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Household Food Insecurity Associated with Antiretroviral Therapy Adherence Among HIV-infected Patients in Windhoek, Namibia

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Abstract

Objective—Food insecurity is emerging as an important barrier to antiretroviral therapy (ART) adherence. The objective of this study was to determine if food insecurity is associated with poor ART adherence among HIV-positive adults in a resource-limited setting that utilizes the public health model of delivery.

Design—A cross-sectional study using a one-time questionnaire and routinely collected pharmacy data.

Methods—Participants were HIV-infected adults on ART at the public ART clinics in Windhoek, Namibia: Katutura State Hospital, Katutura Health Centre, and Windhoek Central Hospital. Food insecurity was measured by the Household Food Insecurity Access Scale (HFIAS). Adherence was assessed by the pharmacy adherence measure medication possession ratio (MPR).

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Multivariate regression was used to assess whether food insecurity was associated with ART adherence.

Results—Among 390 participants, 7% were food secure, 25% were mildly or moderately food insecure and 67% were severely food insecure. In adjusted analyses, severe household food insecurity was associated with MPR <80% (OR 3.84, 1.65 to 8.95). Higher household healthcare spending (OR 1.92, 1.02 to 3.57) and longer duration of ART (OR 0.82, 0.70 to 0.97) were also associated with <80% MPR.

Conclusion—Severe household food insecurity is present in more than half of the HIV-positive adults attending a public ART clinic in Windhoek, Namibia, and is associated with poor ART adherence as measured by MPR. Ensuring reliable access to food should be an important component of ART delivery in resource-limited settings using the public health model of care.

Keywords

HIV; AIDS; Namibia; antiretroviral adherence; food insecurity

Introduction

As of December 2011, over 8 million people infected with HIV were receiving antiretroviral therapy (ART) in low- and middle-income countries, which represents a 26-fold increase since 2003 [1]. Sustaining successful ART scale-up in resource-limited settings depends largely on the ability of ART programs to deliver ART in a way that supports optimal patient adherence, thereby maximizing durability of first- and second-line regimens. Adherence to ART is a predictor of virologic suppression [2–7], emergence of HIV drug resistance [8–9], disease progression [10], and death [11–13].

Food insecurity is emerging as an important barrier to ART adherence, especially in resource-limited settings. Food insecurity can be defined as “the limited or uncertain availability of nutritionally adequate, safe foods or the inability to acquire personally acceptable foods in socially acceptable ways” [14]. The United Nations Food and Agriculture Organization estimated that 923 million individuals were undernourished globally in 2007, representing an increase of 75 million from 2005. Eighty-nine percent of food-insecure individuals live in Asia and Africa [15, 16]. Although data on food insecurity in resource-limited settings is limited, a recent survey of 67,038 patients receiving HIV care in western Kenya reported that 33.5% were food insecure (ranging from 20% to 50%) [17]. A Ugandan survey of 144 households of primarily HIV-infected women, found that 59% had low dietary diversity and 44% were accessing food aid [18].

Namibia is a country in sub-Saharan Africa that has been severely affected by the HIV epidemic and poverty. In a population of 2.1 million, approximately 40% are living in poverty [19], and the income gap between the rich and poor is among the largest in the world [20]. Over 200,000 people are known to be living with HIV and in a recent sentinel survey among 15–49 year-old pregnant women, 18.2% were infected with HIV-1 [21]. The epidemic in Namibia is predominantly spread via heterosexual contact.

ART has been available in Namibia's private sector since 1998 and in the public sector since 2003. In the public sector (84% of all patients on ART), ART is provided free of charge following a population-based model of care [22]. Namibia has one of the highest ART coverage rates in Sub-Saharan Africa (using CD4 <350 as cutoff for ART initiation) [22], with 84% of the 107,154 eligible patients on ART as of March 2013 (Ministry of Health and Social Services (MoHSS) unpublished data). At present, ART is available geographically throughout Namibia at all 40 full ART sites and at an additional 111 satellite-outreach service points, as well as 30 Integrated Management of Adolescent and Adult Illness (IMAI) modules sites (MoHSS unpublished data). Adherence counseling is provided before ART initiation and continuously during care at each subsequent follow-up visit.

