Published in final edited form as:

Drug Alcohol Depend. 2011 October 1; 118(1): 73–77. doi:10.1016/j.drugalcdep.2011.02.020.

Malnutrition in a population of HIV-positive and HIV-negative drug users living in Chennai, South India

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Abstract

Background—Malnutrition is a strong predictor of poor outcomes in people living with HIV (PLHIV). Drug users are at increased risk of malnutrition regardless of whether or not they are infected with HIV. Little data exists on the nutritional status of drug users (with or without HIV infection) in India.

Methods—We describe and compare the nutrition and metabolic status of 107 HIV-positive and 193 HIV-negative male clients of a community-based drop-in center for injection drug users in Chennai, India. Measures of nutrition and metabolic status include body composition, dietary intake, food insecurity, and serum lipid levels.

Results—We found poor overall nutritional status in both the HIV-positive and HIV-negative clients, with HIV-positive men faring worse on some parameters. Both groups had extremely low percent body fat, but levels in HIV-positive participants were significantly lower (6.5% vs. 7.9%, $p=.01$). HIV-positive men also had significantly lower total caloric and fat intakes compared to HIV-negative men. A considerable proportion (70%) of both HIV-positive and HIV-negative drug users were food insecure. HDL cholesterol levels were significantly lower and below normal range in the HIV-positive compared to HIV-negative men.

Conclusions—The high levels of food insecurity and poor nutritional status in this population, regardless of HIV status, indicates critical need for intervention. Improving nutritional status in those who are infected with HIV prior to initiation of antiretroviral treatment may help patients to reap the full benefits of therapy.

Keywords

Nutritional status; injection drug users; India; HIV-infection

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1. INTRODUCTION

According to official estimates, nearly 3 million individuals in India are currently infected with HIV/AIDS (Department of AIDS Control, 2009). In the State of Tamil Nadu in South India, where injection drug use is an important source of new HIV infections, studies show an HIV prevalence of 30–60% among the estimated 10,000 to 15,000 injection drug users (IDUs) living in the city of Chennai (Dorabjee and Samson, 2000; Solomon et al., 2008). The vast majority of these IDUs who are infected with HIV are not able to access antiretroviral treatment (ART) (Chakrapani et al., 2008).

Malnutrition may impact the course of HIV-infection through a variety of mechanisms, including compromising host immune function, diminishing response to therapies, and promoting co-morbidities (Beisel, 1996). Drug users are at increased risk of malnutrition as a result of a combination of behavioral (chaotic lifestyles leading to poor dietary quality and food insecurity), metabolic (inadequate storage of nutrients in damaged livers, increased nutrient excretion through diuresis and diarrhea), and clinical factors (chronic infection with Hepatitis C, HIV, and/or TB) (Normen et al., 2005; Himmelgreen et al., 1998; Gambera and Krohn Clarke, 1976; Corneil et al., 2006; Anema et al., 2010). Early studies reported vitamin deficiencies, anemia, GI distress, malnutrition with observable emaciation, tooth decay, and decreased appetite among drug using populations (Nyswander, 1956; Eldridge, 1963; Way, 1970). More recent studies show that drug users have lower BMI and lower percent fat mass than non-drug users, despite similar or higher dietary intakes (Forrester et al., 2005; Cofrancesco, Jr. et al., 2007; Quach et al., 2008). In addition, at similar levels of BMI, heavier drug use is associated with lower percent body fat (Tang et al., 2010). While weight loss is a significant predictor of mortality (Tang et al., 2002), the effects of low percent body fat on the course of HIV infection are still unknown.

To our knowledge, little data exists on the nutritional status of drug users (with or without HIV infection) in India. In this population, where nutritional status is expected to be worse than in the U.S., small differences in nutritional status due to HIV and/or drug use may have a much larger impact on health status. Our aim is to determine the prevalence of poor nutrition and metabolic status in this population. Our results will help to identify appropriate nutritional interventions to improve quality of life in this vulnerable population, and maximize the benefits of ART for drug users that are HIV-infected.

2. METHODS

2.1 Study participants

In 2007, we recruited 300 (107 HIV-positive and 193 HIV-negative) clients from the Hoppers Foundation in Chennai (formerly the SAHAI Trust Health Care Center), a community-based drop-in center providing a multitude of services for IDUs, including drug use counseling, accompanied referrals for voluntary HIV testing and counseling, counseling for partners of IDU's, condom distribution and needle exchange, opioid substitution therapy, and basic medical services such as treatment for sexually transmitted infections and abscesses. These clients were recruited to participate in a longitudinal study of the causes and consequences of malnutrition in drug using populations. Clients were eligible if they were between the ages of 18 and 65 years, had a history of injection drug use in the past 5 years, understood and agreed to all study procedures, and signed written informed consent. Since there were few to no female clients at the time of recruitment, the study population was restricted to males only. For the current analysis, only data from the baseline study visit are included. This study was reviewed and approved by the Institutional Review Boards of Tufts University School of Medicine (Boston, MA) and the National Institute of Epidemiology (Chennai, India).

