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Association of Supplemental Nutrition Assistance Program (SNAP) with Health Related Quality of Life and Disease State of HIV Infected Patients

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Abstract

The literature on the potential clinical and non-clinical benefits of participation in food assistance programs for people living with HIV in developed countries is scarce. We conducted a cross-sectional study of 165 HIV infected adults to determine the impact of the Supplemental Nutrition Assistance Program (SNAP) on HIV disease status and health related quality of life (HQROL). There was no significant association between SNAP participation and disease status; CD4 cell count ($\beta = 0.02$, $P = 0.837$) and viral load ($\beta = 0.02$, $P = 0.836$). The mean scores for all the HRQOL domains were lower compared to the US population, but none were associated with SNAP participation. Higher scores on the general health domain, were marginally associated with SNAP participation ($\beta = 0.16$, $P = 0.071$). In this study, SNAP participation was not significantly associated with less disease progression, and only marginally associated with quality of life among this population of HIV infected individuals.

Resumen

La literatura sobre los posibles beneficios clínicos y no clínicos de la participación en programas de asistencia alimentaria para las personas infectadas con el VIH es escasa. Se ha realizado un estudio transversal de 165 adultos infectados con el VIH para determinar el impacto del Programa de Asistencia de Alimentación Suplementaria (SNAP) en el estado de la enfermedad VIH y la

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calidad de vida relacionada con la salud (CVRS). No hubo asociación significativa entre el estado de la enfermedad y la participación en SNAP; recuento de células CD4 ($\beta = 0.02$, $P = 0$ 0.837) y la carga viral ($\beta = 0.02$, $P = 0.836$). Las puntuaciones medias para todos los dominios de CVRS eran inferiores en comparación con la población de los Estados Unidos, pero ninguno de ellos se asocia con el estado de participación en el programa. Las puntuaciones más altas en el dominio del estado de salud general fueron marginalmente asociadas con participación en SNAP ($\beta = 0.16$, $P = 0.071$). En este estudio, la participación en SNAP no estuvo asociada significativamente con la disminución en la progresión del VIH, y sólo marginalmente asociada con la calidad de vida en esta población de personas infectadas con el VIH.

Keywords

Supplemental nutrition assistance program (SNAP); Health related quality of life (HRQOL); HIV disease state; Food assistance programs

Introduction

The introduction of antiretroviral therapy (ART) for the treatment of HIV infection has led to declines in disease associated morbidity and mortality, making HIV infection a chronic disease [1]. For this reason, HIV treatment should focus not only on achieving better clinical outcomes but also improving health related quality of life (HRQOL).

HRQOL is a subjective measure of a patients' view of their wellbeing and functionality in relation to having a chronic disease. Poor quality of life has long been associated with HIV disease progression [2]. As a result, measuring HRQOL among persons living with HIV (PLHIV) gives practitioners valuable feedback on treatment efficacy and effectiveness, as well as disease prognosis [2]. Improved quality of life has consistently been associated with survival and healthcare utilization in this population [3–6].

Demographic and lifestyle characteristics associated with poor quality of life among those infected with HIV include being Black or Hispanic, being female, older age, having less education and using recreational drugs [7–10]. Immunologic and virologic status also affects HRQOL, with decreased CD4 cell counts always associated with poorer quality of life. Such associations, however, have not been consistently reported with higher viral load [7, 12–15]. Other disease related factors of HRQOL are the presence of symptoms, whether HIV related or not [10, 15, 16]. Antiretroviral therapy (ART) may improve HRQOL [2]; however, some studies report a negative impact with long term use due to treatment side effects and toxicities [17]. In addition, several studies have shown that psychological and social support influences HRQOL in this population, sometimes even mediating the relationship of quality of life with symptomatology and/or treatment side effects [18–21].

