HHS Public Access

Author manuscript

J Transp Health. Author manuscript; available in PMC 2022 September 01.

Published in final edited form as:

J Transp Health. 2021 September ; 22: . doi:10.1016/j.jth.2021.101140.

Walking and perceived lack of safety: Correlates and association with health outcomes for people living with HIV in rural Zambia

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Abstract

Introduction: Geographic inaccessibility disproportionately affects health outcomes of rural populations due to lack of suitable transport, prolonged travel time, and poverty. Rural patients are left with few transport options to travel to a health facility. One common option is to travel by foot, which may present additional challenges, such as perceived lack of safety while transiting. We examined the correlates of perceived lack of safety when walking to a health facility and its association with treatment and psychosocial outcomes among adults living with HIV.

Methods: Data were collected from 101 adults living with HIV in Eastern Province, Zambia. All participants were receiving antiretroviral therapy at one of two health clinics. Perceived lack of safety was measured by asking respondents whether they felt unsafe traveling to and from the health facility in which they were receiving their HIV care. Outcomes included medication adherence, perceived stress, hope for the future, and barriers to pill taking. Linear and logistic regression methods were used to examine the correlates of perceived safety and its association with health outcomes.

Results: Being older, a woman, having a primary education, living farther from a health facility, traveling longer to reach a health facility, and owing money were associated with higher likelihood of feeling unsafe when traveling by foot to health facility. Perceived lack of safety was associated with medication nonadherence, higher level of stress, lower level of agency, and more barriers to pill taking.

Conclusions: Perceived lack of safety when traveling by foot to a health facility may be a barrier to better treatment and psychosocial outcomes, especially among rural patients. Practitioners and policymakers should consider implementation of differentiated HIV service delivery models to reduce frequent travel to health facilities and to alleviate ART patients' worry about lack of safety when traveling by foot to a health facility.

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CRediT authorship contribution statement

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Keywords

HIV; Safety; Treatment; Perceived stress; Zambia; Rural

1. Introduction

While access to health care is influenced by a myriad of factors, distance to a health facility remains a critical demand-side constraint that affects health care access and health-seeking behaviors (Bohren et al., 2014; Schoeps et al., 2011). Evidence suggests that transportation barriers, such as prolonged travel time, lack of suitable transport, and limited financial resources, explain the inverse association of distance to health facility and health outcomes (Kyei-Nimakoh et al., 2017; Varela et al., 2019; Wolfe et al., 2020). Distance and transportation barriers are also associated with poor HIV care and treatment outcomes across many countries in sub-Saharan Africa (SSA; Lankowski et al., 2014; Tuller et al., 2010). People living with HIV (PLHIV) in rural and remote communities in Zambia face disproportionately long distances and travel times to the nearest health facility, compared to PLHIV in urban areas. In 2011–2012, Zambians seeking care at rural health facilities traveled an average of 70 min, whereas their counterparts living in more urban areas spent an average of 47 min traveling for care (Institute for Health Metrics and Evaluation, 2014). However, options to overcome distances and to reduce travel times are limited and cost prohibitive.

Although motorized transportation is the suitable option to substantially reduce transit time to a health facility, PLHIV in rural Zambian communities are less likely to use such transport compared to their counterparts in urban communities (Sacks et al., 2016). In rural and remote districts, motorized transport, such as cars and motorcycles, are inaccessible and inadequate. In fact, less than 4% of rural Zambian households owned either a car, truck, motorcycle, or scooter in 2018 (Zambia Statistics Agency, Zambia Ministry of Health, and ICF, 2019). Even when suitable transportation is available, fees may become another barrier as many rural and low-income patients do not have adequate financial resources to pay for transport costs. In low-resource settings, unaffordability of transport costs continues to be a barrier to timely and regular health care access (Kyei-Nimakoh et al., 2017; Rooy et al., 2012). Due to unaffordability, inaccessibility, and inadequacy of suitable transportation, PLHIV in rural communities may rely primarily on nonmotorized options such as bicycling, walking, or animal drawn carts (Gabrysch et al., 2011; Varela et al., 2019).

For many rural residents, walking or traveling by foot might be the only option. At the same time, there are other barriers associated with walking to and from the nearest health facility. First, traveling long distances by foot may have adverse effects on physical health, especially for people with chronic conditions, such as HIV. For individuals with impairment in cardiorespiratory capacity and underlying skeletal muscle impairments (Cade et al., 2003; Kristoffersen et al., 2012) related to HIV, prolonged walking may be unsafe, as well as too strenuous. PLHIV may also experience common side effects of antiretroviral drugs, such as fatigue, nausea, and vomiting (Al-Dakkak et al., 2013; Ibbotson and Perry, 2003; Mbuagbaw

et al., 2016) while traveling. Further, PLHIV who experience such side effects may be prone to injury while walking long distances (Mukumbang et al., 2017; Sanjobo et al., 2008).