2.2 Data collection

All participants underwent a Lifestyle questionnaire, a 24 hour dietary recall, measurements of body composition, a brief physical exam, and a blood draw. Participants who did not have recent (within 6 months) documentation of HIV-status at the time of screening were HIV tested, with pre- and post-test counseling according to standard procedures already in place.

The Lifestyle questionnaire included detailed information on sociodemographics (including religion, housing status, jail or prison stay, sexual orientation); a brief medical history; food insecurity; and types, frequency and patterns of recreational drug and alcohol use. Food insecurity was measured using the Household Food Insecurity Access Scale (HFIAS) Measurement Tool (Coates et al., 2006). We began administering this food insecurity questionnaire about one-third of the way into recruitment and thus have this data on only 201 participants.

Dietary intake was assessed using a 24 hour recall method. All 24-hour recalls were coded and analyzed at the National Institute of Epidemiology using the Nutrition Composition Tables of Indian foods published by the National Institute of Nutrition (ICMR), in Hyderabad, India (Gopalan et al., 2000).

All participants were weighed without shoes and in light clothing, using a calibrated standing balance beam scale. Height was measured using a wall-mounted stadiometer. Body mass index (BMI) was calculated as weight (in kg) divided by height (in meters) squared. Categories of BMI were derived according to cut-off values recommended by the World Health Organization (World Health Organization, 1995): BMI<16.0 (chronic energy deficiency (CED) Grade III); BMI 16.0 to <17.0 (CED Grade II); BMI 17.0 to <18.5 (CED Grade I); BMI 18.5 to <25.0 (Normal); and BMI≥25.0 (Overweight or Obese).

Skinfold measurements were taken in triplicate at three sites (triceps, subscapular and suprailiac) using the Lange skinfold caliper (Beta Technology, Inc., Santa Cruz, California) (Gordon et al., 1988). Total body fat was calculated from the average of the three measurements taken at each site and using the age- and sex-specific equations of Durnin and Womersley (Durnin and Womersley, 1974). Fat Free mass (in kg) was calculated as weight minus body fat. Waist, hip, arm, and thigh circumferences were taken without outer clothing, using a tape measure in light contact with, but not compressing the skin (Lohman et al., 1988). All study personnel were trained and standardized on body composition measurements every six to twelve months by an experienced research nutritionist.

Fasting blood levels were obtained for analysis of lipids (total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides).

2.3 Statistical analysis

Univariate analyses were conducted to check the distribution of each variable. Means and proportions of nutritional and metabolic parameters were computed and compared by HIV status using t-tests for continuous variables and chi-square tests for categorical variables. The Fisher's Exact Test was used in cases where expected cell counts were less than five. Differences were considered statistically significant if the p-value was <.05. All data were analyzed using SAS v9.2 (SAS Institute, Cary, NC).

3. RESULTS

Of the 107 HIV positive participants, 40 (37%) were newly diagnosed at enrollment. Mean CD4 levels were 344 ± 188 cells/mm³ and 24% had CD4+ cell counts <200 cells/mm³. Of the

remaining 67 men who were previously diagnosed, 18 reported ever being on ART and 13 were currently on ART.

The mean age ($\pm$ SD) was 37 ± 7 years. Lifetime drug use consisted most commonly of mixed combinations of heroin, Tidigesic (buprenorphine), Avil (chlorpheniramine, an antihistamine) and Calmpose (diazepam, a benzodiazepine). Current use of these drugs (past six months) was low ($\sim 10\%$); however current rates of tobacco (92%), cannabis (63%), and alcohol use (72%) were high. There were few differences in sociodemographic or drug use characteristics by HIV status. HIV-positive participants were slightly less educated and significantly more likely to be bisexual and to have been in jail/prison (data not shown).

Nutritional measures by HIV status are shown in Table 1. Approximately half the men in both HIV groups were classified as underweight or chronically energy deficient ($BMI < 18.5$). The HIV-positive men had significantly lower heights and weights, and therefore significantly lower levels of absolute fat and fat free mass. However, percent body fat was also significantly lower in the HIV-positive men. With respect to diet, HIV-positive participants had significantly lower levels of energy and fat intake, and slightly lower levels of protein intake compared to the HIV-negative group. Nearly 70% of participants in both HIV groups were classified as food insecure with about 50% classified as severely food insecure.

