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Severe Food Insecurity is Associated with Overweight and Increased Body Fat among People Living with HIV in the Dominican Republic

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Abstract

Food insecurity is an important risk factor for overweight and obesity among low-income populations in high income countries, but has not been well-studied among people living with HIV (PLHIV), particularly in resource-poor settings. To explore the association between food insecurity and overweight and obesity among PLHIV in the Dominican Republic, we conducted a cross-sectional study of 160 HIV-infected adults between March-December 2012 in four geographically-dispersed health centers (Santo Domingo, Puerto Plata, San Juan, and Higuey). We collected information on household food insecurity, anthropometric measurements, and socio-demographic data and ran descriptive and multivariate analyses, controlling for fixed effects of clinics and using robust standard errors. Mean age ±SD of participants was 39.9±10.5 years; 68% were women, and 78% were on antiretroviral therapy (ART). A total of 58% reported severe household food insecurity. After controlling for age, gender, income, having children at home, education, and ART status, severe food insecurity was associated with increased body mass index (BMI) (β=1.891, p=0.023) and body fat (β=4.004, p=0.007). Age and female gender were also associated with increased body fat (β=0.259, p<0.001 and β=8.568, p<0.001, respectively) and age

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CONFLICT OF INTEREST STATEMENT
The authors declare no conflicts of interest.

and ART status were associated with increased waist circumference (β=0.279, p=0.011 and β=5.768, p=0.046, respectively). When overweight was examined as a dichotomous variable (BMI ≥ 25.0), severe food insecurity was associated with an increased odds of 3.060 (p=0.013); no other covariates were independently associated with overweight. The association of severe food insecurity with increased BMI, body fat, and overweight among PLHIV has important implications for clinical care as well as food security and nutrition interventions in resource-poor settings. Integrated programs that combine nutrition education or counseling with sustainable approaches to addressing food insecurity among PLHIV are needed to improve long-term health outcomes of this vulnerable population.

INTRODUCTION

After sub-Saharan Africa, the Caribbean region has the highest overall HIV prevalence (UNAIDS, 2014). Currently, three-quarters of the HIV+ population in the Caribbean live in the Dominican Republic (DR) and Haiti (Rojas, Malow, Ruffin, Rothe, & Rosenberg, 2011). The DR has an overall HIV prevalence of 1.0% (UNAIDS, 2015) and approximately 69,000 infected as of 2014. As elsewhere in the region, the DR HIV epidemic is largely driven by social inequalities, evidenced by the disproportionately higher prevalence rates among persons of low socio-economic status (U.S. President's Emergency Plan for AIDS Relief (PEPFAR), 2015)].

Within this context of inequality, food insecurity – defined as limited or uncertain availability of nutritionally adequate, safe foods or the inability to acquire acceptable foods in socially acceptable ways (Anderson, 1990) – presents particular challenges to the management of HIV. Food insecurity disproportionately affects households living in poverty since economic security is a key determinant of food security (Rose, 1999). Among people living with HIV (PLHIV), food insecurity is associated with reduced antiretroviral therapy (ART) adherence (Kalichman et al., 2014; Palar, Martin, Oropeza Camacho, & Derose, 2013; Young, Wheeler, McCoy, & Weiser, 2014), reduced viral suppression (Alexy, Feldman, Thomas, & Irvine, 2013; Wang et al., 2011), and increased morbidity and mortality (Anema et al., 2013; Anema, Vogenthaler, Frongillo, Kadiyala, & Weiser, 2009; McMahon, Wanke, Elliott, Skinner, & Tang, 2011; Semba & Tang, 1999; Weiser et al., 2011).

Food insecurity is often associated with poor nutrition, which complicates HIV management further. Nutrition plays a vital role in each phase of the HIV care continuum to slow disease progression, minimize side effects of ART, and manage comorbidities (Bloem & Saadeh, 2010). The World Food Program's 2010 policy on HIV and AIDS underscored the role of nutrition and called for the integration of nutritional support into treatment programs (World Food Programme (WFP), 2010). To date, nutritional approaches to address food insecurity among PLHIV in resource-poor settings have focused on food supplementation and safety nets for food insecure, underweight individuals, with the goal of promoting weight gain (Aberman, Rawat, Drimie, Claros, & Kadiyala, 2014; de Pee & Semba, 2010). However, there is a growing burden of overweight and obesity among PLHIV, which can lead to increased risk of other chronic conditions including diabetes and cardiovascular disease

(Crum-Cianflone, Tejidor, Medina, Barahona, & Ganesan, 2008). A better understanding of the relationship between food insecurity and overweight or obesity among PLHIV, particularly in low-resource settings, is needed to inform policy and practice.