Quality of life can be affected when there is a limitation or uncertainty with availability and access to adequate amounts of food (food insecurity) [22]. There is a high prevalence of food insecurity among several HIV infected populations [23]; 56 % of this study cohort experienced food insecurity within the last 12 months [I.E.H., unpublished data, 2013]. Evidence shows that providing food support (not nutrient supplements) to food insecure HIV

individuals improves food security, and is associated with weight gain and adherence to treatment [24–27]; all of which are elements positively related to disease outcome and quality of life [22, 28, 29]. In resource limited countries, food assistance may be provided in the form of ready-to-use therapeutic foods, generic food rations, or as rations of locally available staple foods [30]. They are usually provided as rations, at appropriate frequencies (i.e. daily, weekly or monthly) to meet the food needs of the beneficiaries and sometimes that of their families [31].

Research documenting the impact of food assistance on clinical outcomes and quality of life of HIV infected individuals is minimal and inconclusive. Studies conducted in some sub-Saharan African countries showed no significant impact on disease stage [24, 27, 32]. However, a food assistance intervention targeted at HIV infected individuals in Zambia found improved quality of life scores among beneficiaries compared to controls [33]. Food assistance interventions provided to PLHIV are usually targeted to those living in resource poor countries. Evidence shows that food insecurity rates in HIV-infected persons are similar between resource poor and resource adequate settings [23]. In the United States, the largest food assistance program is the Supplemental Nutrition Assistance Program (SNAP) [34], and we recently reported that the participation rate in this program among our cohort is fairly high (I.E.H., unpublished data, 2013), similar to nationwide participation levels. While this food assistance program doesn't provide food rations and is not specifically targeted at food insecure HIV infected individuals, receiving SNAP benefits provides additional resources for food acquisition and, as a result, may help improve disease state and quality of life. We therefore evaluated the relationship of SNAP participation with disease status and health related quality of life among HIV infected adults. We compared these variables between SNAP participants and eligible non-participants. Study participants were considered low income, based on their eligibility to participate in SNAP.

Methods

Study Design and Setting

This was a cross-sectional study approved by the Florida International University (FIU) Institutional Review Board. The research was conducted among HIV infected adults eligible to participate or already participating in SNAP. The study was conducted between April 2011 and August 2012. Participants were a consecutive convenience sample recruited mainly from the FIU HIV and Nutrition Research Clinic (HNRC) located in the Borinquen Health Care Center (BHCC), as well as other centers providing care to HIV patients in Miami, FL. BHCC provides various HIV-related services to persons with low socioeconomic status who are living with HIV/AIDS in Miami-Dade County. HNRC conducts Nutrition and HIV related studies, and evaluates HIV infected adults seeking care at BHCC. Participants were recruited through flyers, referrals and word of mouth. Inclusion criteria for the study were: being 18 years or older, providing documentation of HIV seropositive status, and participating or being eligible to participate in SNAP. Eligibility for SNAP was determined using ACCESS Florida's Pre-screening eligibility tool. This is a basic screening tool used by the State of Florida to determine SNAP eligibility. The tool uses household and individual information such as income, assets, household size, and expenditure to determine eligibility.

SNAP participation was defined as having received SNAP benefits for more than a month within the last 12 months. The average length for program participation among SNAP participants was 10.52 ± 2.90 months. Eligible non-participants qualified to receive SNAP benefits based on SNAP eligibility requirements but were currently not program participants. Some of the reasons for not participating in SNAP among this population include lack of awareness about the program eligibility requirements and benefits, as well as difficulty with application process (I.E.H., unpublished data, 2013). Individuals, who signed a written informed consent after being informed of study protocol, were included in the study. At the study visit, participants completed a self-administered questionnaire that gathered information on sociodemographic characteristics as well as information on health related quality of life. Presence of symptoms, immunologic (CD4 cell count) and virologic (viral load) variables were also assessed. Patients were required to present documentation of their most recent (no more than 3 months from study visit) viral load and CD4 cell count results from their last medical visit. Each participant was given $10 as appreciation for completing the study requirements and as reimbursement for expenses derived from study participation.

Survey Instruments and Variables Assessed

Demographic and Socioeconomic Information—Information collected to determine socio-demographic and economic status were age, gender, ethnicity, marital status, education, employment status, monthly income, country of birth, antiretroviral medication use, use of community food resources and substance abuse (cigarette smoking, illicit drug use, and alcohol use).