Cholesterol levels (total, HDL, and LDL) were significantly lower in the HIV-positive men compared to the HIV-negative men, while triglyceride levels were significantly higher in the HIV-positive group. Mean total and LDL cholesterol levels were in the normal range for both groups, using cutoffs defined by the American Heart Association (< 200 mg/dl for total cholesterol and < 100 for LDL cholesterol). Triglyceride levels were also well within the normal range (< 150 mg/dl) for both groups. Mean HDL levels, however, were below normal (< 40) for the HIV-positive men.

4. DISCUSSION

We found overall poor nutritional status in this population, with a few parameters being worse in HIV-positive compared to HIV-negative men. HIV-positive men had significantly lower percent body fat and lower intakes of energy and fat compared to HIV-negative men. As would be expected for a largely untreated HIV-positive group, cholesterol levels were significantly lower and triglyceride levels were significantly higher compared to the HIV-negative group. Mean lipid levels were all within the normal range with the exception of HDL, which was significantly lower and below normal range in the HIV-positive men. The majority of men (70%), regardless of HIV status, reported being food insecure, with half indicating severe food insecurity.

In our opinion, the high level of food insecurity in this population indicates the most critical need for intervention. Food insecurity exists when people do not have adequate physical, social or economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 2002). There are both physical and psychosocial consequences to being food insecure, all of which lead to reduced health and function (National Research Council, 2006). In people living with HIV, there is a high prevalence of food insecurity and studies have linked food insecurity to several adverse outcomes, including increased risk of HIV transmission, lower levels of adherence to ART, lower CD4 cell counts, incomplete HIV viral suppression, and increased mortality (Anema et al., 2009). Drug users, regardless of HIV status, are at increased risk of food insecurity due to their chaotic lifestyles and often limited funds which are spent on supporting their habits rather than buying food (Himmelgreen et al., 1998; Hendricks and Gorbach, 2009;

Anema et al., 2010). The fact that 70% of our participants reported moderate to severe food insecurity suggests that introduction of other interventions (nutrition counseling, ART, etc) will have limited success if this is not addressed.

In HIV infection, weight loss is common and associated with increased mortality (Tang et al., 2002). Earlier studies showed a preferential loss of lean body mass among patients with low initial levels of body fat (Mulligan et al., 1997; Forrester et al., 2002). This is cause for concern in our population given the extremely low levels of percent fat recorded in our study. When comparing our participants (injection drug users) against participants from a similar study of non-drug users in South India (Swaminathan et al., 2008), we find that body composition measures are much lower in both HIV-positive and HIV-negative drug users. In Swaminathan's study, HIV-positive subjects (both with and without TB) had significantly lower BMI than HIV-negative controls of the same socioeconomic status (44% of HIV-positive/TB-positive men, 32% of HIV-positive/TB-negative men, and 27% of HIV-negative men had BMI < 18.5 kg/m²). In comparison, BMI levels in our population of drug users were substantially lower, with 52% of HIV-positive men and 50% of HIV-negative men having BMI levels below 18.5 kg/m². In Swaminathan's study, mean fat mass and percent body fat were reported as 7.1±4.7 kg and 11.8±5.9%, respectively in HIV-positive men without TB; 5.7±3.5 kg and 10.1±4.7% in HIV-positive men with TB; and 8.9±6.7 kg and 13.1±8.8% in HIV-negative men. Fat mass and percent body fat were, again, considerably lower in both HIV groups in our study (Table 1). Similarly, waist and mid-arm circumference measurements were lower in our study population compared to non-drug using male counterparts in Swaminathan's study.

The comparison of our subjects with non-drug users of similar demographics highlights the amplifying effects that the combination of HIV infection and drug use can have on nutritional status. While the lower heights and weights of the HIV-positive versus HIV-negative men in our study could explain the lower levels of absolute fat and fat-free mass, it does not explain the significantly lower percent body fat in the HIV-positive men. Fat regulates body temperature, cushions and insulates organs and tissues and is the main form of the body's energy storage. For men, the minimum percent body fat considered safe for health is 5% and our participants were only slightly above this level. Dietary intake of fat was low in both HIV groups, but significantly lower in the HIV-positive versus HIV-negative men (22.5% and 25% of total calorie intake, respectively). Although we cannot say at this point that the low intake of fat is the only cause of the low percent body fat, nutrition interventions with higher proportions of fat and protein intake (and lower proportion of carbohydrate intake) should be prioritized for increasing both weight and percent body fat, as the dual insult of HIV and drug use will likely further compromise fat and fat free mass stores (Tang et al., 2010).