Multiple paths have been theorized to link food insecurity and obesity, including interactions between deprivation/stress and the food environment (Frongillo & Bernal, 2014; Laraia, Epel, & Siega-Riz, 2013). Food insecurity and obesity may be associated due to the widespread availability and inexpensive nature of energy-dense foods with added sugars and added fats (Drewnowski & Darmon, 2005). Technological innovations in food preparation and preservation have contributed to the mass production and distribution of foods that increase caloric intake (Cutler, Glaeser, & Shapiro, 2003). Thus, individuals facing food insecurity may resort to consuming relatively inexpensive high-calorie items (Gibson, 2003), and, over time, this can lead to weight gain (Dietz, 1995). Food deprivation can also be associated with stress, anxiety, depression, or distress (Heflin, Siefert, & Williams, 2005; Laraia, Vinikoor-Imler, & Siega-Riz, 2015; Leung, Epel, Willett, Rimm, & Laraia, 2015; Liu, Njai, Greenlund, Chapman, & Croft, 2014), which are associated with stress eating, overeating behaviors (Luppino et al., 2010; Moore & Cunningham, 2012; Torres & Nowson, 2007), visceral fat accumulation, and an increased risk of chronic disease (Laraia, 2013; Seligman, Laraia, & Kushel, 2010).

The purpose of this paper is to assess the relationship between household food insecurity and overweight and obesity among PLHIV in the DR. To our knowledge, only one previous study has examined this relationship among PLHIV, finding that food insecurity with hunger (also called “severe” food insecurity”) was associated with obesity in a cohort of HIV+ and at-risk urban women in Bronx, New York, even after controlling for socio-demographic variables, and HIV status and risk behaviors (Sirotin, Hoover, Shi, Anastos, & Weiser, 2014). However, the extent to which severe food insecurity is related to obesity among PLHIV in resource-poor settings and among men and women with HIV is less clear. One study in South Africa found that 43.4% of PLHIV had either moderate or severe food insecurity and 48.0% were either overweight or obese; however, the relationship between food insecurity and obesity was not assessed (Oketch, Paterson, Maunder, & Rollins, 2011). A study among HIV-positive and HIV-negative women in Rwanda found that although levels of food insufficiency and low dietary diversity were substantial (46% and 43%, respectively), no significant correlations were found between either of these factors and BMI (Sirotin et al., 2012). Finally, a study in Haiti found that at baseline 89% of PLHIV in a food supplementation trial had either moderate or severe food insecurity, but food insecurity was negatively related to BMI (i.e., as food insecurity level increased, BMI decreased) (Rebick, Franke, Teng, Gregory Jerome, & Ivers, 2016). Given the high prevalence of both household food insecurity and obesity among PLHIV in resource poor settings, our study aims to inform policy, programming, and practice to improve ART adherence and HIV treatment outcomes.

METHODS

Study setting

The Dominican government has established comprehensive HIV care clinics, but programs integrating food and nutritional support are still lacking. In response, the World Food Programme initiated a research partnership with the RAND Corporation, a non-profit research organization, to examine nutritional status, describe habitual dietary characteristics, determine nutritional value of habitual dietary intake, and assess the household food security of a sample of persons receiving care at HIV clinics in the DR.

The data reported in this manuscript were collected during June and July 2012 in four geographically-dispersed health centers (Santo Domingo, Puerto Plata, San Juan, and Higuey) selected purposively to represent the diverse cultural and geographic regions and include nongovernmental (NGO) and government-operated clinics. Ethical approval for the study was obtained from the RAND IRB and the DR's National Council of Bioethics in Health (CONABIOS).

Sample

Individuals present in each clinic on the day of the interviews were invited to participate in the study. Inclusion criteria were being age 18 years or older, being registered in the HIV clinic, residency in the community for at least a year, and possessing adequate capacity to respond to the study questions. Exclusion criteria were being pregnant or lactating or having musculoskeletal deformities that could interfere with the anthropometric measurements. The study purposively included people on antiretroviral therapy (ART) and not on ART.

