004; Norman et al., 2011). T-scores were converted to Global Deficit Scores, using the score of 0.5 as the cutoff for cognitive impairment (Carey et al., 2004).

Data analyses

Path analyses were conducted to examine the relationship between proactive behaviors, resources, stress, and QoL. Indirect effects were computed to detect potential mediatory role of proactive behaviors. We first performed a series of multivariate regressions controlling for relevant covariates. The regressions in series 1 examined the relationships between the stress variables (perceived stress and functional impairment) and each three QoL outcome (life satisfaction, self-rated successful aging, and depression) in separate models, controlling for gender, age, education, and cognitive impairment. In series 2, the resource variables (mastery, resilience, and social support) were added to each of the models defined in series 1. In series 3, we added proactive behaviors (ART management and participating in leisure activities) to the models defined in series 2. Proactive behaviors were examined as potential mediators between resources and QoL outcomes by including indirect pathways of influence from resources to QoL through proactive behaviors. Fit of the full conceptual model was evaluated using standard indices of relative model fit (i.e. CFI, RMSEA, and SRMR; Hu & Bentler, 1999). All analyses were carried out in Mplus v7.11 (Muthen & Muthen, 1998–2017) using robust maximum likelihood estimation and the tests of the significance of indirect effects were assessed using bootstrapping (MacKinnon et al., 2002).

Results

Most of the participants in this study identified as non-Hispanic White (53.9%) and male (83.6%). Participants were, on average, 50.3 years of age ($SD = 8.5$) with 13.9 years of education ($SD = 2.4$). Because a moderate proportion of the sample (39.1%) was determined to have cognitive impairment, this variable was controlled for in multivariate analyses. See Table 1.

Table 2 presents the correlation matrix table for all variables examined in analyses. Table 3 presents the results of the regressions performed in series 1. Consistent with our hypotheses, participants who reported greater perceived stress also reported poorer life satisfaction ($\beta = -0.49$, $p < 0.001$), lower self-rated

Table 1. Participant characteristics ($N = 128$).

	Descriptive statistics	Observed range/Coding
Age, mean (SD)	50.29 (8.46)	35 – 65
Years of education, mean (SD)	13.93 (2.42)	7 – 20
Male, n (%)	107 (83.6%)	0 = Female, 1 = Male
Race/Ethnicity		0 = Minority ethnicity, 1 = White
Non-Hispanic white, n (%)	69 (53.9%)	
Black, n (%)	23 (18.0%)	
Hispanic, n (%)	24 (18.8%)	
Other, n (%)	10 (7.8%)	
Years living with HIV, mean (SD)	16.8 (8.8)	0.3 – 31.6
Current CD4 cell count, mean (SD)	654.4 (326.0)	64 – 640
Undetectable viral load, n (%)	114 (92.7%)	
Cognitively Impaired, n (%)	50 (39.1%)	0 = Not impaired, 1 = Impaired
Outcome variables		
Depressive symptoms, mean (SD)	17.4 (7.3)	0 – 60
Self-rated successful aging, mean (SD)	7.4 (2.0)	0 – 10
Satisfaction with life, mean (SD)	21.1 (7.7)	0 – 30
Model variables		
Perceived stress, mean (SD)	15.21 (8.3)	0 – 39
Functional impairment, n (%)	40 (31.3%)	0 = Not impaired, 1 = Impaired
Personal mastery, mean (SD)	21.20 (4.6)	9 – 28
Resilience, mean (SD)	29.50 (7.8)	2 – 40
Social support, mean (SD)	8.33 (1.9)	4 – 12
ART adherence, mean (SD)	5.44 (0.8)	3 – 6
Leisure activities, mean (SD)	13.40 (5.3)	4 – 29

Note. ART = antiretroviral therapy.

Table 2. Correlation matrix between QoL outcomes, resource variables, and proactive behavior variables.