Second, road conditions may pose a threat to safety when traveling by foot to a health facility. In Zambia, many rural roads are in disrepair. Non-major motorways are typically unpaved with gravel or dirt. Hazardous conditions, which can cause injury, illness and death, include large potholes, uneven pavements, and eroding roads. Road conditions further deteriorate during the rainy season (from November to April) when roads may become impassable due to flooding and erosion associated with increased precipitation (Chinowsky et al., 2015; Mukumbang et al., 2017). Unsurprisingly, seasonal changes may affect decisions to travel and use facility-based health services (Gabrysch et al., 2011; Munthali et al., 2019). Safety concerns also include road collisions, which remain one of the leading causes of injuries and deaths in Zambia (Chisumpa et al., 2019). Alongside suboptimal road conditions and HIV patients' chronic condition, the precariousness of road safety may put them at a higher risk of injury, illness, and even death. Last, long distance and prolonged transit time when traveling by foot may make PLHIV susceptible to harassment and discrimination due to stigma, especially when others are aware of their destination and reasons for visiting a health facility (Theilgaard et al., 2011). Thus, in addition to lack of suitable transport and limited financial resources, perception of safety, or lack thereof, when walking to and from a health facility may be another mechanism that explains the association of distance with health outcomes.

Perceived lack of safety attributable to hazardous road conditions, fear of stigma and discrimination, and risk of injury and illness may deter HIV patients from walking to and from the health facility where they obtain their treatment and care. PLHIV who travel by foot to reach a health facility may consider safety concerns when deciding whether to walk to and from the health facility or to skip scheduled health facility visits and prescription refills. Additionally, perceived lack of safety when traveling may heighten stress and anxiety, which are barriers to treatment adherence and retention in care (Ammassari et al., 2002; Croome et al., 2017). Perceived lack of safety may also affect PLHIV's hope or motivation to adhere to treatment through diminished sense of successful agency and increased barriers to carrying out plans (Snyder et al., 1991). In other words, PLHIV may be discouraged from achieving their goal of treatment adherence due to perceived lack of safety. When traveling to and from a health facility, PLHIV may believe that their goal of treatment adherence carries greater risks than benefits and that alternative options to access their medications are limited relative to barriers. Given the implications for treatment adherence and prevention of future HIV infections and its effect on psychosocial factors affecting adherence, perceived lack of safety may be a relevant factor to consider when designing and implementing HIV prevention and treatment programs for rural communities. However, perceived lack of safety is an understudied topic. Few studies have examined factors associated with perceived lack of safety when traveling to and from a health facility. In addition, there is paucity of studies pertaining to association of perceived lack of safety with health outcomes in PLHIV. Empirical evidence is needed to substantiate whether perceived lack of safety primarily affects rural patients as they live far from the health facilities, and whether perceived lack of safety is associated with treatment and psychosocial outcomes in PLHIV on antiretroviral therapy (ART). This study aims to address evidence gaps by (a) investigating correlates of

perceived lack of safety, and (b) examining the association of perceived lack of safety with treatment and health outcomes in a sample of rural HIV patients in Zambia.

2. Methods

2.1. Study design and sample

This study used a cross-sectional design with data collected between December 2014 and January 2015. We collected baseline data from 101 treatment experienced PLHIV who participated in an integrated HIV and livelihood program. The sample size was estimated based on the ability to detect an effect in a study with a primary binary outcome, i.e., treatment adherence (Teare et al., 2014). Thus, the target sample size was 100 treatment experienced PLHIV. At the time of baseline data collection, all participants were receiving outpatient care at one of two study hospitals. All study participants were between 18 and 50 years old, economically poor, defined as living below the Zambian national poverty threshold of approximately $90 USD per month (Zambia Central Statistical Office, 2012a), not pregnant, and not experiencing rapid weight loss at the time of recruitment. The relevant Ethics Committee in Zambia and the Institutional Review Board at a large, public research university in southeastern United States reviewed and approved the study protocol. Informed consent was obtained from all participants.

2.2. Study setting

The study setting was Lundazi District in the Eastern Province. Lundazi District was selected because the original study aimed to test an integrated HIV and livelihood program in a rural setting with high prevalence of HIV and with substantial proportion of smallholder farmers. Lundazi District is predominantly rural, with more than 90% of the 314,281 residents living in rural areas (Zambia Central Statistical Office, 2012b). Most recent and available data indicate that Lundazi District has an HIV prevalence of 15% (Zambia National AIDS Council, 2014). The district is one of the highest producers of maize, cotton, groundnuts, and tobacco. Most of the district's annual agricultural output is produced by an estimated 68,000 small-scale farmers (Zimba, 2015).

Two health facilities were selected as study sites. The first health facility, Lundazi District Hospital (LDH) was, at the time of the study, the only first-level or district hospital in Lundazi District. LDH, which is government-run, is in the District's administrative center, Lundazi. As a level-1 hospital, LDH provides general medical, surgical, obstetric, and diagnostic services. LDH is located on the main street of Lundazi and less than a kilometer away from the District's town center and market. The second health facility, Lumezi Mission Hospital was, at the time of the study, operating as a first-level hospital, although classified as a rural health center. Since study completion in 2016, LMH's status was upgraded to a first-level referral hospital. (Lumezi also became a separate district in 2018.) LMH also provides general medical, surgical, obstetric, and diagnostic services; it is a faith-based facility managed by the Catholic Sisters of Kilimanjaro. LMH had 16 outreach sites located in the southwestern area of Lundazi District (Ministry of Health, Zambia, 2013). LMH is located on the main road connecting Lundazi to Chipata and is 35 km away from LDH.

