# HIV, Social Networks, and Loneliness among Older-Aged Adults in Uganda

Lien T. Quach[a,b,c]; Christine S. Ritchie[b,d]; Zahra Reynolds[a]; Robert Paul[e]; Janet Seeley[f]; Yao Tong[a]; Susanne Hoeppner [d,g]; Samson Okello [h,i]; Noeline Nakasujja[j]; Brianne Olivieri-Mui[k]; Deanna Saylor[l]; Meredith Greene[m]; Stephen Asiimwe [a,h,n]; Edna Tindimwebwa [n] ; Atwiine Flavia [h]; Ruth Sentongo [h]; Mark J. Siedner [a,d,h *]; Alexander C. Tsai[d,g,h *]

*These authors contributed equally to this manuscript

**Affiliations:**

[a] Medical Practice Evaluation Center, Mongan Institute, Department of Medicine, Massachusetts General Hospital, Boston, USA

[b] Centre for Aging and Serious Illness, Massachusetts General Hospital, MA, USA and Division of Palliative Care and Geriatric Medicine, Department of Medicine, Massachusetts General Hospital, Boston, USA

[c] Department of Gerontology, University of Massachusetts Boston, Boston, USA

[d] Department of Medicine, Harvard Medical School, Harvard University, MA, USA

[e] Department of Psychological Sciences, University of Missouri - St Louis, St. Louis, USA

[f] Department of Global Health and Development, Faculty of Public Health and Policy, London School of Hygiene & Tropical Medicine, London, United Kingdom

[g] Department of Psychiatry, Massachusetts General Hospital, Boston, USA

[h] Mbarara University of Science and Technology, Mbarara, Uganda

[i] Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, USA

[j] Department of Psychiatry, College of Health Sciences, Makerere University, Kampala, Uganda

[k] Department of Health Sciences, Bouvé College of Health Sciences, Northeastern University, Boston, USA

[l] Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, USA

[m] Division of Geriatrics, Department of Medicine, University of California at San Francisco, San Francisco, USA

[n] Kabwohe Clinical Research Center, Kabwohe Town, Uganda

## AUTHOR'S NOTE

**Acknowledgments:**

We would like to thank the research participants in Uganda and the study team from Mbarara and Kabwohe in Uganda, and the Medical Practice Evaluation Center in the US for making this work possible.

**Funding:**

This work was supported by the US National Institutes of Health (R01HL141053, R01AG059504, K43TW010715, K24HL166024, and R01MH113494). The findings and conclusions in this report are those of the authors and do not necessarily represent the official views of the US National Institutes of Health.

**Declaration of Conflicting Interests**

ACT reports receiving a financial honorarium from Elsevier, Inc. for his work as Co-Editor in Chief of the Elsevier-owned journal *SSM-Mental Health.* The other Authors declare no conflicts of interest.

**Data availability statement.** The data that support the findings of this study are available from the corresponding author, LQ, upon reasonable request.

## Abstract

**Objectives -** Much less is known about loneliness, and the potential role of social networks in explaining loneliness, among older people with HIV (PWH) in sub-Saharan Africa, where 70% of PWH reside. Therefore, this study was to estimate the association between HIV serostatus and loneliness. In addition, we also sought to compare and compare the two groups in terms of social networks, social support, and social integration, in order to investigate how they affect loneliness in rural Uganda.

**Design -** a cross-sectional data analysis

**Setting -** older PWH in ambulatory care and an age- and sex-similar group of people without HIV (PWOH) in rural Uganda.

**Participants -** We analyzed data from 599 participants enrolled in the Quality of Life and Ageing with HIV in Rural Uganda study

**Measurements -** We measured loneliness with the 3-item UCLA Loneliness Scale. Our primary explanatory variable was HIV serostatus. We used logistic regression to estimate the relationship between loneliness, HIV, and social networks.

**Results**: There was no statistically significant correlation between loneliness and HIV status (28.3% vs. 23.8%, P=0.22). However, PWH had smaller household sizes (mean 3.5 vs. 3.9 household members; P=0.01), fewer types of physical support (2.3 vs. 3.3; P<0.001), and financial support (0.9 vs. 1.3; P=0.01), and were less socially integrated (2.8 vs. 3.8; P<0.001). In multivariable logistic regression models, loneliness was more likely among people who lived alone (aOR:3.38, 95% CI:1.47-7.76) and less likely among people who were married (aOR:0.34,

95% CI:0.22-0.53) and among people who had a higher level of social integration (aOR:0.86, 95% CI: 0.79-0.92).

**Conclusions**: Older-age PWH and PWOH had similar levels of loneliness, even though PWH had smaller social networks and less physical and financial support. Improved quality of social support networks among PWH may explain these findings, but further research is needed to better understand the mechanisms.

**Word limit: 299/300**

## BACKGROUND

In 2020, approximately 70% of the 37 million people with HIV (PWH) worldwide lived in sub-Saharan Africa, and more than 50% were over 50 years of age.[1] Loneliness is prevalent among older people, and particularly so among older PWH in high-income settings.[2] It is associated with poor control of chronic medical conditions, depression,[2,3] and adverse health outcomes, including death, and these associations are greater among older adults.[4–8] The experience of loneliness has been conceptualized as the feeling of distress that accompanies a perceived unmet need for the desired quantity and/or quality of one's relationships. [9–13] Much of the literature on loneliness and health among older-age people has been derived from high-income countries, where feelings of loneliness are endorsed by approximately one-third of older adults [14,15] and nearly half of older PWH.[2] [16] Much less is known about loneliness in older PWH in Sub-Saharan Africa.