	Depression	Life satisfaction	Successful aging	Mastery	Resilience	Social support	ART management	Leisure activities
Depression	1.00	−0.45***	−0.33***	−0.48***	−0.40***	−0.27***	−0.16	−0.10
Life satisfaction	−0.45***	1.00	0.54***	0.59***	0.53***	0.36***	0.07	0.20**
Successful aging	−0.33***	0.54***	1.00	0.55***	0.47***	0.27***	0.09	0.25***
Mastery	−0.48***	0.59***	0.55***	1.00	0.66***	0.29***	0.12	0.20
Resilience	−0.40***	0.53***	0.47***	0.66***	1.00	0.30***	0.13	0.24***
Social support	−0.28***	0.36***	0.27***	0.29***	0.31***	1.00	0.09	0.45***
ART management	−0.16	0.07	0.10	0.12	0.13	0.09	1.00	0.16
Leisure activities	−0.10	0.20**	0.20***	0.24**	0.45***	0.16***	0.25	1.00

Note.
**0.001 < p < 0.01, ***p < 0.001.

Table 3. Regression estimates for series 1: relationship between stress and quality of life outcomes.

	Life satisfaction			SRSA			Depression		
		95% CI			95% CI			95% CI	
	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper
Stress									
PSS	−0.485*** (0.075)	−0.632	−0.337	−0.144*** (0.021)	−0.186	−0.109	0.553*** (0.071)	0.414	0.693
Functional impairment	−1.790 (1.209)	−4.160	0.580	−0.926* (0.389)	−1.687	−0.286	4.395** (1.324)	1.800	6.990
Control variables									
Ethnicity	0.672 (1.229)	−1.736	3.081	0.405 (0.332)	−0.246	0.952	0.843 (1.100)	−1.313	2.999
Gender	1.144 (1.431)	−1.661	3.949	0.376 (0.451)	−0.508	1.118	−2.630* (1.079)	−4.745	−0.516
Age	−0.038 (0.071)	−0.177	0.101	0.006 (0.020)	−0.034	0.039	0.035 (0.061)	−0.083	0.154
Years of education	−0.077 (0.234)	−0.536	0.381	−0.072 (0.069)	−0.207	0.041	0.366† (0.220)	−0.064	0.797
Cognitive impairment	−1.574 (1.165)	−3.858	0.710	−0.386 (0.311)	−0.995	0.125	−0.247 (1.149)	−2.499	2.005

Notes.
*0.01 < p < 0.05, **0.001 < p < 0.01, ***p < 0.001.
SRSA = self-rated successful aging; PSS = Perceived Stress Scale.

Table 4. Regression estimates for series 2: relationship among stress, resources, and quality of life outcomes.

	Life satisfaction			SRSA			Depression		
		95% CI			95% CI			95% CI	
	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper
Stress									
PSS	−0.208 (0.111)	−0.426	0.009	−0.111*** (0.030)	−0.170	−0.052	0.486*** (0.131)	0.230	0.742
Functional impairment	−1.011 (1.091)	−3.149	1.127	−0.836* (0.385)	−1.591	−0.082	4.123** (1.307)	1.560	6.686
Resources									
Mastery	0.438* (0.211)	0.025	0.851	0.081 (0.058)	−0.033	0.195	−0.093 (0.194)	−0.473	0.287
Resilience	0.120 (0.108)	−0.092	0.332	−0.013 (0.033)	−0.078	0.053	−0.001 (0.108)	−0.214	0.211
Social support	0.531 (0.324)	−0.105	1.166	0.111 (0.081)	−0.047	0.270	−0.461 (0.321)	−1.091	0.169
Control variables									
Ethnicity	0.901 (1.253)	−1.554	3.357	0.481 (0.332)	−0.170	1.132	0.562 (1.118)	−1.630	2.754
Gender	1.066 (1.459)	−1.793	3.926	0.449 (0.457)	−0.447	1.345	−2.721** (1.027)	−4.734	−0.708
Age	−0.005 (0.066)	−0.134	0.123	0.011 (0.019)	−0.027	0.049	0.024 (0.061)	−0.096	0.144
Years of education	−0.128 (0.241)	−0.601	0.345	−0.059 (0.070)	−0.195	0.077	0.342 (0.228)	−0.104	0.787
Cognitive impairment	−0.998 (1.176)	−3.303	1.307	−0.370 (0.297)	−0.952	0.212	−0.376 (1.165)	−2.659	1.908

Notes.
*.01<p< .05, **.001<p< 0.01, ***p < 0.001.
SRSA = self-rated successful aging; PSS = Perceived Stress Scale.

successful aging (β = −0.14, p < 0.001), and greater depressive symptoms (β = 0.55, p < 0.001). Additionally, those with functional impairments reported lower self-rated successful aging (β = −0.93, p = 0.017) and greater depressive symptoms (β = 4.40, p = 0.001).