Health Related Quality of Life—The SF-36v2 [35] health survey was used to assess health related quality of life. It consists of 36 items aggregated into eight health domains scales, and further into two component summary measures, namely the Physical and Mental Component Summary scores (PCS and MCS) respectively. The physical health measure is made up of (1) Physical Functioning (PF), which measures limitations for performing physical activity, (2) Role-Physical (RP), which measures limitations in the kind of work/activities and capacity to work or engage in usual activities, (3) Bodily Pain (BP), which measures intensity of bodily pain and the magnitude to which it affects normal work activities, and (4) General Health (GH), which covers perceptions and expectation of the respondent's health [35].

The mental health measures comprise (1) Vitality (VT), which measures energy and fatigue levels, (2) Social Functioning (SF), which assesses health related burden on the number and quality of social activities, (3) Role Emotional (RE), which is a measure of the impact of mental health on time spent on work/activities, the amount of work/activity achieved and the care devoted to activities performed, and lastly (4) Mental Health (MH) which addresses four mental health dimensions: anxiety, depression, loss of behavioral/emotional control and psychological wellbeing [35].

The reliability scores for all the domains are high, ranging from 0.84 to 0.95 [35]. Scoring for the scales was performed using the Quality Metric Health Outcome Software. Two scores were generated, one based on a standard scoring scale between 0 and 100, a second

based on norm-based T-scores. The norm-based scores were used in calculating the component summary scores [36]. The norm-based scoring allows for comparison both between and within the domains and summary scores. It also allows for a direct comparison with the general US population scores where the normed mean is 50 and the standard deviation is 10. A low score on any of the domains is indicative of a poor state [36]. The scores from the scoring software were exported to SPSS for analysis.

Disease Status—Viral load and CD4 cell counts were assessed as part of clinical outcomes. These were obtained from participant's medical reports with their written permission. The participants either provided documentation of their recent blood work obtained from their providers or they signed a HIPAA authorization of medical release form with which we secured their information directly from their provider. The results from the blood work was required to be no more than 3 months old, from the day of study assessment.

Symptoms—A medical history questionnaire developed for use in HIV disease was used to evaluate incidence of symptoms [37]. Study participants were asked about any symptoms that were experienced (pertaining to general malaise and also those related to HIV) within the past month. These included diarrhea, constipation, nausea, fever, fatigue, and unexplained changes in weight. Number of symptoms ranged from 0 to 9.

Statistical Analysis

A descriptive analysis of participants' sociodemographic, lifestyle and clinical profile was completed and the results were expressed as mean ± standard deviation or percentages. The square root of CD4 cell count and the log of viral load were calculated and used in the analysis, since their distributions were not normal. Viral load was also categorized based on levels indicative of degree of virologic control while CD4 cell count was categorized based on guidelines for initiating treatment [38]. To test differences in variables between SNAP participants and non-participants, student's *t* test was used for continuous variables and Chi square test for categorical variables. The means of the various quality of life health domain scales and component summaries were calculated and compared with the US general population using a one sample *t* test.

Univariate analysis using Pearson's correlation was performed to test the relationship of demographic characteristics with immunologic and virologic variables as well as quality of life domains. Pearson's correlation analysis was also performed to assess association of SNAP participation with disease status and health related quality of life. Multiple linear regression models were used to further assess the associations with SNAP participation. Regression models were constructed with log viral load, square root CD4 cell count, MCS, PCS and all the other HRQOL scales as dependent variables. Independent variables other than SNAP participation that were used in the analysis were identified from the literature. These were age, gender, ethnicity, education, employment status, income, marital, child status, household number, ART use, smoking status, alcohol and drug use. All statistical analyses were performed using SPSS version 21. Statistical significance for all analyses was considered as $P < 0.05$.