Loneliness may be driven in part by a lack of social connections, manifested as smaller social networks, more social isolation, less social integration, and less social support.[5,6,79,17] Social connections are crucial for improved health outcomes for older adults with chronic health conditions because they can help them adhere to treatments, maintain healthy lifestyles, cope with daily challenges, and help improve their general quality of life.[4] Older PWH have been found to have more fragile social networks compared with people without HIV (PWOH), due to a combination of HIV stigma and discrimination, racism, and ageism [3, 18,19,20(pDiversity, stigma, and social integration among older adults with HIV),20,21,22,23] and losses of partners and/or friends[2,24]. As a result, PWH in high income countries often depend on community-based service providers for social support rather than on networks of friends and kin. [23] Patterns of social networks among older

people in low-income countries, on the other hand, likely differ from those of people in high-income countries. A recent multi-country study demonstrated smaller social networks among older adults in high-income countries compared to younger adults, but similar social networks among older vs. younger adults in low-income countries.[25] Studies of older PWH in rural South Africa and Uganda have shown that having a stronger and more extensive social network, primarily family-based, leads to greater interaction with social network members and greater community interdependence. [25,26] Furthermore, studies from South Africa indicate that older PWH have access to healthcare support, which older people who are not living with HIV may not have to the same degree.[27,28] Overall, data from high-income countries have been instrumental in characterizing loneliness and social networks among older adults, but much less is known about loneliness, and the potential role of social networks in explaining loneliness, among older PWH in sub-Saharan Africa.

To address these gaps in the literature, we conducted a cross-sectional analysis of data from Quality of Life and Ageing with HIV in Rural Uganda study. The primary objective of this study was to estimate the association between HIV serostatus and loneliness in rural Uganda. We also sought to compare the two groups in terms of social networks, social support, and social integration, in order to investigate how they affect loneliness in this setting.

## METHODS

*Study population and data collection*

We analyzed data from 599 participants enrolled in the *Quality of Life and Ageing with HIV in Rural Uganda Study*, a study of quality of life among older PWH in a rural region of

southwestern Uganda.[29] PWH were eligible to participate if they were older than 49 years of age and had been on ART for at least three years and were engaged in ambulatory HIV care at the Mbarara Regional HIV Clinic or the Kabwohe Clinical Research Center HIV Clinic (n=297). We then recruited an age- and sex-similar group of people without HIV (PWOH) from census data located in the same clinic catchment areas[30]. Data were collected during October 2020-October 2021. Due to the COVID-19 epidemic, data were collected via phone interview during this wave of the study.

*Measurements*

Our primary explanatory variable of interest was HIV serostatus, which was based on confirmatory HIV testing in PWOH.[31] The primary outcome was the 3-item UCLA Loneliness Scale, [32] which queries participants about whether they "never," "sometimes," or "often" feel a lack of companionship, feel left out of community meetings or events, or feel isolated from others. We assigned one point to "never" responses, two points to "sometimes," and three points to "often" responses, allowing for a total loneliness score ranging from 3-9, with higher scores indicating a higher degree of loneliness. We followed Steptoe et al. [33] in defining loneliness as a loneliness score of the fifth quintile of the distribution of total loneliness score (≥5 in this study population). The UCLA loneliness scale has been used in many settings, including Uganda, South Africa and Zimbabwe and Ghana, and has shown consistent and reliable measurement properties across many countries. [34–38]

To better understand similarities or differences in loneliness between PWH vs. PWOH, we compared the two groups on several measures of social connection, including social networks, social support and social integration: [5,6,7 4 39]

- We measured three structural aspects of social networks by eliciting the number of people living in the respondent's household, marital status (married or cohabitating with a partner vs. divorced/separated, widowed, or single), and whether the study participant reported living alone.
- We measured physical social support [40] by characterizing the *types* of physical support they received from others (e.g., buying food, agricultural work, fetching water, cooking, going to the clinic or traditional healer, and collecting firewood; maximum of 6 types) and the *sources* of familial physical support (spouse, parent, son/daughter, grandson, granddaughter, son/daughter-in-law, and other relatives; maximum of 4 sources). We also elicited whether they received physical support from any community source (community members, neighbors, church attendees, or paid helpers).
- Similar to the above, we measured financial social support [40] by characterizing the *types* of financial support (e.g., paying for medicines, doctor visits, clinical or hospital fees, food, clothing, transportation, school expenses for offspring; maximum of 6 types), the s*ources* of familial financial support (maximum of 3 sources as above), and receipt of any financial support from any community source.
- We measured social integration by assessing the total number of social groups in which each respondent participated. We took a comprehensive census of all community groups in the area and categorized them as follows:[41] vocational groups; positive living groups for PWH; local council committees; water committees; village health teams; National

Agriculture Advisory Services groups; church or other religious groups; women's groups; gardening committees; community burial groups; clan groups; and revolving funds, savings and credit co-operative society (SACCO) groups, registered savings groups, or other community or village savings groups. The total social integration score was the total number of groups in which the respondent reported participation (out of a maximum of 20).

Additional covariates included age; sex; educational attainment; self-reported alcohol consumption (never vs. any); and the number of self-reported comorbidities, including diabetes, high blood pressure, heart attack or heart failure, kidney problems, stroke, cancer, chronic obstructive pulmonary diseases, asthma, pneumonia, high cholesterol, and tuberculosis.

*Statistical Analysis*

We compared PWH vs. PWOH on the loneliness and social connection variables, using student t-tests, log-rank tests, and Chi-squared tests as appropriate. To estimate the association between HIV status and loneliness, we fitted a multivariable logistic regression model with loneliness specified as the outcome and HIV as the primary explanatory variable, while adjusting for the covariates listed above. As described in more detail below, we unexpectedly observed statistically significant differences between PWH and PWOH on several of the social connection variables but no statistically significant difference on the primary outcome. We therefore estimated a series of multivariable logistic regression models specifying loneliness as the outcome and the social connection variables as the explanatory variables, with each regression model including one of the social connection variables and adjusting for the covariates listed

above (10 regression models in total). To assess the robustness of our findings to misclassification resulting from the potentially arbitrary cutoff threshold in the outcome, we also fit a series of negative binomial regressions specifying the total loneliness score (ranging from 3-9) as a count outcome variable. Statistical significance was designated at the conventional 0.05 level. All analyses were conducted with SAS version 9.4.[42]

*Ethical Considerations*

The study was approved by the ethics committees at Mass General Brigham in the United States and at the Mbarara University of Science and Technology in Uganda. We also obtained clearance to conduct the study from the Uganda National Council of Science and Technology. All participants consented to participate in the study verbally. The review committees waived written consent due to the COVID-19 pandemic and the infeasibility of obtaining written consent during remote data collection.