The regressions performed in series 2 examined the simultaneous influence of stress and resources on each QoL outcome. These results are presented in Table 4. Consistent with our hypotheses, higher levels of mastery were associated with greater levels of life satisfaction (β = 0.44, p = 0.038). However, neither resilience nor social support were directly associated with QoL outcomes. Higher levels of perceived stress continued to be significantly associated with lower self-rated successful aging (β = −0.11, p < 0.001) and greater depression (β = 0.49, p < 0.001), but were no longer significantly associated with life satisfaction (p > 0.05). Additionally, having functional impairments remained associated with lower self-rated successful aging (β = −0.84, p = 0.030) and greater depressive symptoms (β = 4.12, p = 0.002).

Series 3 (Table 4) further examined these relationships in the context of a path analysis. Indirect pathways between resources and QoL through proactive behaviors were examined. Fit indices of the full conceptual model suggested adequate relative fit (CFI = 0.97, RMSEA = 0.06, SRMR = 0.03). Greater social support was associated with more frequent engagement in leisure activities (β = 1.21, p < 0.001), which in turn was significantly associated with higher self-rated successful aging (β = 0.09, p = 0.006). In bootstrapped analyses of indirect effects (Table 5), the indirect association of social support with self-rated successful aging through leisure activities was significant (β = 0.10, p = 0.020), suggesting mediation of the relationship between social support and self-rated successful aging. No other indirect effects between resources and QoL through proactive behaviors were significant. The relationships among tested variables are illustrated in Figure 2. Table 6 shows the results of a correlation matrix.

Discussion

Analyses initially showed stress, specifically perceived stress and having functional impairments, to be significantly associated

Table 5. Regression estimates for series 3: relationship among stress, resources, proactive behaviors, and quality of life outcomes.

	Life satisfaction			SRSA			Depression			ART adherence			Leisure activities		
		95% CI			95% CI			95% CI			95% CI			95% CI	
	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper	Estimate (SE)	Lower	Upper
Stress															
PSS	−0.212 (0.113)	−0.434	0.011	−0.131*** (0.028)	−0.186	−0.076	0.459*** (0.120)	0.224	0.694	–			–		
Functional impairment	−0.991 (1.078)	−3.103	1.121	−0.791* (0.359)	−1.494	−0.087	4.288** (1.338)	1.666	6.910	–			–		
Resources															
Mastery	0.436* (0.209)	0.027	0.845	0.063 (0.057)	−0.050	0.175	−0.111 (0.183)	−0.470	0.248	0.008 (0.019)	−0.030	0.045	0.020 (0.115)	−0.205	0.245
Resilience	0.120 (0.112)	−0.099	0.339	−0.028 (0.031)	−0.089	0.033	−0.007 (0.106)	−0.214	0.200	0.010 (0.016)	−0.021	0.042	0.087 (0.063)	−0.036	0.210
Social support	0.507 (0.368)	−0.215	1.229	0.005 (0.084)	−0.161	0.170	−0.634 (0.386)	−1.390	0.122	0.030 (0.047)	−0.062	0.122	1.205*** (0.272)	0.673	1.737
Proactive behaviors															
ART management	−0.141 (0.878)	−1.862	1.579	0.081 (0.247)	−0.403	0.564	−1.098 (0.727)	−2.523	0.327	–			–		
Leisure activities	0.021 (0.122)	−0.219	0.260	0.086** (0.031)	0.024	0.147	0.160 (0.146)	−0.126	0.445	–			–		
Control variables															
Ethnicity	0.853 (1.273)	−1.643	3.348	0.422 (0.325)	−0.216	1.060	0.219 (1.070)	−1.878	2.317	–			–		
Sex	1.100 (1.525)	−1.888	4.089	0.387 (0.411)	−0.419	1.192	−2.469 (1.084)	−4.594	−0.344	–			–		
Age	−0.005 (0.066)	−0.133	0.123	0.008 (0.019)	−0.030	0.046	0.028 (0.061)	−0.091	0.148	–			–		
Years of education	−0.132 (0.244)	−0.610	0.345	−0.040 (0.071)	−0.178	0.098	0.309 (0.217)	−0.116	0.734	–			–		
Cognitive impairment	−0.979 (1.220)	−3.370	1.413	−0.443 (0.307)	−1.045	0.158	−0.268 (1.142)	−2.507	1.970	–			–		