Procedures

Trained field workers used an oral consent procedure and conducted: 1) structured interviews with patients attending the clinic to collect data on household food insecurity and socio-demographic characteristics; and 2) anthropometric assessments.

Measures

Dependent variables (anthropometrics)

Body mass index (BMI): Each participant's height and weight were assessed using the World Health Organization's (WHO) technical standards (WHO, 2000) and BMI was calculated using body weight (kg)/height (m^2).

Body fat percentage was estimated using electrical bio-impedance analysis with a portable body fat analyzer (Model HBF 306, OMRON Healthcare, Vernon Hills, IL).

Waist circumference was measured at the midpoint between the inferior border of the ribcage and the superior aspect of the iliac crest by using a non-distensible measuring tape (WHO, 2000).

Primary Independent (Predictor) Variable

Household food insecurity: We used the validated Latin American and Caribbean Food Security Scale or ELCSA (α = .91–.96 across LAC countries) (ELCSA, 2012; Melgar-Quiñonez et al., 2010), which assesses household food security over the past 90 days using 8 questions about conditions that characterize households having difficulty meeting their food needs, complemented by 7 questions that are applied only in households with children < 18 years. Questions focus on household experiences and anxiety regarding food availability, access, and consumption (ELCSA, 2012), and cover a wide range of issues, from worrying about running out of food to children going to bed hungry. Scores classify households into 4 categories: "food secure," "mild food insecurity, "moderate food insecurity" and "severe food insecurity." The ELCSA is based on the United States (U.S.) Household Food Security Survey Module. Both scales measure food insecurity in a similar manner, but the ELCSA uses a "last 3 months" reference period instead of "last 12 months" as the U.S. version (Bickel, Nord, Price, Hamilton, & Cook, 2000). The category of "severe food insecurity" in the ELCSA corresponds to "very low food security" (and food insecurity with hunger) in the U.S. version. Severe food insecurity was used as the main predictor (vs. moderate/mild/no food insecurity), given that this level of food insecurity has been associated with important clinical outcomes in the U.S. (Sirotin et al., 2014).

Control Variables

Demographics: Demographic characteristics included age, gender, education (collapsed to <primary school and ≥primary school for analysis), presence of children under 18 years of age at home, and income (collapsed to <US$170/month vs. ≥US$170/month).

ART status: patients were coded as "on ART" or "not on ART" based on chart review.

Statistical analysis: Analyses were performed using Stata 11.0 (StataCorp, College Station, TX). Data were expressed as mean ± standard deviation (SD) and frequency (percentage). Bivariate analyses using t test and Chi^2 test were used to compare study participants with severe food insecurity to those without on the dependent variables (BMI, body fat, and waist circumference) and control variables (age, gender, income, children, education, and ART status). Multivariable linear regression, controlling for fixed effects of clinics and using robust standard errors, was used to assess the independent association between severe food insecurity and BMI, body fat, and waist circumference, controlling for age, gender, income, having children at home, education and being on ART. We also used multivariable logistic regression controlling for fixed effects of clinics and with robust standard errors to assess the independent association between severe food insecurity and overweight (as determined by BMI ≥ 25.0). We conducted various sensitivity analyses with alternative specifications of our primary independent variable. P values <0.05 were considered statistically significant.

RESULTS

Among our participants (n=160), food insecurity status was as follows: none (food secure), n=19 (12%); mild, n=32 (19%); moderate n=18 (11%); and severe, n=91 (58%). Table 1 provides participant characteristics (n=160), comparing those who reported severe household food insecurity (n=92 or 58%) vs. those who did not (reported no, light or moderate food insecurity, n=68 or 42%). The mean ± SD age was 39.9±10.5 years; 69% were women. Socioeconomic data indicated low educational attainment and income; of the 160 participants, 61% had not completed primary school and nearly half (48%) earned less than US$170/month. Over half (56%) had children at home. Seventy-eight percent were receiving ART. Mean BMI, body fat, and waist circumference ± standard deviation were 23.7±5.4 kg/m^2, 24.7 ±9.3 %, and 88.4±15.0 cm, respectively. The only statistically significant differences were: those with severe food insecurity were more likely to be women (74% vs. 60% p=.047), have completed less than primary school (70% vs. 49%, p=.01), and have higher levels of body fat (26.3±9.3% vs 22.4±8.9%, p=0.01).