2.3. Variables and measures

2.3.1. Perceived lack of safety—Perceived lack of safety referred to whether participants felt unsafe walking to and from the health facility where they obtained HIV care. This variable was measured using one item, which asked participants whether and how often they did not attend their clinic appointments because they felt unsafe walking to and from the clinic. The variable was measured using a 5-point Likert-type scale ranging from 0 (*never*) to 4 (*always*). Based on the distribution of responses, we created a dummy variable with the following binary categories: 0 (*never felt unsafe walking to and from the clinic*) or 1 (*felt unsafe walking to and from the clinic some of the time or more frequently*).

2.3.2. Correlates of perceived lack of safety—Based on our review of the literature (e.g., Gabrysch et al., 2011; Kyei-Nimakoh et al., 2017; Lankowski et al., 2014; Sacks et al., 2016), we included sociodemographic, microeconomic, and health facility characteristics as correlates of perceived lack of safety. These variables comprised age (in years), sex (female or male), education (primary or secondary/post-secondary education), marital status (not married or married), livestock ownership, monthly income (measured in two categories: ≤250 Zambian kwacha [ZMW] or ≥251 ZM W), debt (did not owe money or owed money), distance to health facility (in kilometers), travel time to health facility (in minutes), and place of residence (Lundazi or Lumezi). Livestock ownership referred to the number of livestock, which included chicken, pigs, goats, cattle, donkeys, and sheep, owned by participants. We calculated livestock ownership using an asset index (Filmer and Scott, 2012). Distance asked participants approximately how far from their home, in kilometers, was the health facility they go to for their HIV care (i.e., either Lundazi District or Lumezi Mission Hospital). Travel time asked participants approximately how long in minutes it takes them to travel from their home to the health facility they go to for their HIV care.

2.3.3. Treatment outcomes—First, adherence to antiretroviral therapy (ART) was measured using two methods: patient self-assessment and pharmacy refill information. Patient self-assessment was collected using a visual analogue scale (VAS). The VAS assessed adherence during the past 30 days. Participants were asked to place an “X” inside the box above the point showing the best guess about how much of their current antiretroviral (ARV) medications were taken in the past 30 days. Despite their limitations, self-reported ART adherence has been shown to perform well (i.e., no evidence of significant overestimation) in comparison with other more objective adherence measures such as pharmacy records (Finitsis et al., 2016; Simoni et al., 2014). Brief self-reported adherence such as VAS is easily administered and reduces reporting burden on patients.

Pharmacy refill information referred to the timing of ARV prescription pick-up. In the event that refills were not obtained in a timely manner, it was assumed that patients were not taking their medications between refills or were missing doses to ensure their medication lasted longer than it should (Steiner and Prochazka, 1997). The pharmacy adherence measure in this study was based on a variation of the medication possession ratio (MPR), defined as the proportion of days an ART patient possessed his or her medications relative to the total amount of time between two ARV prescription pick-ups (McMahon et al., 2011) MPR was calculated as 1 – (number of days late for ARV pick-up/total number of

days between the two most recent ARV pick-ups), expressed as a percentage (Hong et al., 2013). Pharmacy records from the first and second quarters of 2015 were used to calculate MPR. Pharmacy records have been shown to be highly associated with biological markers of adherence among HIV patients (Henegar et al., 2015; Rougemont et al., 2009) and to outperform self-reported methods in predicting ART-related outcomes (McMahon et al., 2011; Sangeda et al., 2014).

We created two binary adherence variables, one using VAS and the other using MPR data. We defined adherence as ≥95% of scheduled doses taken (Paterson et al., 2000). Participants were adherent if they took ≥95% of prescribed doses, and non-adherent if they took <95% of prescribed doses. As a sensitivity test, a third binary adherence variable, which defined adherence as ≥80% of scheduled doses taken based on the MPR data, was created (Abara et al., 2017).

Second, *barriers to pill taking* referred to the extent to which different structural barriers to pill- or medication-taking applied to participants' own situations in the past 30 days. As a treatment-related outcome, barriers to pill taking was measured using an adaptation of the structural barriers to medication-taking scale, originally developed and validated in South Africa (Coetzee and Kagee, 2013). Our adapted version comprised 11 items with a 5-point Likert-type scale that asked participants how often structural factors, such as food insecurity, stigma, limited social support, and dissuasion by religious leaders prevented them from taking their medications as prescribed. We removed two items from the original 13-item scale due to their limited applicability to our study sample of rural Zambians. The first deleted item asked participants how often they skipped taking their pills to keep their eligibility for a disability grant, a South African social assistance program. The second deleted item asked participants how often they skipped taking their pills to prevent their employers from knowing their HIV-positive status. Our study participants lived in rural areas and were predominantly self-employed, with subsistence agriculture as the primary source of livelihood. The scale's multiple structural barriers recognize the dynamic and multidimensional nature of medication-taking decisions and their influence on the emotional, cognitive, and behavioral functioning of PLHIV (Tomlinson et al., 2010). Scale items were aggregated to obtain the barrier to pill taking scores. A higher score indicated frequent experience of barriers preventing participants from taking their pills as prescribed.