Qualitative studies in sub-Saharan Africa have identified food insecurity as a potential risk factor for ART non-adherence [23–26]. However, fewer quantitative data are available on the association between food insecurity and ART adherence in resource-limited settings [27]. Namibia is a high HIV prevalence country, which has achieved success in ART rollout. Therefore, supporting ART adherence is a high priority in order to prevent the emergence of HIV drug resistance and to optimize patient outcomes. To our knowledge, there are no data published on household food insecurity and its relationship with ART adherence in Namibia. Along with qualitative data, quantitative data on the prevalence of food insecurity and its association with ART adherence in Namibia's HIV-infected population could lead to the impetus for interventions targeting at-risk populations, which may result in improved ART outcomes. The objective of this study was to determine if household food insecurity is associated with poor ART adherence in HIV-infected patients in Windhoek, Namibia.

Methods

Study design and participants

The study population consisted of adult patients diagnosed with HIV-1 who were being prescribed ART and managed at public ART delivery sites in Windhoek, Namibia. Windhoek, the largest urban setting in the country, has an estimated population of 342,000 [28]. Patients were recruited from the three public ART delivery sites in Windhoek treating the largest number of patients at the time: Katutura State Hospital, Katutura Health Centre, and Windhoek Central Hospital. Patients were eligible to be included in the survey if they were HIV positive, currently on an adult ART regimen for at least 30 days, at least 18 years of age, and willing to provide verbal informed consent. Patients were ineligible if they were less than 18 years of age, unable to communicate in English, Oshiwambo, or Afrikaans, or if they were only temporarily receiving ART at the site.

Consecutive eligible HIV-infected patients attending their routine clinic visits were asked to participate from June to July, 2011. Those who gave verbal informed consent were administered a one-time questionnaire, which included questions about food insecurity, socio-demographic factors, access to healthcare, alcohol and substance abuse, depression, and ART adherence.

The standardized questionnaire was administered via face-to-face interviews by a trained interviewer. The questionnaire was translated into Oshiwambo and Afrikaans, back-

translated, and pre-tested with key informants and focus groups to ensure accuracy. The questionnaire was administered in English, Oshiwambo, or Afrikaans depending on the participant's preference. English is the official language in Namibia, and Oshiwambo and Afrikaans are spoken in 37% and 24% of households, respectively [28].

ART Adherence

The primary outcome was ART adherence as measured by the medication possession ratio (MPR), which measures the amount of time an individual is in possession of their antiretroviral (ARV) pills as a proportion of the time between two ARV pick-ups [29]. The MPR was derived from data obtained from the national Electronic Dispensing Tool (EDT), which is used to dispense ART at all public ART sites in Namibia. In real time, EDT captures date of ART pick-up, ART regimen, and number of pills picked up. For each individual patient, MPR was calculated retrospectively for a maximum of 12 months from the time of the questionnaire with the formula:

$1 - (\text{number of days ARV dispensed} / \text{number of days between first and last ARV pick-up})$.

As previously studied by our group, MPR is associated with short-term virologic response in Namibia [30] and with virologic suppression and prevention of HIV drug resistance at 12 months (unpublished data). We chose this method for its validity as proven by our previous studies, and because it is not prone to recall or social desirability bias as compared to patient self-reported adherence measures. Additionally, the MPR captures treatment interruptions because it takes into account time periods without medication coverage. Twelve months was chosen as the maximum time period for the adherence assessment in order to assess the time period of adherence that would be long enough to capture adherence patterns but not too far from the four-week time period of the household food insecurity assessment.

During individual interviews, participants were asked why they ever missed any ARV doses. This information was organized into a list of the most common explanations for missed medication doses.

Food Insecurity

Food insecurity was evaluated with the Household Food Insecurity Access Scale (HFIAS). The HFIAS is a tool that has been validated to universally distinguish the food secure from the insecure across a variety of cultural settings [31]. Questions in the HFIAS represent universal domains of the household food insecurity experience and can be used to assign households and populations along a continuum of severity, from food secure to severely food insecure. The HFIAS questions ask participants to report on the past four weeks and are based on three different domains known to be common in differing cultures: 1. anxiety and uncertainty about the household food supply, 2. insufficient quality, and 3. insufficient food intake and its physical consequences. HFIAS data was analyzed according to published methods [31].

Covariates

The Center for Epidemiological Studies Scale (CES-D) was used to assess for depression. The CES-D has been shown to be a reliable measure for assessing depressive symptoms across varied race, gender, and age groups [32, 33]. The tool also has been demonstrated to

have good validity by clinical and self-report criteria [33]. For this analysis, depression was defined using the standard cutoff of 16.