## RESULTS

The study sample included 297 PWH and 302 PWOH (**Table 1**). The mean age of participants was 58 years (range, 49-88 years). By design, women accounted for 49% of the study population (295/599). Most study participants had achieved a primary school level of education or less (74%, 442/599). The mean number of comorbidities was 0.5 (standard deviation [SD] 0.8; range, 0-5). PWH were less likely to be married or report alcohol use, but otherwise there were no statistically significant differences in age, sex, education, or comorbidities between PWH and PWOH .

**Table 1:** Characteristics of the Sample, Stratified by HIV Status

| Characteristics | Total (N=599) | HIV- (N=302) | HIV+ (N=297) | P-value |
|---|---|---|---|---|
| Age (years), mean (SD) | 58.41 (6.59) | 58.47 (6.78) | 58.34 (6.4) | 0.99 |
| Women, N (%) | 295 (49.2) | 148 (49) | 147 (49.5) | 0.91 |
| Educational attainment, N%) | | | | 0.79 |
| Primary or less (no school, or P1-P7) | 442 (73.8) | 226 (74.8) | 216 (72.7) | |
| Secondary (S1-S6) | 95 (15.9) | 47 (15.6) | 48 (16.2) | |
| Post-secondary the others | 62 (10.4) | 29 (9.6) | 33 (11.1) | |
| Alcohol consumption, N (%) | 143 (23.7) | 82 (27.2) | 60 (20.2) | 0.05 |
| Total comorbidities, mean (SD) | 0.49 (0.77) | 0.48 (0.75) | 0.5 (0.79) | 0.77 |
| **Household composition** | | | | |
| Living with spouse/partner, N (%) | 404 (67.4) | 242 (80.1) | 162 (54.5) | <0.001 |
| Son, N (%) | 287 (47.9) | 151 (50) | 136 (45.8) | 0.30 |
| Daughter, N (%) | 279 (46.6) | 149 (49.3) | 130 (43.8) | 0.17 |
| Non-biological dependent child, N (%) | 14 (2.3) | 6 (2) | 8 (2.7) | 0.57 |
| Biological dependent child, N (%) | 389(64.9) | 209(69.2) | 180(60.6) | 0.03 |
| Grandson, N (%) | 184 (30.7) | 97 (32.1) | 87 (29.3) | 0.45 |
| Granddaughter, N (%) | 162 (27) | 88 (29.1) | 74 (24.9) | 0.24 |
| Paid helper, N (%) | 47 (7.8) | 21 (7) | 26 (8.8) | 0.41 |
| Parent, N (%) | 24 (4) | 13 (4.3) | 11 (3.7) | 0.71 |
| Other relative, N (%) | 19 (3.2) | 10 (3.3) | 9 (3) | 0.84 |
| Nephew, N (%) | 17 (2.8) | 7 (2.3) | 10 (3.4) | 0.44 |
| Niece, N (%) | 13 (2.2) | 7 (2.3) | 6 (2) | 0.80 |
| Sister, N (%) | 6 (1) | 0 (0) | 6 (2) | 0.01 |
| Brother, N (%) | 9 (1.5) | 5 (1.7) | 4 (1.3) | 0.75 |
| Parent-in-law, N (% | 2 (0.3) | 1 (0.3) | 1 (0.3) | 0.99 |
| Sister-in-law, N (%) | 4 (0.7) | 2 (0.7) | 2 (0.7) | 0.98 |
| Brother-in-law, N (%) | 1 (0.2) | 1 (0.3) | 0 (0) | 0.32 |
| Daughter-in-law, N (%) | 13 (2.2) | 4 (1.3) | 9 (3) | 0.15 |
| Son-in-law, N (%) | 2 (0.3) | 0 (0) | 2 (0.7) | 0.15 |
| | | | | |
| **Social networks** | | | | |
| Living with spouse/partner, N (%) | 404 (67.4) | 242 (80.1) | 162 (54.5) | <0.001 |
| Household size, mean (SD) | 3.7 (2.2) | 3.91 (2.1) | 3.46 (2.2) | 0.010 |
| Living alone | 25 (4.2) | 4 (1.3) | 21 (7.1) | <0.001 |

| | | | | |
|---|---|---|---|---|
| Types of physical support, mean (SD) | 2.8 (1.9) | 3.25 (1.8) | 2.3 (1.9) | <0.001 |
| Number of familial sources of physical support, mean (SD) | 1.3 (1.1) | 1.6 (1.1) | 1.1 (1.2) | <0.001 |
| Any community source of physical support, N (%) | 81 (13.5) | 36 (11.9) | 45 (15.2) | 0.28 |
| Types of financial support, mean (SD) | 1.1 (1.9) | 1.27 (2.0) | 0.9 (1.8) | 0.01 |
| Number of familial sources of financial support, mean (SD) | 0.3 (0.6) | 0.4 (0.6) | 0.28 (0.6) | 0.004 |
| Any community source of financial support, N (%) | 8.0 (1.3) | 4.0 (1.3) | 4.0 (1.4) | 0.98 |
| Social integration score, mean (SD) | 3.3 (3.2) | 3.77 (3.3) | 2.8 (3.1) | <.001 |
| Total loneliness score, mean (SD) | 3.9 (1.4) | 3.83 (1.3) | 4.03 (1.4) | 0.04 |
| Classified as “lonely”, N (%) | 156 (26.0) | 72 (23.8) | 84 (28.3) | 0.22 |

PWH had smaller household sizes (3.5 [SD, 2.2] vs. 3.9 [SD, 2.1], P=0.01) and were more likely to live alone (7.1% [21/297] vs 1.3% [4/302], P<.001). PWH had lower social integration scores (2.84 [SD, 3.1] vs. 3.77 [SD, 3.3], P<.001) **(Figure 1A),** received fewer types of physical support (2.3 [SD, 1.9] vs. 3.3 [SD, 1.8], P <.001) **(Figures 1B)** and fewer sources of physical support (1.12 [SD, 1.2] vs. 1.55 [SD, 1.1], P <0.001) **(Figure 1C).** They also had fewer types of financial support (0.80 [SD, 1.8] vs. 1.27 [SD, 2.0], P<.001) **(Figure 1D)**, and fewer sources of financial support (0.28 [SD, 0.6] vs. 0.4 [SD, 0.6], P=.004) **(Figures 1E)**. We found no statistically significant differences in the receipt of community physical support and community financial support.