2.3.4. Psychosocial outcomes—We used two indicators of psychosocial functioning. First, *perceived stress* referred to the degree to which participants assessed their life situation as stressful and their ability to manage the same life events in the last four weeks. Perceived stress was measured using the 10-item, 5-point Likert-type perceived stress scale (PSS; Cohen et al., 1983). After reverse-coding the four positively stated items, we then summed the responses for all scale items (Cohen and Williamson, 1988). A higher score indicated higher level of perceived stress and inability to manage its consequences.

Second, *hope for the future* referred to participants' motivation to achieve their goals and their perceived ability to create pathways necessary to accomplish their desired goals (Snyder, 1995). We used an adaptation of the Snyder hope scale (SHS) to measure participants' levels of hope. While SHS comprised 12 items, only eight items are used

to calculate three types of scores, while the remaining four items are used as fillers (Snyder et al., 1991). The three types of scores were: an overall hope for the future scale and two separate scores that measure agency and pathways. The overall or total hope score was the summed responses for all eight items. The additional two separate scores measured pathways and agency. Pathways referred to the planning that individuals pursue to meet their desired goals and their perceived ability to carry out their plans. Agency was defined as the motivation to carry out plans as a means to achieve the end goals. The two dimensions were measured using four items with a 6-point Likert-type scale. A higher score on each scale indicated greater hope for the future.

2.3.5. Analysis—Multivariable analyses were conducted to examine: (a) correlates of perceived safety when walking as a barrier to clinic attendance and (b) association of perceived safety with treatment and psychosocial outcomes. We used logistic regression for binary dependent variables (perceived safety and treatment adherence) and linear regression using ordinal least squares method for continuous dependent variables (barriers to pill taking, perceived stress, and hope for the future). Significance level was set at $p \leq .05$, two-tailed test.

Additionally, we performed multiple imputation (MI) to address potential missing data issues. First, we examined missing data patterns. Study variables with missing values included VAS (12%), MPR (2%), travel time to health facility (3%), and perceived stress (1%). Second, we conducted diagnostic tests to explore missing-data mechanisms (Eddings and Marchenko, 2012). Results suggested that the missing at random (MAR) assumption may be reasonable. Third, we built an imputation model based on best practices suggested in the literature (Allison, 2002; Enders, 2010; White et al., 2011). For example, all variables in the MI model were minimally associated with the variables containing the missing values. We also created a more general imputation model compared with a specific analytical model to capture more associations between the variables (Enders et al., 2006). Our imputation model comprised all variables in our analytic models, including all outcome variables, and auxiliary variables, such as barriers to clinic attendance, body mass index, household food insecurity, household size, and self-rated health. These auxiliary variables were not included in our analytic models but were added to the imputation model to increase statistical power and plausibility of the MAR assumption (Enders, 2010; Johnson and Young, 2011; White et al., 2010). We determined auxiliary variables based on our review of the literature. Fourth, MI datasets were created by imputation using the chained equations approach (White et al., 2011). We also used regression with augmented data to avoid problems associated with perfect prediction in multiple imputation of categorical variables (White et al., 2010). Last, we created our primary MI model with 100 imputed data sets to yield accurate statistical results and improve power (Enders, 2010; Graham et al., 2007). We also compared the results based on complete-case analysis and MI; results were similar. While complete case results had larger coefficient sizes, the direction of associations did not change when using either complete-case analysis or MI method, except for one model. This model examined the association of perceived safety with VAS adherence. In the complete-case analysis, HIV patients who reported feeling unsafe when traveling to and from a health facility were more likely to adhere to treatment, compared to their counterparts who did not report feeling

unsafe. In the MI model, the direction was reversed, i. e., HIV patients who reported feeling unsafe were less likely to be adherent.

Using MI data sets, we estimated seven multivariable models. Model 1 examined correlates of perceived safety. The remaining six models examined associations of perceived safety with treatment adherence based on VAS (model 2) and MPR (model 3), barriers to pill taking (model 4), perceived stress (model 5), and hope for the future, which was operationalized using the pathways (model 6) and agency (model 7) subscales in the Snyder hope scale. All analyses were conducted using Stata 15 (Stata, 2017).