Results

A total of 165 participant were included in the study of which 109 (66 %) were male. The mean age of the sample was 46.99 ± 7.87 years. As shown in Table 1, most study participants were African American (74.5 %) and were born in the US (83.6 %), with the latter being significantly different between the SNAP participation and non-participation groups (91.5 vs. 64.6 %, $P < 0.001$, $\Phi = 0.33$). Significantly more non-SNAP participants were employed and fewer reported disability compared to SNAP participants. Also a significantly higher percentage of SNAP participants reported having less than $1,000 monthly income (84.6 vs. 70.8 %, $P < 0.042$, $\Phi = 0.16$). Significantly greater percentage of SNAP participants (36.8 %), used illicit drugs (including crack cocaine, and marijuana) than the non-participants (12.5 %), $P = 0.002$, $\Phi = 0.24$. On the other hand, a significantly higher percentage of the SNAP participants received ART treatment compared to non-participants (94 vs. 70.8 %, $P < 0.001$, $\Phi = 0.32$). The mean norm-based PCS and MCS for the study population was significantly lower compared to the US general population (46.46 vs. 50, $P < 0.001$ and 44.64 vs. 50, $P < 0.001$) respectively.

Relationship Between SNAP Participation and HRQOL

Table 2, compares the domain and summary scores between groups and also with the general population. SNAP participants ($M = 45.63$) had somewhat more bodily pain than the non-participants ($M = 49.69$), $P = 0.065$, $d = -0.33$(highest score indicates “no pain or limitations due to pain”). SNAP participants scored significantly lower on all HRQOL domains than the general population, with the exception of vitality. The non-SNAP participants scored significantly lower on four of the HRQOL domains. Multiple regression models were constructed to further assess the relationship of all of the HRQOL domain scales on SNAP participation status. All the models, which included SNAP participation status and all the independent variables, were significant. The models for the Physical Component Summary Score (PCS) and Mental Component Summary Scores (MCS) explained 23.4 and 38 % of their respective variance (Tables 3, 4). After controlling for the independent variables, neither PCS nor MCS were significantly associated with SNAP participation status. SNAP participation status was not significant for any of the HRQOL domain scales, although it approached significance in the regression model for general health. In this model, SNAP participation status explained 1.6 % additional variability, $\beta = 0.16$, $P = 0.071$. Higher general health scores were associated with SNAP participation (Results not shown).

Several demographic characteristics were significantly associated with many of the HRQOL domains, however, only those related to PCS and MCS are reported. In the regression model, higher PCS scores were associated with having fewer symptoms ($\beta = 0.20$, $P = 0.013$), being younger ($\beta = 0.21$, $P = 0.014$), not using other food assistance programs ($\beta = 0.19$, $P = 0.017$), and not being born in the US ($\beta = 0.22$, $P = 0.035$). Higher MCS scores were associated with having fewer symptoms ($\beta = 0.38$, $P < 0.001$), having a lower viral load ($\beta = 0.30$, $P = 0.003$), having more than a high school education ($\beta = 0.20$, $P = 0.009$), not using ART ($\beta = 0.18$, $P = 0.03$), and not being born in the US ($\beta = 0.18$, $P = 0.05$).

Relationship Between SNAP Participation and Disease Status

In univariate analysis, participation in SNAP was not associated with any disease parameters, although a higher observed percentage of SNAP participants had controlled viral load compared to non-participants; 49.6 vs. 37.5 % (Table 5). Participation in SNAP, in addition to all the control variables, explained 41 and 52.5 % of the variability in CD4 cell count and viral load respectively. In these models, several demographic characteristics were associated with these disease parameters. Higher CD4 cell counts were associated with having a lower viral load ($\beta = -0.63$, $P < 0.001$), not using ART ($\beta = -0.24$, $P = 0.003$), having monthly income higher than $1000 ($\beta = -0.18$, $P = 0.019$), and not drinking alcohol ($\beta = -0.16$, $P = 0.05$). Lower viral loads were associated with using ART ($\beta = -0.26$, $P < 0.001$), higher CD4 cell count ($\beta = -0.51$, $P < 0.001$), larger household size ($\beta = -0.22$, $P = 0.003$), not using drugs ($\beta = 0.21$, $P = 0.008$), using vitamins ($\beta = -0.18$, $P = 0.006$), and more symptoms ($\beta = -0.12$, $P = 0.043$) (Tables 6, 7)

Discussion

Most of the findings from the analyses of demographic data were expected. Individuals who were US citizens, disabled, unemployed, and had lower income were more likely to participate in SNAP [39]. The larger number of males and African Americans represented in this study population is a reflection of the epidemic's distribution pattern with respect to gender and ethnicity in Miami-Dade County. The epidemic disproportionally affects African-Americans compared to other ethnicities in the United States [40]. The differences observed between SNAP participants and non-participants with respect to drug and alcohol use, with those participating in SNAP using more alcohol, may be related to having more income to spend on non-nutritive items, since the income for food was supplemented by SNAP. Those participating in SNAP were more likely to receive ART, which suggests a better connection within health and nutrition services.