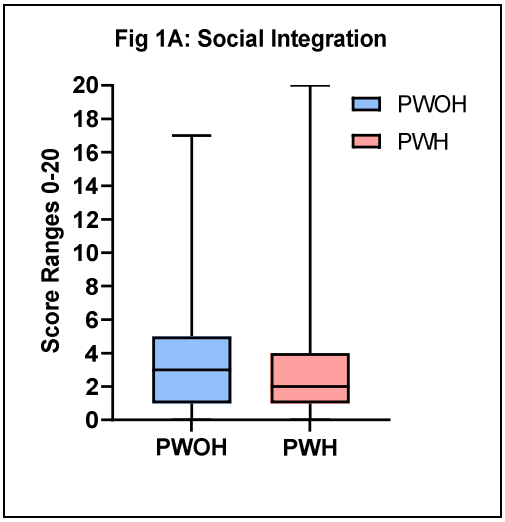
Fig 1A: Social Integration
Score Ranges 0-20
20
18
16
14
12
10
8
6
4
2
0
PWOH
PWH
PWOH
PWH

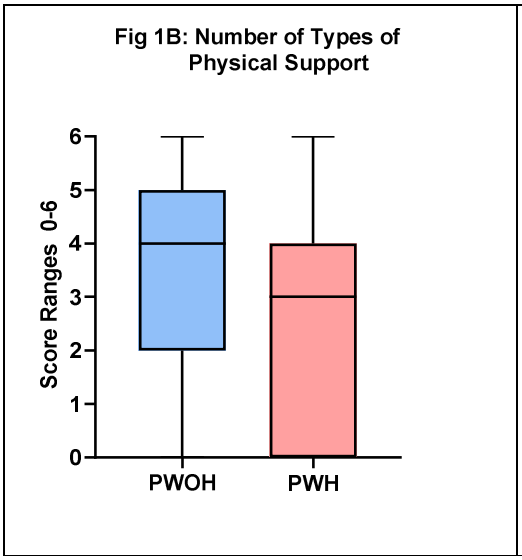
Fig 1B: Number of Types of Physical Support
Score Ranges 0-6
6
5
4
3
2
1
0
PWOH
PWH

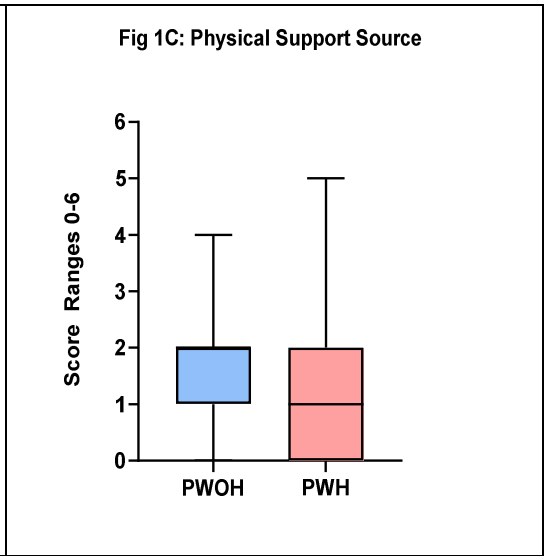
Fig 1C: Physical Support Source
Score Ranges 0-6
6
5
4
3
2
1
0
PWOH
PWH

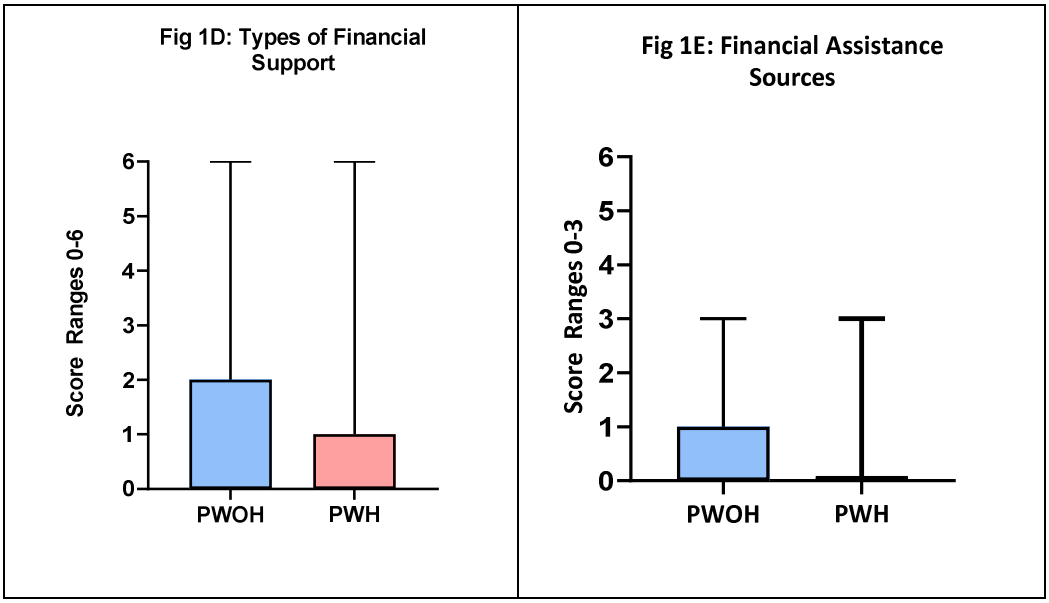
Fig 1D: Types of Financial Support
Score Ranges 0-6
6
5
4
3
2
1
0
PWOH
PWH
Fig 1E: Financial Assistance Sources
Score Ranges 0-3
6
5
4
3
2
1
0
PWOH
PWH

A substantial proportion of study participants reported feeling lonely: 179 felt they "sometimes"/"often" lacked companionship (29.8%), 158 felt left out of community meetings (26.3%), and 118 felt isolated from others (19.7%). Altogether 156 (26%) met the threshold definition of loneliness, with a score of 5 or greater on the loneliness scale. A higher proportion of PWH reported loneliness, but in contradiction of our hypothesis based on existing literature, the comparison with PWOH did not reveal statistically significant differences in loneliness by HIV serostatus (28.3% vs. 23.8%, P=0.22). This finding persisted after multivariable adjustment (adjusted odds ratio [aOR]: 1.24: 95% CI: 0.86-1.80, Table 2). In a series of multivariable logistic regression models in which we specified the social connection variables as the primary explanatory variables of interest while adjusting for sociodemographic covariates (10 regression models in all), loneliness was inversely associated with living with a spouse/partner (aOR: 0.34, 95% CI: 0.22-0.53) and with greater social integration (aOR: 0.86 per community group, 95% CI: 0.81-0.91), but positively associated with living alone (aOR: 3.38, 95% CI: 1.47-1.86). Loneliness did not have a statistically significant association with any of the physical or financial support variables (Table 2).