3. Results

3.1. Sample characteristics

Table 1 lists sample characteristics. Nineteen percent of participants reported feeling unsafe when walking to and from a health facility. The sample included more women (56%) than men and participants who were married (75%) versus unmarried. Fewer study participants reported owing money (24%), completing secondary education or higher (35%), and earning more than 250 kwacha per month (18%). Overall, women (63%), participants who were married (68%), and those with primary education (89%) reported feeling unsafe. The mean distance to a health facility was 11 km, with values ranging from 0.3 to 70 km. The mean travel time to a health facility was 100 min, with values ranging from 2 to 300 min. Average distance and travel time differed between participants going to LDH or LMH. The mean distance and travel time to LDH was 8 km and 77 min, respectively, while the mean distance and travel time to LMH was 15 km and 123 min, respectively.

3.2. Correlates of perceived lack of safety

Table 2, column 2 presents results of our multivariable analysis, which examined correlates of perceived safety. Education level, livestock ownership, distance and travel time to a health facility, and place of residence were significant correlates of perceived safety. Participants with a secondary education or higher were 93% less likely to report feeling unsafe, compared to their counterparts with primary education. Ownership of more livestock was associated with higher likelihood of feeling unsafe; for every one-unit increase in livestock ownership index, the likelihood of feeling unsafe when walking to and from a health facility increased by 23%. Lumezi residents were 83% more likely to report feeling unsafe when walking to and from LMH, compared to Lundazi residents when they were walking to and from LDH. Every 1-km increase in distance was associated with a 6% increase in the probability of feeling unsafe when walking. Travel time was also associated with a higher likelihood of feeling unsafe. For every 1-min increase in travel time, participants were 1% more likely to report feeling unsafe when walking to and from a health facility.

3.3. Perceived lack of safety and treatment outcomes

Table 2, columns 3 and 4 are the multivariable results of the association of perceived safety with treatment adherence and barriers to pill taking. The association between perceived safety and treatment adherence was consistent regardless of adherence measure. While the results were not statistically significant ($p > .05$), participants who reported feeling

unsafe when walking were less likely to be adherent based on the two binary measures of adherence, compared to participants who did not report feeling unsafe. Participants who reported feeling unsafe were 23% and 29% less likely to be adherent based on adherence cutoffs of ≥95% for MPR and VAS, respectively. When we decreased adherence level to ≥80% for MPR, the direction of relationship remained the same, i.e., participants who felt unsafe when walking were 72% less likely to be adherent. The association of perceived safety and adherence at ≥80% MPR demonstrated statistical significance ($p = .08$).

Additionally, perceived safety was significantly associated with barriers to pill taking. Participants who felt unsafe when walking to and from a health facility scored 7.10 ($p = .001$) points higher on the barriers to pill taking scale, compared to their counterparts, who did not feel unsafe. This finding suggests that people who felt unsafe reported more frequent experiences of different barriers to pill taking, such as food insecurity and stigma, compared to people who did not feel unsafe.

3.4. Perceived lack of safety and psychosocial outcomes

Table 3 presents the multivariable results illustrating the association of perceived safety with psychosocial outcomes. Lacking perceived safety was associated with poor psychosocial functioning. Participants who felt unsafe scored 4.12 ($p < .001$) points higher on the perceived stress scale, compared to their counterparts who did not feel unsafe. This statistically significant association suggests that people who felt unsafe reported higher levels of stress and inability to manage its consequences. Additionally, participants who felt unsafe when walking to and from a health facility scored 3.12 points lower on the overall hope scale, compared to their counterparts who reported not feeling unsafe when walking, albeit a non-statistically significant association ($p = .28$). When we analyzed the two dimensions of hope in separate multivariable models, the direction of relationship was identical and consistent with the results for the overall hope scale. However, coefficient size and p values differed between the two dimensions. On the one hand, participants who reported feeling unsafe when walking scored .37 points lower on the pathway subscale, compared to participants who did not report feeling unsafe ($p = .82$). On the other hand, participants who reported feeling unsafe when walking scored 2.76 points lower on the agency subscale, compared to participants who did not report feeling unsafe ($p = .06$). These results indicate that, while participants who felt unsafe when walking reported lower levels of hope for the future, perceived safety seems to have a larger negative association with participants' motivation to carry out their plans compared to their perceived ability to carry out plans to achieve desired goals.

4. Discussion

Our study has two key findings. First, perceived lack of safety when traveling by foot appears to predominantly affect rural and low socioeconomic (e.g., low education level and greater livestock ownership) ART patients. Study participants going to LMH were more likely to feel unsafe when walking to and from LMH, compared to participants going to LDH. This finding may not be surprising given that Lumezi participants, on average, live farther and travel longer to reach the health facility where they receive HIV care, compared

to Lundazi participants. The average distance that Lumezi participants travel to reach LMH is 15 km, which is twice the average distance (7 km) for Lundazi participants. Similarly, mean travel time was slower for Lumezi participants (123 min) than for Lundazi participants (77 min). Consistent with study results, it is plausible that the combination of increasing distance and slow transit time heightens ART patients' concern about their safety. For example, walking for hours is wearisome and risky due to various road hazards. While physical activity improves health of people with or without HIV (Erlandson et al., 2018; Ibeneme et al., 2019), prolonged walking, which requires greater physical effort might be too strenuous for PLHIV due to HIV-related physiological impairments (Kristoffersen et al., 2012; Oursler et al., 2006). Additionally, lack of perceived safety may pertain to poor road conditions and continued harassment and stigmatization, which may increase PLHIV's risk of injury. LDH and LMH are connected by a 35-km road with large sections in disrepair and various hazards, including lack of sidewalks, untrained drivers, and speeding vehicles. Furthermore, increased precipitation during the rainy season may result in flooding that washes away dirt and gravel roads, which in turn, makes any kind of travel dangerous.