The low norm-based score (less than 47) reported for both the physical and mental domain of the HRQOL among this sampled population, compared to the US general population, is an indication of the functional impairment from having a chronic disease [41]. Similar to other chronic diseases, HIV infection has been shown to affect HRQOL [7, 11, 12]. However, compared to the literature on individuals with other chronic diseases, the mean PCS and MCS reported from this HIV infected group were higher [41].

The main goal of our study was to examine the relationship between participating in SNAP and improved disease status and quality of life. We found no significant association between parameters of disease status and participation in SNAP. Our results are consistent with those from previous studies that evaluated the impact of food assistance on disease parameters among individuals infected with HIV. After a 12 month intervention, which provided food aid in the form of maize meal, vegetable oil, corn-soy flour and pulses, Rawat et al. [32] found no significant difference in disease stage between the intervention and control groups. Similar results were reported by Cantrell et al. [27], who found no significant difference in CD4 cell count after a 12 month intervention. Our findings of marginal association between some HRQOL domains and SNAP participation is consistent with results from a study conducted by the Catholic Relief Service (CRS) in Zambia, where the provision of food

assistance led to significant improvement in the quality of life of beneficiaries [33]. The marginal association suggest that our sample size was probably insufficient to find significance and not necessarily that the relationship does not exist. Another study that provided food assistance to HIV infected Haitians, also found marginal improvements in HRQOL, with none of the results being significant [25]. Although this study presents results consistent with those indicated in earlier studies, the methods used in food assistance provision differed. Food assistant recipients in this study received cash to procure food while beneficiaries from previous studies received food rations. Not having control over the type and amount of food consumed, may have contributed to the results observed, as this study could not ensure adequacy of dietary and nutrient intake. Receiving SNAP benefits may not necessarily lead to the attainment of food security for participants, especially if food resources are shared with other individuals such as family members. Additionally, although SNAP participants may have more food acquisition resources available to them, their dietary and nutrient intake was not adequate to achieve the optimal nutrition needed to effect changes in clinical outcomes. Analysis of nutrient intakes between the SNAP participating and non-participating groups showed no significant differences. More than 50 % of SNAP participants had suboptimal intakes of several vitamins (A, B_6, C, D, E, and folate) and minerals (magnesium, potassium, copper and zinc) (I.E.H., unpublished data, 2013). Finally, the majority of our participants were ART recipients and as such, already had successfully reconstituted immune systems, hence the inability to observe significant changes in CD4 levels as a parameter for disease progression.

In further analysis, we looked at the relationships between immunological parameters and HRQOL, as there is inconsistency in the literature concerning these relationships. Most studies found that higher CD4 cell counts were associated with better HRQOL [10–12]. This was not found in our cohort; CD4 cell count was not associated with any of the HRQOL domains or summary scales. Decreased viral load, on the other hand, was associated with improvements in the mental component of the HRQOL but not with the physical component. This finding contrasts that by Call et al. [12], who found viral load to be an independent predictor of the physical component score (PCS), role physical (RP), and bodily pain (BP), all of which describe physical health. Role Physical was the only physical scale we found to be associated with viral load. Though not a surprising finding, the number of symptoms was associated with increased viral load and poor scores on all the HRQOL domains and scales except physical function (PF). This supports what has already been reported by other studies, emphasizing the need to treat these symptoms immediately, in order to decrease their impact on the consequence of the disease [11, 15, 16].

Several studies investigating the demographic and behavior related factors that affect HRQOL have reported older age, being of Hispanic origin, having less education and using recreational drugs as common contributing factors [7, 8, 10]. These were all consistent with our findings, and in addition, our study identified being born in the United States, using other food assistance programs, and use of antiretroviral agents as factors associated with HRQOL. Drug and alcohol use were not associated with HRQOL in our study, which is contrary to reports from other studies [7–9, 42]. Drug and alcohol use were, however, associated with decreased CD4 cell count and increased viral load.