A standardized questionnaire collected information on marital status, education, monthly income, income source, living location, number of dependents, presence of a treatment supporter, travel mode to clinic, travel time to clinic, healthcare spending, food spending, drinking alcohol, and reasons for missing doses of ART.

Electronic medical records were used to extract information on patients' age, sex, height, weight, CD4 cell counts, ART clinic, time on ART, WHO clinical stage, treatment supporter, tuberculosis status and treatment, and ART regimen, and pill pickup dates.

Ethics statement

Ethical approval was obtained from the institutional review board at Tufts University School of Medicine in Boston, USA and the Republic of Namibia MoHSS Ethics and Research Committee in Windhoek, Namibia. Verbal informed consent was obtained from all participants.

Statistical Analysis

Univariate statistics were examined for each variable included in this analysis. Frequencies and distributions were examined for unusual values. For our primary adherence outcome, we created a binary MPR measure categorized as low (MPR <80%) vs. high (MPR ≥ 80%), since this threshold has been associated with mortality [29].

Differences in characteristics between those with high vs. low adherence were assessed using the chi square or Fisher's exact test for categorical variables and the t-test or Wilcoxon Rank Sum test for continuous variables (Table 1). Multivariable logistic regression models were then used to adjust for individual predictors or potential confounders in the association between household food insecurity and our binary MPR measure (high vs. low) (Table 2). Variables that were pre-determined to be independent predictors of adherence or associated with household food insecurity were considered candidate variables for the multivariable logistic regression model. We then used backwards elimination to determine the final multivariable model. Variables that were significant at $\alpha < .05$ or changed the coefficient for household food insecurity by more than 15% when eliminated were kept in the final model. All analyses were performed using STATA (College Station, TX: StataCorp LP).

Results

Out of 390 patients, 60% were female (in comparison, 53.6% of patients on ART in Windhoek are female) (MoHSS unpublished data) and 19% married, with median age 38 years (interquartile range (IQR) 34, 43) (Table 1). Median time on ART was 2.7 years. At time of ART initiation, 37% had World Health Organization (WHO) clinical stage 3 or 4 and median CD4 cell count was 183 cells/ μ L. The median body mass index (BMI) at ART initiation was 21.1 kg/m². Median monthly income was 1,000 Namibian dollars (US\$ 124) (in comparison, mean monthly income for Namibia is US\$ 444) [34], and median travel time to the ART clinic was 30 minutes. Thirty-five percent had primary school education or

less. Alcohol use was reported by 14% of participants. Depression was found in 22% of participants.

The mean and median of MPR was 0.92 and 0.98 respectively (IQR 0.91–1.0). Fifty (13%) had an MPR <80%. At the time of the questionnaire, 263 (67%) were found to be living in households with severe food insecurity, 91 (23%) with moderate food insecurity, seven (2%) with mild food insecurity, and 29 (7%) with food security.

In unadjusted analyses, those living in households with severe food insecurity had a 3.4 times higher odds of having low MPR (<80% medication possession ratio) compared with those living in households without severe food insecurity (95% CI 1.46–7.68). Traveling to clinic by walking, hitchhiking, or biking, receiving ART at Katutura Health Centre, shorter time on ART, and depression were all significantly associated with low MPR (Table 2).

The second column of Table 2 shows the final multivariable model of the association between household food insecurity and low MPR after adjusting for confounders and other important predictors. In adjusted analyses severe household food insecurity was significantly and positively associated with poor ART adherence (OR 3.84, 95% CI 1.65 to 8.95). Other variables that were inversely associated with low MPR were low household healthcare spending of <\$N50 per month (US\$ 6.25) (0.52, 95% CI 0.28 to 0.98) and time on ART (0.82, 95% CI 0.70 to 0.97).

Table 3 lists the top ten reasons cited by patients for missing a medication dose. Of the ten reasons, four pertained to food: #3) ARVs made me hungry and I did not have enough food, #5) I don't have enough food to prevent side effects of ARVs, #6) I only had enough money for food and not ARVs, #7) I cannot afford good food while taking ARVs.

Discussion

This study examining the association between food insecurity and ART adherence in Namibia adds to the few existing quantitative studies in resource-limited settings [27]. With 67% of participants classified as living in households with severe food insecurity in our study population, these data suggest that household food insecurity is a common problem among HIV-infected individuals in Namibia. The large proportion of individuals living in households with severe food insecurity observed in this study is greater than most other reported prevalence rates among HIV-infected individuals, but similar to the level of severe household food insecurity reported recently in Kenya (79%) [35] and similar to levels of household food insecurity reported in a study done in the general population of Windhoek (63%) [36]. The level of adherence observed in the three public ART delivery sites in Windhoek, Namibia was high as estimated by the pharmacy adherence measure (MPR). This finding is not surprising and is consistent with previously published rates of adherence in Namibia and other African settings [36–41, 30].