HIV-positive participants in our study had lower cholesterol levels and higher triglycerides than HIV-negative participants. This is consistent with data from earlier pre-HAART studies which found decreased total and HDL cholesterol in early HIV infection, while advanced HIV and AIDS was associated with elevated triglycerides and further decreases in total, HDL, and LDL cholesterol (Grunfeld et al., 1992; Feingold et al., 1993; Hellerstein et al., 1993; Shor-Posner et al., 1993). Based on the U.S. adult treatment panel (ATP) III guidelines (Adult Treatment Panel III, 2001), few participants had hypercholesterolemia (>200 mg/dl) or hypertriglyceridemia (>150 mg/dl) in our study population (7% and 12%, respectively). However, a large proportion of both HIV-positive and HIV-negative participants had low (<40 mg/dl) HDL cholesterol levels (75% of HIV-positives and 43% of HIV-negatives, p<.0001).

Our study has some limitations. Participants were all recruited from a single drop-in center in Chennai and may not be representative of all injection drug users in Chennai. In addition, this paper only describes and highlights differences in nutritional status by HIV status. We feel it is important to initially present the data in this fashion to draw attention to the needs of this underserved population. Future analyses, however, will explore the independent determinants of specific nutritional abnormalities in order to develop more targeted interventions.

In summary, we found a high prevalence of poor nutritional status in both HIV-positive and HIV-negative male drug users in Chennai, with HIV-positive drug users faring worse. The high levels of food insecurity in both groups indicate critical need for intervention. In addition, given that 37% of HIV-positive men were newly diagnosed as a result of our study, the importance of outreach and routine HIV testing at centers such as Hoppers Foundation should be emphasized. Given the emerging evidence that poor nutritional status at the start of ART is predictive of mortality (Stringer et al., 2006; Zachariah et al., 2006; Johannessen et al., 2008), improving nutritional status early and prior to initiation of ARV treatment may enable patients to reap the full benefits of therapy.

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Table 1

Nutritional status of 300 HIV-positive and HIV-negative male clients attending the Hopers Foundation Drop-In Center, Chennai, India, 2007

	HIV-positive (n=107)	HIV-negative (n=193)	p-value
Body Composition			
BMI (kg/m ²)	18.6 ± 1.9	19.1 ± 3.0	0.05
BMI			
<16.0 CED * Grade III	6 (5.6%)	22 (11.4%)	0.04
16.0–16.9 CED Grade II	17 (15.9%)	24 (12.4%)	
17.0–18.4 CED Grade I	33 (30.8%)	50 (25.9%)	
18.5–24.9 Normal	51 (47.7%)	86 (44.6%)	
≥25.0 Overweight or Obese	0 (0%)	11 (5.7%)	
Height (cm)	162 ± 5	164 ± 7	0.001
Weight (kg)	49.0 ± 6.0	52.0 ± 9.5	0.001
Fat mass (kg)	3.3 ± 2.4	4.5 ± 3.8	0.001
Fat free mass (kg)	45.8 ± 4.4	47.5 ± 6.2	0.006
% Body fat	6.5 ± 4.0	7.9 ± 5.4	0.01
Mid-arm circumference (cm)	23.7 ± 3.6	24.4 ± 3.8	0.11
Waist circumference (cm)	69.1 ± 4.6	70.5 ± 8.2	0.06
Dietary Intake (24 Hour Recall)			
Energy intake (kcal)	2311 ± 756	2589 ± 1270	0.02
Carbohydrate (g)	382 ± 129	397 ± 161	0.36
Protein (g)	59.4 ± 25.7	65.7 ± 31.8	0.06
Fat (g)	58.0 ± 34.1	71.2 ± 50.4	0.007
Fiber (g)	4.3 ± 1.7	4.6 ± 2.7	0.24
Food Security			
	(n=68)	(n=133)	
Food secure	21 (30.9%)	41 (30.8%)	0.12
Mildly food insecure	1 (1.5%)	14 (10.5%)	
Moderately food insecure	9 (13.2%)	19 (14.3%)	
Severely food insecure	37 (54.4%)	59 (44.4%)	
Lipid Levels			
Total cholesterol (mg/dl)	131 ± 34	152 ± 39	<0.001
HDL cholesterol (mg/dl)	35 ± 11	41 ± 11	<0.001
LDL cholesterol (mg/dl)	81 ± 22	95 ± 28	<0.001
Triglycerides (mg/dl)	95 ± 45	90 ± 47	0.03

* CED=Chronic Energy Deficiency