**Table 2: Correlates of loneliness**

| | **Unadjusted** | **Adjusted *** |
|---|---|---|
| | **OR (95%CI)** | **AOR (95% CI)** |
| HIV status | 1.26 (0.87, 1.82) | 1.27 (0.88, 1.86) |
| Live alone | 3.27 (1.46, 7.32) | 3.38 (1.47, 7.76) |
| Marital status | 0.29 (0.2, 0.42) | 0.34 (0.22, 0.53) |
| Household size | 0.95 (0.88, 1.04) | 0.96 (0.88, 1.05) |
| Types of physical support | 0.97 (0.88, 1.07) | 1.003 (0.91, 1.11) |
| Familial sources of physical support | 0.87 (0.74, 1.03) | 0.92 (0.77, 1.09) |
| Any community source of physical support | 0.66 (0.37, 1.19) | 0.61 (0.33, 1.12) |

| | | |
|---|---|---|
| Types of financial support | 1.04 (0.95, 1.15) | 0.98 (0.89, 1.08) |
| Familial sources of financial support | 1.12 (0.83, 1.52) | 0.92 (0.67, 1.27) |
| Any community source of financial support | 1.72 (0.41, 7.28) | 1.26 (0.29, 5.51) |
| Social integration | 0.86 (0.8, 0.93) | 0.85 (0.79, 0.92) |

** Each cell represents the output of a single regression model with loneliness specified as the outcome and the row variable specified as the primary explanatory variable of interest. Thus, the estimates in column 1 are derived from 11 univariable logistic regression models. The estimates in column 2 are derived from 11 multivariable logistic regressions that also include covariate adjustment for age, sex, education, alcohol consumption, and comorbidities*

The results from negative binomial regressions, in which the total loneliness score was specified as a count variable, indicated similar findings for the association between HIV and loneliness, and between several of the social connection variables and loneliness (**Table 3**).

**Table 3: Correlates of loneliness, specified as a count dependent variable**

| **Parameter** | **Univariate models** | **Adjusted models* for the covariates** |
|---|---|---|
| | IRR (95%CI) | IRR (95%CI) |
| HIV status | 1.05 (0.97, 1.14) | 1.05 (0.97, 1.14) |
| Living alone | 1.22 (1.02, 1.47) | 1.21 (1.01, 1.46) |
| Marital Status | 0.80 (0.74, 0.87) | 0.82 (0.74, 0.91) |
| Number of people living in the same household | 0.99 (0.97, 1.00) | 0.99 (0.97, 1.01) |
| Number of types of physical support | 0.99 (0.97, 1.02) | 0.9995(0.98, 1.02) |
| Number of familial sources of physical support | 0.98 (0.94, 1.01) | 0.98 (0.95, 1.02) |
| Any community source of physical support (binary variable) | 0.95 (0.84, 1.07) | 0.93 (0.83, 1.06) |
| Number of types of financial support | 1 (0.98, 1.03) | 0.99 (0.97, 1.01) |
| Number of familial sources of financial support | 1 (0.94, 1.08) | 0.97 (0.9, 1.04) |
| Any community source of financial support (community savings/other community (binary variable) | 1.05 (0.74, 1.48) | 0.997 (0.71, 1.41) |

| | | |
|---|---|---|
| Social integration | 0.98 (0.96, 0.99) | 0.97 (0.96, 0.99) |

** Each cell represents the output of a single regression model with loneliness specified as the outcome and the row variable specified as the primary explanatory variable of interest. Thus, the estimates in column 1 are derived from 11 univariable negative binomial regression models. The estimates in column 2 are derived from 11 multivariable negative binomial regressions that also include covariate adjustment for age, sex, education, alcohol consumption, and comorbidities*

## DISCUSSION

In a cross-sectional study of 599 older PWH in rural Uganda, and an age- and sex-similar sample of PWOH, we found no statistically significant difference in loneliness between the two groups. This finding differs from similar studies in high-income settings, where PWH generally report a higher prevalence of loneliness than PWOH.[2] This finding was unexpected, particularly given that we did find that PWH generally had a restricted range of social connections: they were more likely to live alone, were less likely to live with a spouse or primary partner, had smaller household sizes, reported fewer types and sources of support, and were less socially integrated. In this regard, our findings are consistent with prior work. [43] Considered in light of other recent findings from this same cohort showing that PWH had higher health-related quality of life compared with PWOH[29,44], this suggests PWH might display a certain degree of psychological resilience despite structural disadvantages in the nature and breadth of their social connections.[45] This assumption is supported by a previous study's finding of strong resilience among PWH that helps them manage their health conditions in order to survive and flourish [46]. Furthermore, social support garnered through access to medical care, such as antiretroviral therapy programs and peer support groups, could play a role in increased resilience and better coping among PWH, helping them to reduce the impacts of stigma and discrimination and, thus, reduce loneliness among older PWH. [47] Consistent with this idea, other studies of PWH in rural Uganda have shown that both depression and internalized stigma decline over time on antiretroviral therapy.

[48–50] Future work should explore the differences in traditional social cohesion across generations[51] and the effect of reduced cohabitation on access to and receipt of care and support, particularly as PWH grow into older age.[52]

Notwithstanding the relatively smaller social networks among PWH, most study participants lived with extended family, and less than 10% lived alone. This finding is consistent with previous studies conducted in Uganda and other countries throughout sub-Saharan Africa, which have demonstrated how family structures can serve as a *de facto* social security system and compensate for the often limited formal services available for aging populations. [46 51 53 54(pp1970–2002)] These social arrangements contrast starkly with data from resource-rich settings. Furthermore, a previous study based on a household survey in Uganda discovered that older people living alone in Uganda lacked extended family support networks, a familial system, and a formal community care center to assist and protect them in their later years. Because traditional social cohesion is changing across generations as a result of immigration and economic development, there is a need to strengthen the social support system for older adults in their later years, especially older PWH living alone. [51] The more expansive social networks, stronger kinship ties, and greater community interdependence in rural areas of Africa likely have an impact on the needs of PWH as they age, with concomitant implications for the support services needed for this population.