The long distance and prolonged travel time that rural and low socioeconomic ART patients experience are likely attributable to transportation barriers that limit rural ART patients' transit options (Sacks et al., 2016; Varela et al., 2019). Availability and access to suitable transport in the District's rural and remote areas are limited as the number of motorized vehicles is scarce. Only 5% of study participants reported owning a motor vehicle, and all but one reported living in Lundazi. If a suitable mode of transport is available, transportation costs might be prohibitive for rural HIV patients that generally obtain their income from subsistence or small-scale farming (World Bank, 2018). Nearly all (98%) Lumezi participants derived income from farming, compared to 53% of Lundazi participants. Income from farming tends to be variable and seasonal, which heightens risk of income poverty and inability to meet essential needs, including paying for transport fees.

Second, perceived lack of safety may be a critical but understudied factor affecting ART patients' psychosocial health. Perceived lack of safety was significantly associated with more barriers to pill taking, increased levels of stress, and low levels of hope. In turn, these outcomes have been documented to negatively influence HIV treatment outcomes, including adherence and retention in care (Blashill et al., 2011; Mills et al., 2006; Weinstein and Li, 2016). Perceived lack of safety may discourage PLHIV from visiting a health facility and accessing treatment in a timely manner. In turn, skipping or missing clinic and pharmacy visits may heighten stress and put additional barriers to taking medications as prescribed. Foregoing travel by foot to a heath facility may be attributable to ART patients' worry about possible injuries due to various road hazards and the likely impact of prolonged walking on their physical health.

Perceived lack of safety may also undermine the effectiveness of antiretroviral therapy because of its association with adverse psychosocial factors, such as higher levels of perceived stress and low levels of agency, that have been linked to HIV disease progression and severity (Attonito et al., 2014; McIntosh et al, 2015, 2016). Stress can either be a triggering or an aggravating factor for many diseases (Cohen et al., 2016). Perceived lack of safety while traveling by foot to a health facility, a stressful event, may trigger anxiety,

fear, guilt, and other negative affective states. In turn, these negative emotions may produce behavioral and biological responses that may adversely affect the progression of diseases, including HIV (Cohen et al., 2016; Turner et al., 2020). For example, higher stress levels have been linked to viral replication (McIntosh et al., 2017). Thus, additional stress may further impair the immune system of PLHIV and heighten their vulnerability to other infections.

Additionally, skipping health facility visits and foregoing travel by foot due to safety concerns highlight how perceived lack of safety may affect ART patients' level of hope, including their agency and goal-directed efforts. In our study, it is likely that the goal is to live healthy and longer. To achieve that goal, PLHIV need to accomplish different tasks, which include regular visits to a health facility and timely pick-up of prescription refills. If participants believe that safety is a concern, they may delay or cancel their clinic visits and discourage ART patients to carry out immediate actions toward their goal. If perceived lack of safety persists, it may negatively affect ART patients' motivation to visit a health facility as one route toward their goal. In other words, perceived lack of safety may deprive PLHIV of agency as their capacity to act independently and make their own choices is constrained by factors beyond their control. In turn, their limited agency may create a feeling of hopelessness and contribute to adverse health and well-being outcomes (Moore, 2016; Welzel and Inglehart, 2010).

Our findings indicate the importance of addressing perceived lack of safety to improve health outcomes of underserved rural ART patients and to reduce health disparities between urban and rural HIV patients. Although wide-scale road infrastructure initiatives are critical to providing year-round access for mobility, especially in rural communities (O'Neill, 2011), this effort is unlikely feasible in the near term. However, there are existing HIV service delivery models that can be implemented to reduce frequent travel to health facilities and to alleviate ART patients' worry about lack of safety when walking to a health facility (Bemelmans et al., 2014; Hagey et al., 2018; Lazarus et al., 2014). One option is multi-month dispensing (MMD) of ART at a health facility. Patients with good adherence and on ART for at least 6 months without interruption are given a 90-day or 180-day supply of their medications, compared to a 30-day supply standard-of-care approach (Hoffman et al., 2017; Prust et al., 2017).