Table 2 provides the results from the multivariable analyses examining the association between severe food insecurity and study outcomes. Of the 160 participants, 19 were missing data on either education or income and were dropped from the analyses, leaving a sample of 141. Severe food insecurity was positively associated with BMI (β=1.891, p=. 023) and body fat (β==4.004, p=.007). Age and female gender were also associated with body fat (β=0.259, p<.001 and β=8.568, p<.001, respectively). Severe food insecurity was not associated with waist circumference, however age (β=0.279, p=.011) and being on ART (β=5.768, p=.046) were. The amount of variance explained by each regression model was 33.9% (BMI), 49.0% (body fat) and 10.5% (waist circumference). [As a sensitivity analysis, we also ran these regressions without those who were underweight, and the findings were similar. We also ran the regressions without those who were food secure, comparing those with severe food insecurity to those with mild or moderate, and the results were similar].

When we examined overweight as a dichotomous variable (BMI ≥ 25.0), we found that severe food insecurity was associated with an increased odds of overweight of 3.060 (p=. 013); no other covariates were independently associated with overweight.

DISCUSSION

We found severe food insecurity associated with increased BMI and body fat as well as higher odds of being overweight among PLHIV in the DR. Approximately 57% of our sample had severe food insecurity and 11% had moderate food insecurity, which is different than what has been found in the DR among the general population using a 12 month reference frame (18% severe and 35% moderate) (FAO, 2016). Well over a third of our sample of PLHIV were either overweight or obese according to BMI, which is consistent with other cohort studies conducted with PLHIV in Latin America (mostly Brazil) and the U.S. that reported approximately 30% were overweight or obese (Crum-Cianflone, Roediger, Eberly, Headd, et al., 2010; Hendricks, Willis, Houser, & Jones, 2006; Jaime, Florindo, Latorre, & Segurado, 2006; Leite & Sampaio, 2010; Mariz et al., 2011). However, none of these previous studies measured food insecurity nor examined its relationship with overweight or obesity among PLHIV. Our findings have important implications for clinical care of PLHIV in the DR and similar settings, as well as for interventions to address food insecurity among this vulnerable population.

The association between severe food insecurity and increased BMI and body fat among PLHIV is concerning clinically because obesity is a major risk factor for type 2 diabetes mellitus (Mokdad et al., 2003) and has emerged as a growing problem among individuals with treated HIV infection in the U.S. (Crum-Cianflone, Roediger, Eberly, Headd, et al., 2010), especially women (Amorosa et al., 2005). Excess weight can exacerbate metabolic syndrome, which is sometimes a side effect of ART (Alvarez et al., 2010; Friis-Møller et al., 2003), and is associated with increased risk of cardiovascular disease and type 2 diabetes mellitus (Alberti, Zimmet, & Shaw, 2005; Grundy et al., 2005). Diabetes is a major risk factor for cardiovascular disease (Kannel & McGee, 1979) and chronic kidney disease (Medapalli et al., 2012) in both the general and HIV-infected population (Grinspoon & Carr, 2005). Obesity is also associated with poorer immunologic response to ART (Crum-Cianflone, Roediger, Eberly, Vyas, et al., 2010) and is therefore not likely to be protective, as some studies conducted prior to ART availability suggested (Shor-Posner et al., 2000).

The association of severe food insecurity with increased BMI, body fat, and overweight among PLHIV also has important implications for food security and nutrition policy and programs in resource poor settings. Food supplementation for food insecure, underweight individuals have tended to provide micronutrient fortified blended flours (e.g., fortified corn soy blend) and demonstrated benefits for addressing food insecurity, nutritional well-being and ART adherence, but are typically not sustainable (Aberman et al., 2014). Further, effects on food insecure PLHIV who are overweight have been understudied. Work elsewhere in Latin America (Honduras) found that although nutritional counseling plus a household food basket (maize, rice, beans, corn soy blend, and vegetable oil) for food insecure PLHIV on ART was more effective in decreasing food insecurity than nutritional counseling alone, it had the undesired effect of increasing weight among already overweight and obese patients (Palar et al., 2015). More comprehensive and sustainable approaches that dually increase food security *and* promote balanced nutrition among PLHIV with a variety of nutritional statuses are needed, particularly for urban or peri-urban settings.