Two additional findings from our study are worthy of note. First, we found that greater social integration is inversely associated with loneliness. This finding, which is consistent with reporting from high-income countries, [55,56] may strengthen the case for the benefit of

involvement in social activities, which increases social capital, positive health outcomes, and overall well-being in older adults in the region as well. [52,57–59] In addition, a previous study showed that social integration is associated with a sense of belonging because it allows older adults to engage with and expand their social networks and to feel more loved. Interventions to strengthen the social integration of older-age people in rural Uganda may reduce loneliness among both PWH and PWOH. Second, we found that loneliness was more prevalent among women. Prior studies on sex differences in loneliness have yielded mixed findings. Two studies of older adults in Germany similarly showed that loneliness was more prevalent among women,[60,61] potentially due to longer life expectancies and therefore greater risks for widowhood, living alone, chronic illness, disability, and functional limitations, all of which are likely associated with higher risk of depression in women in high income settings.[61,62] In contrast, a study of community-dwelling older-age Mozambican migrants in South Africa found that loneliness was more prevalent among men, due to their lower rates of social support, social participation and smaller social networks.[63] Future studies may identify specific psychosocial mechanisms to explain these gender differences in loneliness.

Interpretation of our findings is subject to certain limitations. The primary limitation of this study is the cross-sectional study design and our inability to infer the causal relationship between social network variables and loneliness. Second, our data were collected in a rural region of southwestern Uganda and may not generalize to other settings and other populations. Third, although loneliness is reliably measured across many countries, there is insufficient information on the topic in sub-Saharan Africa, especially in Uganda.[64] Fourth, the measurements of social connections used in this study focused on structural aspects of social connections and did not

assess aspects of tie strength, including frequency of contact, reciprocity, and intimacy. [65] As such, additional data are required to provide information about the quality and density of social support to understand the extent to which these may help prevent loneliness among PWH.

In conclusion, this analysis of cross-sectional data on older PWH and PWOH in rural Uganda identified no statistically significant differences in loneliness, even though PWH had smaller social networks and less financial and physical support. We hypothesize that the improved quality of social support networks and formal health services may explain these findings, but further research is needed to better understand the mechanisms underlying the observed differences.

## References


1. WHO. HIV/AIDS. https://www.who.int/health-topics/hiv-aids#tab=tab_1. Published online 2020. https://www.who.int/health-topics/hiv-aids#tab=tab_1

2. Greene M, Hessol NA, Perissinotto C, et al. Loneliness in Older Adults Living with HIV. *AIDS Behav*. 2018;22(5):1475-1484. doi:10.1007/s10461-017-1985-1

3. Grov C, Golub SA, Parsons JT, Brennan M, Karpiak SE. Loneliness and HIV-related stigma explain depression among older HIV-positive adults. *AIDS Care*. 2010;22(5):630-639. doi:10.1080/09540120903280901

4. Holt-Lunstad J, Robles TF, Sbarra DA. Advancing social connection as a public health priority in the United States. *Am Psychol*. 2017;72(6):517-530. doi:10.1037/amp0000103

5. Theeke LA, Mallow JA, Moore J, McBurney A, Rellick S, VanGilder R. Effectiveness of LISTEN on loneliness, neuroimmunological stress response, psychosocial functioning, quality of life, and physical health measures of chronic illness. *Int J Nurs Sci*. 2016;3(3):242-251. doi:10.1016/j.ijnss.2016.08.004

6. Holt-Lunstad J, Smith TB, Baker M, Harris T, Stephenson D. Loneliness and social isolation as risk factors for mortality: a meta-analytic review. *Perspect Psychol Sci*. 2015;10(2):227-237. doi:10.1177/1745691614568352

7. Hawkley LC, Thisted RA, Cacioppo JT. Loneliness predicts reduced physical activity: cross-sectional & longitudinal analyses. *Health Psychol*. 2009;28(3):354-363. doi:10.1037/a0014400

8. Holt-Lunstad J, Smith TB. Loneliness and social isolation as risk factors for CVD: implications for evidence-based patient care and scientific inquiry. *Heart*. 2016;102(13):987-989. doi:10.1136/heartjnl-2015-309242

9. Donovan NJ, Blazer D. Social Isolation and Loneliness in Older Adults: Review and Commentary of a National Academies Report. *Am J Geriatr Psychiatry*. 2020;28(12):1233-1244. doi:10.1016/j.jagp.2020.08.005

10. Russell D, Peplau LA, Ferguson ML. Developing a measure of loneliness. *Journal of Personality Assessment*. 1978;42:290-294. doi:10.1207/s15327752jpa4203_11

11. Cacioppo JT, Hawkley LC, Crawford LE, et al. Loneliness and health: potential mechanisms. *Psychosom Med*. 2002;64(3):407-417. doi:10.1097/00006842-200205000-00005

12. Peplau LA, Perlman D. *Loneliness: A Sourcebook of Current Theory, Research and Therapy*. Wiley; 1982.

13. *Social Isolation and Loneliness in Older Adults: Opportunities for the Health Care System*. National Academies Press; 2020. doi:10.17226/25663

14. Valtorta N, Hanratty B. Loneliness, isolation and the health of older adults: do we need a new research agenda? *J R Soc Med*. 2012;105(12):518-522. doi:10.1258/jrsm.2012.120128

15. de Jong Gierveld J, van Tilburg T. Living arrangements of older adults in the Netherlands and Italy: coresidence values and behaviour and their consequences for loneliness. *J Cross Cult Gerontol*. 1999;14(1):1-24. doi:10.1023/a:1006600825693

16. Harris M, Brouillette MJ, Scott SC, et al. Impact of Loneliness on Brain Health and Quality of Life Among Adults Living With HIV in Canada. *JAIDS Journal of Acquired Immune Deficiency Syndromes*. 2020;84(4):336. doi:10.1097/QAI.0000000000002355