The observed association between household food insecurity and low MPR, along with the reasons stated by the participants for missing doses of ART, suggests that household food insecurity negatively impacts ART adherence. Similar findings have been demonstrated in resource-rich countries. In British Columbia, food insecure patients had more than twice the

odds of being less than 95% adherent to ART (based on pharmacy refill data) compared with patients who were food secure, after adjusting for socio-economic status, lower baseline CD4 cell counts, illicit drug use, symptoms of depression, and fewer years on ART [41]. In San Francisco, California, patients with severe household food insecurity were less likely to be highly (more than 80%) adherent, as measured by random pill counts, than patients who were not in households with severe food insecurity [42].

In resource-limited settings, a number of qualitative studies have identified food insecurity as a potential risk factor for ART non-adherence, and have explored why this relationship might exist [27]. In Rwanda, 76% of patients interviewed described fear of “having too much appetite and not enough to eat” as an obstacle to their ART adherence [23]. In Zambia, the belief that ART must be taken with food caused patients to skip doses in the absence of available or accessible food [24]. In Kenya, researchers found that a fear of taking medications on an empty stomach to be a common reason for refusing to take ART, even with free access to medications [25]. In Uganda, the competing expenses of food for one’s family versus paying for transportation to an ART clinic caused missed doses amongst HIV-positive individuals [26]. Food insecurity has been cited as a barrier to even starting an ART regimen in Tanzania [43]. Our study is consistent with these previous studies in that our patients cited similar food-related reasons why they missed ARV doses. (Table 3) From these studies, it is clear that food insecurity may adversely affect ART adherence through various potential mechanisms.

Quantitative data in resource-limited settings supporting the relationships between food insecurity and ART adherence are fewer. A longitudinal study of 134 patients in urban Peru found food insecure individuals (assessed by single question) had a 2.4 higher odds of poor adherence (assessed by 30-day self-report <95% adherent) than food secure individuals [44]. Another prospective cohort study of 499 patients in rural Zambia found baseline food insecurity (using non-validated food insecurity tool) was associated (in unadjusted model) with sub-optimal ART adherence (using pharmacy pickup data) [45]. This effect disappeared in multivariate analysis. A recent longitudinal study on household food insecurity and ART adherence in rural Uganda also found a positive association between poor ART adherence and household food insecurity [46]. Household food insecurity was associated with incomplete viral load suppression and low CD4 cell counts, however, ART non-adherence only predicted poor virologic suppression and not decreased CD4 cell counts. These findings suggest household food insecurity may play an important role in biologic treatment response. Of note, this group used a subjective measure of adherence, a seven day pill recall visual analogue scale, which relies on patient self reported adherence and may not accurately reflect variations in patient adherence.

To support the positive association between food security and ART adherence, data have suggested a potential positive impact of nutritional support on ART adherence in Zambia. A pilot study on the effect of food supplementation on ART adherence found that patients receiving food supplementation had higher levels of adherence measured by MPR. Two hundred and fifty-eight of 366 (70%) patients in the food supplementation group achieved an MPR of 95% or greater, compared with 79 of 166 (48%) among controls [47]. It is important to keep in mind that in this study, food rations were distributed with medications

at the same time in the health clinics. Therefore, it is likely that patients were more motivated to attend their clinic visits on time with the promise of food, thereby improving MPR. A similar effect was found in Haiti where timely attendance at monthly clinic visits were better at 6 and 12 months in the food assistance group vs the non-food group [48]. Therefore, a potential study to evaluate a food intervention on ART adherence would likely need to use other measures of adherence such as unannounced pill counts or a medication event monitoring system in order to evaluate effects on specific pill-taking behavior.

An additional finding in our study was that patients who were on ART for a longer time had better ART adherence. Some population-level studies have found that the level of adherence declines or does not change over time [49, 50]. However, one very large study including nearly 3,000 participants in Uganda and Zimbabwe also found improving ART adherence over the first year of treatment for the population [51]. It is possible that the patients in our population had improved ART adherence due to being on treatment longer, suggesting that continuous ART adherence counseling may be having a beneficial effect. However, it is equally plausible from our data to conclude that those who were better at adhering to their ART medications were more likely to remain in care longer.