The high prevalence of household food insecurity and its relationship to increased BMI and body fat among PLHIV justify an *integrated* and multi-sectoral program of nutritional counseling and diverse strategies to promote economic security for PLHIV. To have a robust impact, nutritional programs must include mechanisms for addressing food security, bolstering supply of nutritious foods and providing comprehensive nutritional education across the spectrum of nutritional statuses. Researchers have begun to describe and evaluate integrated health and livelihood programs for PLHIV, mostly in rural settings in Africa, but much is unknown about optimal program and policy design (Gillespie & Kadiyala, 2005; Holmes, Winskell, Hennink, & Chidiac, 2011; Roopnaraine, Rawat, Babirye, Ochai, & Kadiyala, 2011; Samuels & Rutenberg, 2011; Yager, Kadiyala, & Weiser, 2011). Urban agriculture is being developed to strengthen capacity for sustainable livelihoods and food security among PLHIV in Kenya (Karanja et al., 2010), while urban farming among PLHIV in the U.S. has been proposed as a way to reduce psychological distress and social isolation and thereby reduce risk behaviors and improve chronic disease-related behaviors (Shacham et al., 2012). Although not specifically focused on PLHIV, another strategy in the U.S. to address food insecurity is via food rescue organizations, which obtain donations from farmers, manufacturers, wholesalers, supermarkets and restaurants (Hampl & Hall, 2002).

To our knowledge, none of these previous agricultural interventions with PLHIV have integrated comprehensive nutrition education, which is important for addressing the range of nutritional statuses among PLHIV.

Given the prevalence of overweight and obesity, offering nutritional counseling as part of HIV care is crucial. Nutrition education and counseling may be more sustainable than long-term food support, but reviews of nutritional interventions for PLHIV have noted these as weak components (Aberman et al., 2014). Further, although nutrition education has been studied in conjunction with food supplementation, its independent effects have rarely been studied. Prior pilot work in Latin America (Honduras) has found that a peer-delivered nutritional counseling intervention for PLHIV was associated with improvements in dietary quality and reduced food insecurity among PLHIV of diverse nutritional statuses (Derose et al., 2015), and nutritional counseling (by trained nutritionists) significantly improved ART adherence as well as weight, with overweight and obese patients at baseline *losing* weight and underweight and normal weight patients *gaining* weight over the 12 month follow-up (Martinez et al., 2014). Additional work is needed to ensure that nutrition education and counseling and programs that promote food and economic security are indeed the standard of care in most settings.

Limitations

The cross-sectional design of our study limits the extent to which causal inferences between food insecurity and obesity can be drawn. Our clinic-based convenience sampling limits generalizability and might have caused us to mis-specify the relationship between food insecurity and obesity. Further, given the distribution of our main predictor (food insecurity), we could not examine the extent to which mild and moderate food insecurity were associated with BMI, body fat, and waist circumference when compared to food insecure individuals. And, although we tried to control for the effects of ART on adiposity, we did not have good data on *time on ART*, which would have more sufficiently controlled for these effects. A larger, prospective, population-based study would be preferable to examine causal relationships between different levels of food insecurity and obesity among PLHIV. Further, such a study would need to take into account the type of medication prescribed, as lipodystrophy is related to the use of specific drugs such as the nucleoside reverse transcriptase inhibitor stavudine and the protease inhibitor (PI) ritonavir (Heath et al., 2002).

Despite these limitations, our study makes a contribution as one of the first to document both nutritional status and food insecurity among PLHIV in Spanish-speaking Latin America and the Caribbean. Further, as far as we know, ours is the first to find an independent relationship between food insecurity and overweight/obesity among PLHIV in resource-poor settings. Since our study took place within a national care program for people with HIV, it has already helped inform the public health care sector and local policy for PLHIV. Given our findings that overweight and obesity occur often among PLHIV in the DR and that food insecurity increases their risk of occurrence, efforts are needed to further track and address these trends among PLHIV in resource-poor settings.