Major limitations of our study are its cross-sectional nature and small sample size. Generalizability of our findings is also limited because study participants were recruited from only one US city and may not reflect results from varying HIV infected populations. Nevertheless, this study shed light on the relationships between HIV disease state and HRQOL outcome in SNAP and non-SNAP participants. Future studies are needed to determine SNAP's contribution to meeting the food and nutritional needs of low-income HIV infected individuals, and its translation to improved disease status and quality of life. These studies will form the basis for the possible need of food support interventions, specifically targeted at persons living with HIV in developed countries like the United States.

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Table 1

Sociodemographic,health and behavior related characteristics by SNAP participation status

Variables	Total (N = 165) n (%)	SNAP (n = 117)	Non-SNAP (n = 48)	*P*-value
Male	109 (66.1)	77 (65.8)	32 (66.7)	–
Ethnicity				
African American	123 (74.5)	90 (76.9)	33 (68.8)	–
Hispanic American	27 (16.4)	19 (16.2)	8 (16.7)	
White	7 (4.2)	4 (3.4)	3 (6.2)	
Other	8 (4.8)	4 (3.4)	4 (8.3)	
US Born ***	138 (83.6)	107 (91.5)	31 (64.6)	<0.001
Single	148 (89.7)	82 (88.9)	44 (91.7)	–
No children	76 (46.1)	50 (42.7)	26 (54.2)	–
Less than High School	77 (46.7)	52 (44.4)	25 (52.1)	–
Employment Status *				
Unemployed	77 (46.7)	49 (41.9)	28 (58.3)	0.017
Employed	19 (11.5)	11 (9.4)	8 (16.7)	
On disability	69 (41.8)	57 (48.7)	12 (25.0)	
Monthly income < $1,000 *	133 (80.6)	99 (84.6)	34 (70.8)	0.042
Living condition				
Alone	63 (38.2)	46 (39.3)	17 (35.4)	–
With family	75 (45.5)	54 (46.2)	21 (43.8)	
Shelter	27 (16.4)	17 (14.5)	10 (20.8)	
Uses other food assistance	24 (14.5)	18 (15.4)	6 (12.5)	–
Has symptoms	128 (77.6)	90 (76.9)	38 (79.2)	–
Smokes cigarettes	103 (62.4)	77 (65.8)	26 (54.2)	–
Uses drugs **	49 (29.7)	43 (36.8)	6 (12.5)	0.002
Drink alcohol +	80 (48.5)	62 (53.0)	18 (37.5)	0.071
On ART ***	144 (87.3)	110 (94.0)	34 (70.8)	<0.001
Takes vitamins	77 (46.7)	54 (46.2)	23 (47.9)	–

ART antiretroviral therapy

+ $P < 0.10$,

* $P < 0.05$,

** $P < 0.01$,

*** $P < 0.001$

Table 2

Mean T scores by SNAP participation status compared to the general population (N = 165)

SF-36 Summaries and domains	SNAP participants		Non-SNAP participants	
	Mean[a]	SD	Mean	SD
Physical component summary	45.90***	10.76	48.25	10.71
Physical functioning	44.51***	11.76	46.99	11.96
Role-physical	41.57***	12.08	44.71**	12.02
Bodily pain	45.63***	12.70	49.69	12.89
General health	47.67*	11.30	46.96	11.61
Mental component summary	44.20***	13.55	45.72*	12.30
Vitality	51.26	10.71	52.68	12.50
Social functioning	42.59***	11.46	44.12**	11.71
Role-emotional	38.77***	15.11	42.52**	15.69
Mental health	45.89**	12.68	46.90	11.62

SD standard deviation

[a]Comparison with general population mean of 50

*$P < 0.05$,

**$P < 0.01$,

***$P < 0.001$

Table 3

Regression of Physical Component Summary (PCS) on SNAP participation status (N = 165)