Another option is a decentralized medication delivery, in which PLHIV pick up their medication at a distribution point away from a health facility (Fox et al., 2019; Prust et al., 2017). A distribution point for rural patients should be accessible and near their villages (Amstutz et al., 2019). There are other forms of decentralized models such as community-based ART groups in which one member of the group goes to a health facility every month to pick up drug refills for all ART group members and (Bemelmans et al., 2014; Prust et al., 2017). Medication dispensing happens at community meetings. While differentiated models of HIV service delivery are currently being tested (Amstutz et al., 2019; Hoffman et al., 2017), one study estimated that three-quarters of all adult ART patients in Zambia are eligible for differentiated service delivery (Hoffman et al., 2020). Evidence also suggests that decentralized medication delivery models are acceptable and have similar HIV treatment outcomes as standard care (Fatti et al., 2020; Fox et al.,

2019; Hagey et al., 2018). Decentralized and community-supported models of medication delivery may lighten the burden and decrease costs for PLHIV by reducing the need to travel frequently to a health facility, which gives more time to income-generating activities (Hubbard et al., 2020).

Last, unless medication dispensing is home-based, walking will still be required for PLHIV to reach community distribution points or meeting locations to get their medications and to be seen by health personnel. A complementary strategy to decentralized and community-supported HIV service delivery models is a microeconomic intervention, in which PLHIV may be encouraged to save for a bicycle or a motorcycle. Community-based ART groups may function as a savings group, in which any interested member can open an account. A few group members can be trained and supervised as a banking agent. The banking agent will then use a digital banking platform, typically through a mobile phone, certified and secured by a local financial institution to accept deposits and issue digital receipts.

4.1. Limitations

While study findings expand what we know about correlates of perceived safety and its association with health outcomes in a sample of rural ART patients in Zambia, findings should be interpreted in view of study limitations. First, our small sample size may not be representative of rural ART patients in Zambia, which limits generalizability of study results. Second, a small sample size may affect statistical power, whereas missing data may result in biased findings. We conducted multiple imputation to minimize potential bias in findings due to sample size reduction and to increase statistical power. Third, although the single item measure of perceived safety was relatively easy to understand, it may not validly represent a latent construct such as perceived safety. Fourth, lack of qualitative data restricted our ability to substantiate our discussion on why ART patients in our study felt unsafe walking to and from a health facility. However, our familiarity and experience working in this part of Zambia provided us with some knowledge of plausible explanations for our study findings.

5. Conclusions

The negative association of perceived lack of safety with psychosocial outcomes, such as stress and motivation, underscores plausible pathways in which feeling unsafe when traveling to a health facility may contribute to adverse treatment outcomes and disease severity. Tackling perceived lack of safety might improve treatment outcomes by way of improving psychosocial functioning of PLHIV. When perceived lack of safety is addressed, it may also narrow treatment gaps between rural and urban ART patients. Perceived lack of safety may be an understudied factor that practitioners and researchers should consider as they develop interventions for ART patients in rural and remote communities.

Financial disclosure

This work was supported by the UNC Center for AIDS Research (P30 AI050410) and the Armfield Reeves Innovation Fund at UNC School of Social Work. The sponsors had no role in the design, analysis and writing of this article; and in the decision to submit the article for publication.

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Table 1

Sample characteristics.

	Lundazi (N = 51)		Lumezi (N = 50)		Lundazi and Lumezi (N = 101)	
	n	**M(SD)**	**n**	**M(SD)**	**n (%)**	**M(SD)**
Patient characteristic						
Sex						
Female	31		26		57 (56%)	35.75 (7.39)
Age (years)		35.97 (7.65)		35.5 (7.21)		
Male	20		24		44 (44%)	39.86 (6.79)
Age (years)		39.8 (7.22)		39.92 (6.57)		
Age (men & women)	51	37.47 (7.65)	50	37.62 (7.19)		37.54 (7.39)
Marital status						
Married	40		36		76 (75%)	
Not married	11		14		25 (25%)	
Education						
Primary	33		33		66 (65%)	
Secondary+	18		17		35 (35%)	
Livestock ownership	51	1.84 (3.83)	50	0.89 (1.68)		1.37 (2.99)
Monthly income						
≤250 ZM W	33		50		83 (82%)	
≥251 ZM W	18		0		18 (18%)	
Owed money						
No	34		43		77 (76%)	
Yes	17		7		24 (24%)	
Distance to nearest health facility (kilometers)	51	7.64 (7.35)	50	15.29 (14.91)	101	11.42 (12.28)
Travel time to nearest health facility (minutes)	49	77.18 (67.73)	49	123 (80.22)	98	100 (77.36)

Table 2

Correlates of Perceived Lack of Safety and its Association with Treatment Outcomes.