Notes.

*$0.01 < p < 0.05$, **$0.001 < p < 0.01$, ***$p < 0.001$.

SRSA = self-rated successful aging; PSS = Perceived Stress Scale; ART = antiretroviral therapy.

with lower QoL (as measured by life satisfaction, successful aging, and depressive symptoms). However, this association disappeared after resources were adjusted for in the regression model. With resources added, mastery remained significantly associated with life satisfaction, above and beyond the impact of perceived stress and other relevant covariates. This finding highlights the importance of accounting for psychological resources when investigating QoL impacts in the context of stress and adversity. Specifically, mastery has been shown to be protective against depressive symptoms across adults in midlife and older age (Nicolaisen et al., 2018). A strong sense of mastery can mitigate psychological distress in later life among African American and white older adults (Morin & Midlarsky, 2016).

Our study also found indirect relationships between social support and proactive behaviors, specifically as it relates to engagement in leisure activities. Engagement in leisure activities is a form of social participation that is encapsulated in the concept of social integration (Berkman et al., 2000). Social integration refers to the ways individuals interact and benefit from their social relationships and social environments. Berkman et al. (2000) suggest that social support, social networks, and social engagement, are all impacted by and influence one another. Interpreted within the context of social integration, findings from our model suggest that individuals with greater social support may also have increased opportunities to engage in leisure and other beneficial social activities, which in turn is related to well-being and sense of successful aging.

This study extends the current literature on QoL among PWH by examining the role of psychological resources on QoL while concurrently accounting for the impact of stress. Guided by Proactivity Model of Successful Aging, our findings provide evidence that proactive behaviors, namely engagement in leisure activities, mediate the relationship between external resources (e.g. social support) and QoL (e.g. self-rated successful aging). A study by Wion et al. (2021) similarly demonstrated that more frequent engagement in social leisure activities is associated with better health-related QoL among middle-age and older people living with HIV, and that the mechanism by which social leisure activities improve QoL is through a positive impact on mood.

As PWH are living longer, the focus of care has shifted from surviving to thriving. QoL is an important metric that not only provides a global assessment of current levels of well-being but is also an important predictor of future health status. Current QoL has been shown to predict future QoL (Hellevuo et al., 2018), future health events (Benzer et al., 2016; Xie et al., 2016), treatment outcomes (Schuepbach et al., 2019), and overall survival (Haring et al., 2011; Liang et al., 2017; Nagy et al., 2018; Roncolato et al., 2017; Thompson et al., 2018). Particularly among PWH, lower QoL predicts all-cause hospitalization (Emuren et al., 2018), mortality, emergency department utilization, and hospital discharge rates (Jacobson et al., 2003; Mathews & May, 2007). The findings from our study confirm previous studies that have shown life stress to be associated with poorer QoL (Baum et al., 1995; Seib et al., 2014). However, many studies limit QoL assessment to a single measure such as the 36-item Short Form Survey (SF-36), which involves more generic, limited QoL questions. Our study examined QoL through multiple domains such as life satisfaction and a novel measure of self-reported successful aging. Although depressive symptoms are not typically included as a standard QoL measure, the Proactivity Model of Successful Aging broadly includes affective states as part of the model's conceptualization of QoL.