Variable	B	SE(B)	*β*	*P*-value
SNAP participation Significant control variables	0.31	2.16	0.01	0.888
Number of symptoms	−1.11	0.44	−0.20 *	0.013
Age	−0.28	0.11	−0.21 *	0.014
Use of other food assistance	−5.71	2.36	−0.19 *	0.017
US born	−6.35	2.98	−0.22 *	0.035

Model R^2 = 0.234, F (23,141) = 1.87, P = 0.015. ΔR^2 (SNAP participation) = 0.000

Other control variables were gender, ethnicity, education, child status, employment status, income, household size, smoking status, alcohol use, drug use, ART use, vitamin use, viral load and CD4 cell count

* $P < 0.05$

Table 4

Regression of Mental Component Summary (MCS) on SNAP participation status (N = 165)

Variable	B	SE(B)	β	*P*-value
SNAP participation	1.47	2.38	0.05	0.538
Significant control variables				
Number of symptoms	−2.62	0.48	−0.38***	<0.001
Viral load	−2.69	0.88	−0.30**	0.003
Less than high school	−5.37	2.03	−0.20**	0.009
ART use	−7.08	3.23	−0.18*	0.030
US born	−6.48	3.29	−0.18*	0.050

Model R^2 = 0.380, F (23,141) = 3.75, $P < 0.001$. DR^2 (SNAP participation) = 0.002

ART antiretroviral therapy

* $P < 0.05$,

** $P < 0.01$,

*** $P < 0.001$

Other control variables were age, gender, ethnicity, child status, employment status, income, household size, smoking status, alcohol use, drug use, vitamin use, use of other food assistance, and CD4 cell count

Table 5

Immunologic and virologic parameters by SNAP participation status

Variable	Total (N = 165)	SNAP participants (n = 117)	Non-SNAP Participants (n = 48)	*P*-value
CD4 cell count				0.166
≤199	32 (19.4)	21 (17.9)	11 (22.9)	
200–499	52 (31.5)	42 (35.9)	10 (20.8)	
≥500	81 (49.1)	54 (46.2)	27 (56.2)	
Viral load				0.097
≤75	76 (46.1)	58 (49.6)	18 (37.5)	
76–9,999	49 (29.7)	29 (24.8)	20 (41.7)	
≥10,000	40 (24.2)	30 (25.6)	10 (20.8)	

All variables reported as n (%)

Table 6

Regression of CD4 cell count on SNAP participation status (N = 165)

Variable	B	SE(B)	β	*P*-value
SNAP participation	0.26	1.28	0.02	0.837
Significant control variables				
Viral load	−3.19	0.39	−0.63***	<0.001
ART use	−5.16	1.69	−0.24**	0.003
Income < $1,000	−3.35	1.42	−0.18*	0.019
Alcohol use	−2.29	1.17	−0.16*	0.052

ART Antiretroviral therapy

* $P < 0.05$,

** $P < 0.01$,

*** $P < 0.001$

Model $R^2 = 0.411$, $F(23,141) = 4.5$, $P < 0.001$. DR^2 (SNAP participation) = 0.000

Other control variables were age, gender, ethnicity, country of birth, education, child status, employment status, household size, smoking status, drug use, vitamin use, number of symptoms, and use of other food assistance programs

Table 7

Regression of SNAP Viral Load on SNAP participation status (N = 165)

Variable	B	SE(B)	*β*	*P*-value
SNAP participation	0.05	0.23	0.02	0.836
Significant control variables				
CD4 cell count	−0.10	0.01	−0.51***	<0.001
ART use	−1.14	0.29	−0.26***	<0.001
Household size	−0.26	0.08	−0.22**	0.003
Vitamin use	−0.52	0.19	−0.18**	0.006
Drug use	0.65	0.24	0.21**	0.008
Number of symptoms	−0.09	0.05	−0.12*	0.043

Model R^2 = 0.525, F (23,141) = 7.13, $P < 0.001$. DR^2 (SNAP participation) = 0.000

ART antiretroviral therapy

* $P < 0.05$,

** $P < 0.01$,

*** $P < 0.001$

Other control variables were age, gender, ethnicity, country of birth, education, child status, employment status, income, smoking status, alcohol use, and use of other food assistance programs