We also found in our final model that higher household healthcare spending (\$50 Namibian dollars a month) was associated with poor adherence as assessed by MPR. In this relatively poor population of HIV-infected patients, obtaining ART at the public clinics requires very minimal resources. Patients in households spending more than \$50 Namibian dollars per month on healthcare may be sicker and therefore experience ART treatment interruptions related to hospitalizations, missed pickups, or other factors causing sickness to decrease ARV adherence. Alternatively, these patients may have family members who are sick, causing more burden on the patients, leading to poorer adherence.

This study has several limitations. First, the study was conducted only in Windhoek, which is not representative of the country. However, because Windhoek has a mixture of the different socio-economic and ethnic populations present in Namibia, we may expect a similar relationship between household food insecurity and ART adherence elsewhere in the country. Second, these data are only cross-sectional and any associations found cannot verify causality. Since HFIAS was assessed in the past four weeks and MPR was assessed for up to 12 months, the time periods of the assessments may not always correspond. However, we attempted to minimize this potential time discrepancy by limiting the assessment of MPR to a maximum of 12 months. Third, our participants were recruited while at their routine clinic visit, which may not accurately represent all participants on ART, representing a selection bias. Those who attend their routine clinic visits are more likely to be adherent to medication and have less household food insecurity than patients who miss their clinic visits [52]. This selection bias would be expected to bias our results towards the null.

In conclusion, this study provides the first data from Namibia describing household food insecurity among HIV-infected patients. Importantly, this is the first quantitative data in sub-Saharan Africa reporting an association between food insecurity using an objective measure of ART adherence. These data demonstrate that household food insecurity may be a

significant problem in Namibia's HIV population, which may potentially have detrimental effects on the ability of the ART program to optimize clinical outcomes. Therefore, it is plausible that targeting at-risk populations with interventions to improve household food security may result in improved ART adherence and clinical outcomes. These data further our knowledge of the complicated associations between household food insecurity and HIV, two conditions that are closely related and likely increase one's severity and susceptibility to the other. In the future, Namibia may be a country that could benefit from additional studies of food support, similar to Zambia [47], in order to optimize delivery of ART and thus improve morbidity and mortality in patients living with HIV in Namibia. Further studies are needed to help understand the causal pathway between household food insecurity and ART adherence and the effectiveness of nutritional interventions versus livelihood interventions to improve ART outcomes.

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Table 1

Demographic data for all participants

Characteristics	Overall n (%) mean±SD median (IQR)	MPR <80	MPR 80	p-value (chi-sq, t-test, Wilcoxon Rank Sum, fisher's exact)
N	390	50	340	
Female	234 (60)	33 (66)	201 (59)	0.354
Age (years)	38.7±7.4	38.5±7.8	38.8±7.4	0.821
Marital status				
Married	74 (19)	6 (12)	68 (20)	0.427*
Never married	298 (76)	42 (84)	256 (75)	
Separated/divorced/widowed	18 (5)	2 (4)	16 (5)	
Education (secondary or higher)	253 (65)	28 (56)	225 (66)	0.159
Monthly income				0.128
> 1000 N\$	203 (52)	21 (42)	182 (54)	
1000 N\$	187 (48)	29 (58)	158 (46)	
Income Source – Employed	285 (73)	30 (60)	255 (75)	0.026
Travel mode to clinic				
Walk, hitchhike, bike	85 (22)	17 (34)	68 (20)	0.026
Shared taxi/minibus/own car	304 (78)	33 (66)	271 (80)	
Travel time to clinic (minutes)	30 (20,60)	30 (16,60)	30 (20,60)	0.785
Healthcare spending				0.095
N\$ <50	199 (51)	20 (40)	179 (53)	
50 and above	191 (49)	30 (60)	161 (47)	
Food spending >500 N\$ [†]	186 (48%)	19 (38)	167 (50)	0.122
ART Clinic				
KSH	171 (44)	18 (36)	153 (45)	0.024
KHC	109 (28)	22 (44)	87 (26)	
WCH	110 (28)	10 (20)	100 (29)	
Time on ART (years) [‡]	2.7 (1.3, 4.6)	1.4 (0.8, 4.1)	2.8 (1.4, 4.7)	0.011
ART Regimens at visit [‡]				0.221
AZT/3TC/EFV or NVP	208 (54)	20 (41)	188 (56)	