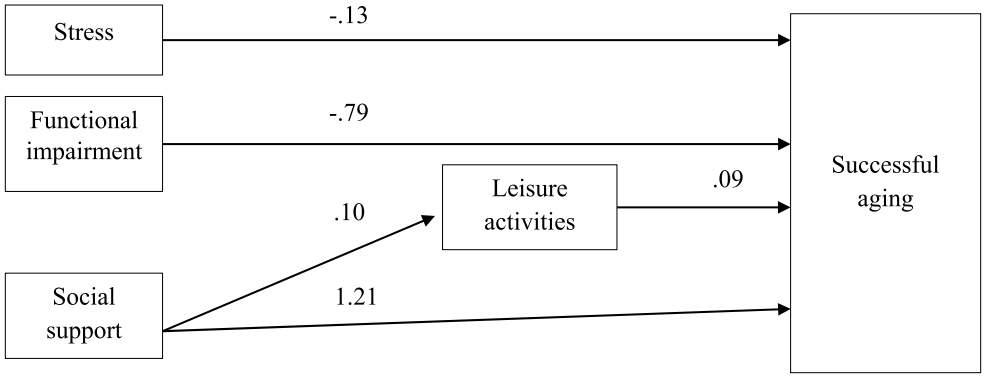

Figure 2. Path diagram illustrating relationships among stress, functional impairment, social support, leisure activities, and successful aging.

Table 6. Bootstrapped direct and indirect effects of the relationship between stress and quality of life through resources.

	Life satisfaction		SRSA		Depression	
	Indirect effect	Direct effect	Indirect effect	Direct effect	Indirect effect	Direct effect
Through personal mastery		0.436*		0.063		–0.111
		0.192		0.054		0.187
ART management	–0.001		0.001		–0.009	
	0.007		0.002		0.024	
Leisure activities	0.000		0.002		0.003	
	0.003		0.010		0.019	
Total Indirect	–0.001		0.002		–0.006	
	0.008		0.011		0.030	
Through resilience		0.120				–0.007
		0.107				0.104
ART management	–0.001		0.001		–0.011	
	0.008		0.003		0.016	
Leisure activities	0.002		0.007		0.014	
	0.011		0.007		0.015	
Total indirect	0.000		0.008		0.003	
	0.013		0.007		0.022	
Through social support		0.528				–0.634
		0.320				0.344
ART management	–0.004		0.002		–0.033	
	0.025		0.008		0.051	
Leisure activities	0.025		0.103*		0.192	
	0.147		0.046		0.148	
Total indirect	0.021		0.106*		0.159	
	0.146		0.046		0.154	

Notes.
*$0.01 < p < 0.05$
SRSA = self-rated successful aging; ART = antiretroviral therapy.

This study has several limitations. We used cross-sectional data in our analyses, precluding inferences regarding directionality of the relationships. Therefore, we cannot definitively state that stress or psychological resources predicted QoL in our study; this relationship may likely be bidirectional. In addition, our data includes primarily self-report measures, which may be affected by bias or poor insight (Obermeit et al., 2017). However, given the inherently subjective nature of QoL, self-reported assessments may be appropriate. We also included depressive symptoms as a QoL outcome, which is not a traditional conceptualization of depressive symptoms. Finally, beyond ART management as a potential mediator, our study did not examine other health behaviors that may be related to QoL.

Despite these limitations, our study suggests directions for interventions to improve QoL among PWH. Mastery has strong, direct effects on life satisfaction among PWH, above and beyond the impact of perceived stress. Personal mastery may serve as an avenue by which life stress and its negative impact on well-being may be mitigated. Prior work has illustrated the success of interventions in improving personal mastery, or self-efficacy, decreasing depression, and increasing personal growth (Rodkjaer et al., 2017; White, 1995). In addition, given that our findings suggest that engagement in leisure activities, a type of proactive behavior, may influence the relationship between social support and successful aging, leisure activity-driven behavioral programs and interventions should be considered for PWH. There is support for these types of interventions in the context of other chronic conditions such as among patients with cardiac conditions (Kodiath et al., 2005), multiple sclerosis (Calandri et al., 2017), cancer (Wu et al., 2016), epilepsy (Caller et al., 2016), and dementia caregivers (Meichsner et al., 2019). Taken together, results from this study suggest potentially modifiable psychosocial mechanisms for mitigating the influence of stressors that diminish QoL among PWH.

Disclosure statement

The authors have none to declare.

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