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Table 1

Characteristics and study outcomes of population with severe food insecurity vs. no/light/moderate food insecurity

	Total N = 160	Severe Food Insecurity N = 92 (57.5%)	No/Light/Moderate Food Insecurity N = 68 (42.5%)	p-value
CHARACTERISTIC				
Age, years (mean ± SD)	39.9±10.5	40.6±11.1	39.0±9.7	0.360
Female gender (%)	110 (68.8%)	69 (75.0%)	41 (60.3%)	**0.047**
Income ≥US$170/month (%)	76 (51.7%)	37 (46.8%)	39 (57.3%)	0.203
Has children <18 years at home (%)	90 (56.3%)	52 (56.5%)	38 (55.9%)	0.936
Education ≥ completed primary (%)	60 (39.0%)	27 (30.3%)	33 (50.8%)	**0.010**
On ART (%)	124 (77.5%)	72 (78.3%)	52 (76.5%)	0.789
STUDY OUTCOMES				
BMI (Kg/m^2 ± SD)	23.7±5.4	24.0±5.7	23.2±5.0	0.338
Underweight (<18.5), n (%)	28 (17.5%)	17 (18.5%)	11 (16.2%)	0.432
Normal (18.5–24.9), n (%)	71 (44.4%)	36 (39.1%)	35 (51.5%)	
Overweight (25.0–29.9), n (%)	39 (24.4%)	24 (26.1%)	15 (22.1%)	
Obese (≥30.0), n (%)	22 (13.8%)	15 (16.3%)	7 (10.3%)	
Body Fat Percentage (% ± SD)	24.7±9.3	26.3±9.3	22.4±8.9	**0.010**
Waist circumference (cm ± SD)	88.4±15.0	88.1±11.5	88.9±18.8	0.735

Data presented as mean ± SD or absolute frequency and percentage (%)

P value for t test or chi2 test

Table 2

Multivariable linear regression analysis of the association between severe food insecurity and BMI, body fat, and waist circumference among people living with HIV* (n=141)

Characteristic	BMI			Body Fat			Waist Circumference		
R^2	**0.339**			**0.490**			**.105**		
	β	**95% CI**	**p**	**β**	**95% CI**	**p**	**β**	**95% CI**	**p**
Severe food insecurity (vs. no/light/moderate)	**1.891**	**0.267, 3.515**	**0.023**	**4.004**	**1.108, 6.901**	**0.007**	1.149	−3-927, 6.224	0.655
Age	0.026	−0.52, 0.104	0.508	**0.259**	**0.132, 0.386**	**<0.001**	**0.279**	**0.065, 0.494**	**0.011**
Female gender (vs. male)	1.573	−0.170, 3.316	0.076	**8.568**	**5.679, 11.457**	**<0.001**	0.323	−6.139, 6.785	0.921
Income ≥US$170/month (vs. <US$170/month)	1.348	−1.108, 3.804	0.280	3.160	−0.318, 6.639	0.075	6.416	−1.542, 14.375	0.113
Has children <18 years at home	0.895	−0.883, 2.673	0.321	0.477	−2.339, 3.292	0.738	4.377	−1.311, 10.064	0.130
Education ≥ completed primary (vs.<primary)	0.348	−1.379, 2.074	0.691	−0.211	−3.040, 2.619	0.883	0.144	−5.836, 6.123	0.962
On ART	0.845	−0.995, 2.686	0.365	0.453	−2.688, 3.594	0.776	**5.768**	**0.093, 11.443**	**0.046**

*Controlling for fixed effects of clinics, with robust standard errors

Table 3

Multivariable logistic regression analysis of the association between severe food insecurity and overweight among people living with HIV[a] (n=141)

Characteristic	**Overweight (BMI ≥ 25)**		
$\mathbf{R^2}$		**0.191**	
	Adjusted Odds Ratio	**95% CI**	**P**
Severe food insecurity (vs. no/light/moderate)	**3.060**	**1.261, 7.429**	**0.013**
Age	0.993	0.953, 1.035	0.746
Female gender (vs. male)	1.650	0.655, 4.153	0.288
Income ≥US$170/month (vs. <US$170)	1.656	0.568, 4.827	0.355
Has children <18 years at home	1.351	0.600, 3.039	0.467
Education ≥ completed primary (vs. < primary school)	1.586	0.642, 3.917	0.317
On ART	1.361	0.536, 3.452	0.517

[a]Controlling for fixed effects of clinics, with robust standard errors