Characteristics	Overall n (%) mean±SD median (IQR)	MPR <80	MPR 80	p-value (chi-sq, t-test, Wilcoxon Rank Sum, fisher's exact)
D4T/3TC/EFV or NVP	13 (3)	2 (4)	11 (3)	
TDF/3TC/EFV or NVP	133 (35)	23 (47)	110 (3)	
AZT or D4T or TDF/3TC/LPV-r (or TDF/AZT/3TC/LPV-r)	29 (8)	4 (8)	25 (7)	
CD4 (at baseline) †	183 (106, 237)	186 (116, 283)	182 (103.5, 236.5)	0.336
WHO Stage (at baseline) †				0.304 *
1	149 (40)	23 (49)	126 (38)	
2	91 (24)	11 (23)	80 (24)	
3	111 (30)	9 (19)	102 (31)	
4	25 (7)	4 (9)	21 (6)	
Depressed (score 16)	84 (22)	17 (34)	67 (20)	0.022
Drink alcohol (any in past 6 months)	55 (14)	11 (22)	44 (13)	0.086
Household Food Insecurity Scale				0.012
Food Secure	29 (7)	2 (4)	27 (8)	
Mild Insecure	7 (2)	1 (2)	6 (2)	
Moderate Insecure	91 (23)	4 (8)	87 (26)	
Severe Insecure	263 (67)	43 (86)	220 (65)	
MPR – medication possession ratio				
N\$ – Namibian dollars				
ART – antiretroviral therapy				
KSH – Katutura State Hospital				
KHC – Katutura Health Centre				
WCH – Windhoek Central Hospital				
AZT – zidovudine				
D4T – stavudine				
3TC – lamivudine				
EFV – efavirenz				
NVP – nevirapine				
TDF – tenofovir				

LPV-r – lopinavir/ritonavir

WHO – World Health Organization

[†] Missing data resulting in n<390

* Fisher's exact test

Table 2

Factors associated with low ART adherence (MPR <80)

Factor	Unadjusted Model OR (95% CI)	Adjusted Model OR (95% CI)
Severe food insecurity	3.35 (1.46 to 7.68)	3.84 (1.65 to 8.95)
Female	1.34 (0.72 to 2.50)	---
Age (years)	1.00 (0.96 to 1.04)	---
Education (secondary or higher)	0.65 (0.36 to 1.19)	---
Living location (own home/rented home)	1.67 (0.82 to 3.40)	---
Healthcare spending (N\$ 50)	1.67 (0.91 to 3.03)	1.92 (1.02 to 3.57)
Travel mode (Shared taxi/minibus/own car)	0.49 (0.26 to 0.93)	---
ART Clinic		---
KSH	ref	
KHC	2.15 (1.09 to 4.23)	
WCH	0.85 (0.38 to 1.92)	
Time on ART (years)	0.83 (0.70 to 0.97)	0.82 (0.70 to 0.97)
Depressed (score 16)	2.10 (1.10 to 3.99)	---
Drink alcohol (Yes)	1.90 (0.91 to 3.98)	---
Income Source – Employed	0.50 (0.27 to 0.93)	---
Monthly income (<=1000 N\$)	1.59 (0.87 to 2.90)	
Money on food (N\$ >500)	0.62 (0.34 to 1.14)	---

ART – antiretroviral therapy

MPR – medication possession ratio

KSH – Katutura State Hospital

KHC – Katutura Health Centre

WCH – Windhoek Central Hospital

N\$ -- Namibian dollar

BMI – body mass index

Table 3

Ranked reasons for missed doses of ART

Rank number	Reason for missed doses	n=117 n (%)
1	Forgot to take ARV's	85 (73)
2	Work schedule caused me to forget to take ARV's	36 (31)
3	Did not take ARV's because they make me hungry and I did not have enough food	31 (26)
4	Did not have money for transport to pick up ARV's	31 (26)
5	Did not take ARV's because I don't have enough food to prevent side effects	29 (25)
6	Did not take ARV's because I only had enough money for food and not medicine	28 (24)
7	Did not take ARV's because I cannot afford good food while taking medicine	22 (19)
8	Did not take ARV's because of feeling too sick or weak	20 (17)
9	Did not take ARV's because of fear of people knowing I have HIV	15 (13)
10	Did not take ARV's because of side effects	12 (10)

ART – antiretroviral therapy

ARV's – antiretrovirals