17. Fakoya OA, McCorry NK, Donnelly M. Loneliness and social isolation interventions for older adults: a scoping review of reviews. *BMC Public Health*. 2020;20(1):129. doi:10.1186/s12889-020-8251-6

18. Shippy A, Karpiak S. The aging HIV/AIDS population: fragile social networks. *Aging & mental health*. 2005;9:246-254. doi:10.1080/13607860412331336850

19. Tran BX, Ho RCM, Ho CSH, et al. Depression among Patients with HIV/AIDS: Research Development and Effective Interventions (GAPRESEARCH). *Int J Environ Res Public Health*. 2019;16(10):1772. doi:10.3390/ijerph16101772

20. Brennan-Ing M. Diversity, stigma, and social integration among older adults with HIV. *Eur Geriatr Med*. 2019;10(2):239-246. doi:10.1007/s41999-018-0142-3

21. Rueda S, Mitra S, Chen S, et al. Examining the associations between HIV-related stigma and health outcomes in people living with HIV/AIDS: a series of meta-analyses. *BMJ Open*. 2016;6(7):e011453. doi:10.1136/bmjopen-2016-011453

22. Greysen SR, Horwitz LI, Covinsky KE, Gordon K, Ohl ME, Justice AC. Does Social Isolation Predict Hospitalization and Mortality Among HIV+ and Uninfected Older Veterans? *Journal of the American Geriatrics Society*. 2013;61(9):1456-1463. doi:10.1111/jgs.12410

23. Brennan-Ing M, Seidel L, Karpiak SE. Social Support Systems and Social Network Characteristics of Older Adults with HIV. *HIV and Aging*. 2017;42:159-172. doi:10.1159/000448561

24. Mazonson P, Berko J, Loo T, et al. Loneliness among older adults living with HIV: the "older old" may be less lonely than the "younger old." *AIDS Care*. 2021;33(3):375-382. doi:10.1080/09540121.2020.1722311

25. Mousa A, Winskill P, Watson OJ, et al. Social contact patterns and implications for infectious disease transmission – a systematic review and meta-analysis of contact surveys. *eLife*. 10:e70294. doi:10.7554/eLife.70294

26. Brennan-Ing M, Kaufman JE, Porter KE, et al. A Detailed Analysis of the Social Support Networks of Older Adults with HIV in Uganda and South Africa. In: Brennan-Ing M, Porter KE, Kaufman JE, MacPhail C, Seeley J, eds. *Aging with HIV in Sub-Saharan Africa: Health and Psychosocial Perspectives*. Springer International Publishing; 2022:139-175. doi:10.1007/978-3-030-96368-2_8

27. Nyirenda M, Chatterji S, Falkingham J, et al. An investigation of factors associated with the health and well-being of HIV-infected or HIV-affected older people in rural South Africa. *BMC Public Health*. 2012;12:259. doi:10.1186/1471-2458-12-259

28. Negin J, Nyirenda M, Seeley J, Mutevedzi P. Inequality in health status among older adults in Africa: the surprising impact of anti-retroviral treatment. *J Cross Cult Gerontol*. 2013;28(4):491-493. doi:10.1007/s10823-013-9215-4

29. Quach LT, Ritchie CS, Tsai AC, et al. The benefits of care: treated HIV infection and health-related quality of life among older-aged people in Uganda. *Aging Ment Health*. Published online December 12, 2022:1-7. doi:10.1080/13607863.2022.2150143

30. Takada S, Nyakato V, Nishi A, et al. The social network context of HIV stigma: population-based, sociocentric network study in rural Uganda. *Soc Sci Med*. 2019;233:229-236. doi:10.1016/j.socscimed.2019.05.012

31. Siedner MJ, Bibangambah P, Kim JH, et al. Treated HIV Infection and Progression of Carotid Atherosclerosis in Rural Uganda: A Prospective Observational Cohort Study. *J Am Heart Assoc*. 2021;10(12):e019994. doi:10.1161/JAHA.120.019994

32. Russell DW. UCLA Loneliness Scale (Version 3): reliability, validity, and factor structure. *J Pers Assess*. 1996;66(1):20-40. doi:10.1207/s15327752jpa6601_2

33. Steptoe A, Shankar A, Demakakos P, Wardle J. Social isolation, loneliness, and all-cause mortality in older men and women. *Proc Natl Acad Sci U S A*. 2013;110(15):5797-5801. doi:10.1073/pnas.1219686110

34. Newmyer L, Verdery AM, Margolis R, Pessin L. Measuring Older Adult Loneliness Across Countries. *J Gerontol B Psychol Sci Soc Sci*. 2020;76(7):1408-1414. doi:10.1093/geronb/gbaa109

35. Wilson D, Cutts J, Lees I, Mapungwana S, Maunganidze L. Psychometric properties of the revised UCLA Loneliness Scale and two short-form measures of loneliness in Zimbabwe. *J Pers Assess*. 1992;59(1):72-81. doi:10.1207/s15327752jpa5901_7

36. Liu T, Lu S, Leung DKY, et al. Adapting the UCLA 3-item loneliness scale for community-based depressive symptoms screening interview among older Chinese: a cross-sectional study. *BMJ Open*. 2020;10(12):e041921. doi:10.1136/bmjopen-2020-041921

37. Gyasi RM, Peprah P, Abass K, et al. Loneliness and physical function impairment: Perceived health status as an effect modifier in community-dwelling older adults in Ghana. *Prev Med Rep*. 2022;26:101721. doi:10.1016/j.pmedr.2022.101721

38. Alsubheen SA, Oliveira A, Habash R, Goldstein R, Brooks D. Systematic review of psychometric properties and cross-cultural adaptation of the University of California and Los Angeles loneliness scale in adults. *Curr Psychol*. Published online November 12, 2021. doi:10.1007/s12144-021-02494-w

39. Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *Am J Epidemiol*. 1979;109(2):186-204. doi:10.1093/oxfordjournals.aje.a112674

40. Broadhead WE, Gehlbach SH, de Gruy FV, Kaplan BH. The Duke-UNC Functional Social Support Questionnaire. Measurement of social support in family medicine patients. *Med Care*. 1988;26(7):709-723. doi:10.1097/00005650-198807000-00006