	Perceived Safety		Medication Adherence						Barriers to Pill Taking	
			≥95% MPR		≥80% MPR		VAS			
	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*	β (95% CI)	*p*
Patient characteristics										
Age	0.92 (0.85–1.02)	0.11	1.02 (0.96, 1.09)	0.56	1.01 (0.07, 1.18)	0.08	1.00 (0.93, 1.07)	0.60	0.04 (−0.16, 0.25)	0.68
Sex (ref: female)	1.25 (0.30, 5.12)	0.76	1.11 (0.39, 3.13)	0.84	1.01 (0.94, 1.10)	0.19	0.90 (0.29, 2.77)	0.19	1.42 (1.85, 4.70)	0.39
Education (ref: primary)	0.07 (0.01, 0.50)	<0.01	0.46 (0.14, 1.25)	0.13	0.54 (0.17, 1.70)	0.29	0.64 (0.22, 1.87)	0.50	0.44 (−2.79, 3.68)	0.79
Marital status (ref: not married)	0.54 (0.13, 0.50)	0.40	0.85 (0.29, 2.54)	0.78	0.66 (0.19, 2.33)	0.52	0.66 (0.20, 2.20)	0.50	.098 (−2.47, 4.43)	0.57
Livestock ownership index	1.23 (1.00, 1.51)	0.05	0.94 (0.80, 1.10)	0.42	0.92 (0.76, 1.10)	0.35	0.99 (0.83, 1.19)	0.95	0.28 (−0.80, 0.25)	0.30
Monthly income (ref: ≤250 ZM W)	2.83 (0.40, 20.24)	0.30	0.65 (0.14, 2.93)	0.57	0.39 (0.50, 3.22)	0.38	1.68 (0.30, 9.41)	0.56	−3.70 (−8.30, 0.91)	0.11
Debt (ref: no debt)	1.61 (0.36, 7.24)	0.54	0.41 (0.13, 1.28)	0.12	0.66 (0.16, 2.63)	0.56	0.96 (0.27, 3.46)	0.95	1.57 (−2.09, 5.24)	0.40
Health facility characteristics										
Distance to LMH or LDH (km.)	1.06 (1.00, 1.13)	0.05								
Travel time to LMH or LDH (min.)	1.01 (1.00, 1.02)	0.00								
Health facility site (ref: Lundazi)	0.17 (0.03, 0.90)	0.04	0.20 (0.06, 0.64)	0.00	0.06 (0.01, 0.34)	0.00	0.72 (0.24, 2.22)	0.57	−3.68 (−6.99, −0.38)	0.03
Perceived lack of safety (ref: felt safe when walking)			0.77 (0.22, 2.69)	0.69	0.28 (0.07, 1.18)	0.08	0.71 (0.20, 2.55)	0.60	7.07 (3.16, 10.98)	0.00

Note: ZMW stands for Zambian kwacha. LMH stands for Lumezi Mission Hospital. LDH stands for Lundazi District Hospital. MPR stands for medication possession ratio. VAS is a self-reported measure of adherence that stands for visual analogue scale.

Table 3

Association of perceived lack of safety with psychosocial outcomes in people living with HIV.

	Perceived Stress		Hope					
			Overall Hope Score		Dimension: Pathway		Dimension: Agency	
	β (95% CI)	*p*	β (95% CI)	*p*		*p*	β (95% CI)	*p*
Patient characteristics								
Age	0.06 (−0.06, 0.17)	0.34	−0.01 (−0.31, 0.29)	0.94	−0.13 (−0.18, 0.16)	0.88	0.01 (−0.15, 0.15)	0.99
Sex (ref: female)	−0.79 (−2.64, 1.05)	0.39	1.50 (−3.30, 6.29)	0.54	0.87 (−1.86, 3.60)	0.53	0.62 (−1.81, 3.06)	0.61
Education (ref: primary)	0.06 (−1.76, 1.87)	0.95	−0.45 (−5.18, 4.28)	0.85	−0.01 (−2.70, 2.69)	0.99	−0.45 (−2.85, 1.95)	0.71
Marital status (ref: not married)	0.44 (−1.50, 2.38)	0.66	−3.52 (−8.58, 1.53)	0.17	−1.62 (−4.49, 1.26)	0.27	−1.90 (−4.47, 0.66)	0.14
Livestock ownership index	0.06 (−0.24, 0.35)	0.70	0.31 (−0.46, 1.08)	0.43	−0.03 (−0.47, 0.41)	0.89	0.34 (−0.05, 0.73)	0.09
Monthly income (ref: ≤250 ZM W)	−6.87 (−9.46, −4.29)	0.00	4.43 (−2.31, 11.17)	0.20	1.74 (−2.10, 5.58)	0.37	2.69 (−0.73, 6.11)	0.12
Debt (ref: no debt)	0.97 (−1.09, 3.02)	0.35	−0.72 (−6.08, 4.65)	0.43	−1.13 (4.18, 1.93)	0.47	0.41 (−2.31, 3.13)	0.76
Health facility characteristics								
Health facility site (ref: Lundazi)	−1.61 (−3.47, 0.25)	0.09	−14.61 (−19.45, −9.77)	0.00	8.21 (−10.97, 5.46)	0.00	6.40 (−8.85, 3.94)	0.00
Perceived lack of safety (ref: felt safe when walking)	4.12 (1.93, 6.32)	0.00	−3.13 (−8.85, 2.60)	0.28	−0.37 (−3.63, 2.90)	0.82	−2.76 (−5.67, 0.15)	0.06

Note: ZMW stands for Zambian kwacha. LMH stands for Lumezi Mission Hospital. LDH stands for Lundazi District Hospital.