41. Kakuhikire B, Satinsky EN, Baguma C, et al. Correlates of attendance at community engagement meetings held in advance of bio-behavioral research studies: A longitudinal, sociocentric social network study in rural Uganda. *PLoS Med*. 2021;18(7):e1003705. doi:10.1371/journal.pmed.1003705

42. SAS: Analytics, Artificial Intelligence and Data Management. Published July 2013. Accessed June 23, 2022. https://www.sas.com/en_us/home.html

43. Schafer MH, Upenieks L, DeMaria J. Do Older Adults with HIV Have Distinctive Personal Networks? Stigma, Network Activation, and the Role of Disclosure in South Africa. *AIDS Behav*. 2021;25(5):1560-1572. doi:10.1007/s10461-020-02996-x

44. Reynolds Z, Gilbert R, Sentongo R, et al. Priorities for health and wellbeing for older people with and without HIV in Uganda: a qualitative methods study. *J Int AIDS Soc*. 2022;25 Suppl 4:e26000. doi:10.1002/jia2.26000

45. De Jesus M, Ware D, Brown AL, et al. Social-environmental resiliencies protect against loneliness among HIV-Positive and HIV-negative older men who have sex with men: Results from the Multicenter AIDS Cohort Study (MACS). *Soc Sci Med*. 2021;272:113711. doi:10.1016/j.socscimed.2021.113711

46. Brennan-Ing M, Porter KE, Kaufman JE, MacPhail C, Seeley J, eds. *Aging with HIV in Sub-Saharan Africa: Health and Psychosocial Perspectives*. Springer International Publishing; 2022. doi:10.1007/978-3-030-96368-2

47. Mburu G, Ram M, Skovdal M, et al. Resisting and challenging stigma in Uganda: the role of support groups of people living with HIV. *J Int AIDS Soc*. 2013;16(3 Suppl 2):18636. doi:10.7448/IAS.16.3.18636

48. Bebell LM, Kembabazi A, Musinguzi N, et al. Internalized stigma, depressive symptoms, and the modifying role of antiretroviral therapy: A cohort study in rural Uganda. *SSM Ment Health*. 2021;1:100034. doi:10.1016/j.ssmmh.2021.100034

49. Tsai AC, Bangsberg DR, Bwana M, et al. How does antiretroviral treatment attenuate the stigma of HIV? Evidence from a cohort study in rural Uganda. *AIDS Behav*. 2013;17(8):2725-2731. doi:10.1007/s10461-013-0503-3

50. Camlin CS, Charlebois ED, Getahun M, et al. Pathways for reduction of HIV-related stigma: a model derived from longitudinal qualitative research in Kenya and Uganda. *J Int AIDS Soc*. 2020;23(12):e25647. doi:10.1002/jia2.25647

51. Wandera SO, Ddumba I, Akinyemi JO, Adedini SA, Odimegwu C. Living Alone among Older Persons in Uganda: Prevalence and Associated Factors. *Ageing Int*. 2017;42(4):429-446. doi:10.1007/s12126-017-9305-7

52. Chang LW, Nakigozi G, Billioux VG, et al. Effectiveness of Peer Support on Care Engagement and Preventive Care Intervention Utilization Among Pre-antiretroviral Therapy, HIV-Infected Adults in Rakai, Uganda: A Randomized Trial. *AIDS Behav*. 2015;19(10):1742-1751. doi:10.1007/s10461-015-1159-y

53. Mathambo V, Gibbs A. Extended family childcare arrangements in a context of AIDS: collapse or adaptation? *AIDS Care*. 2009;21(sup1):22-27. doi:10.1080/09540120902942949

54. Hagewen KJ, Morgan SP. Intended and Ideal Family Size in the United States, 1970–2002. *Population and Development Review*. 2005;31(3):507-527. doi:10.1111/j.1728-4457.2005.00081.x

55. Stephens C, Alpass F, Towers A, Stevenson B. The effects of types of social networks, perceived social support, and loneliness on the health of older people: accounting for the social context. *J Aging Health*. 2011;23(6):887-911. doi:10.1177/0898264311400189

56. Stokes JP. The relation of social network and individual difference variables to loneliness. *Journal of Personality and Social Psychology*. 1985;48:981-990. doi:10.1037/0022-3514.48.4.981

57. Seeman TE. Social ties and health: The benefits of social integration. *Annals of Epidemiology*. 1996;6(5):442-451. doi:10.1016/S1047-2797(96)00095-6

58. Geffen LN, Kelly G, Morris JN, Howard EP. Peer-to-peer support model to improve quality of life among highly vulnerable, low-income older adults in Cape Town, South Africa. *BMC Geriatr*. 2019;19(1):279. doi:10.1186/s12877-019-1310-0

59. Hao G, Bishwajit G, Tang S, Nie C, Ji L, Huang R. Social participation and perceived depression among elderly population in South Africa. *Clin Interv Aging*. 2017;12:971-976. doi:10.2147/CIA.S137993

60. Pagan R. Gender and Age Differences in Loneliness: Evidence for People without and with Disabilities. *Int J Environ Res Public Health*. 2020;17(24):9176. doi:10.3390/ijerph17249176

61. Boehlen FH, Maatouk I, Friederich HC, Schoettker B, Brenner H, Wild B. Loneliness as a gender-specific predictor of physical and mental health-related quality of life in older adults. *Qual Life Res*. 2022;31(7):2023-2033. doi:10.1007/s11136-021-03055-1

62. Girgus JS, Yang K, Ferri CV. The Gender Difference in Depression: Are Elderly Women at Greater Risk for Depression Than Elderly Men? *Geriatrics (Basel)*. 2017;2(4):35. doi:10.3390/geriatrics2040035

63. Kim YB, Lee SH. Gender Differences in Correlates of Loneliness among Community-Dwelling Older Koreans. *Int J Environ Res Public Health*. 2022;19(12):7334. doi:10.3390/ijerph19127334

64. Surkalim DL, Luo M, Eres R, et al. The prevalence of loneliness across 113 countries: systematic review and meta-analysis. *BMJ*. Published online February 9, 2022:e067068. doi:10.1136/bmj-2021-067068

65. Tsai AC, Papachristos AV. From social networks to health: Durkheim after the turn of the millennium. Introduction. *Soc Sci Med*. 2015;125:1-7. doi:10.1016/j.socscimed.2014.10.045