ORIGINAL PAPER

Evaluation of anthropometric indices, eating habits, and their relationship with CD4 level in individuals with HIV/AIDS

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Abstract

Introduction: Malnutrition is one of the important and complex complications of human immunodeficiency virus (HIV), and anthropometry is a valuable clinical indicator in health planning and policy making among HIV/acquired immunodeficiency syndrome (AIDS) patients. The purpose of this study was to evaluate anthropometric indices, eating habits, and their association with CD4 in individuals with HIV/AIDS.

Material and methods: This descriptive-analytical study was conducted on all individuals with HIV/AIDS over 20 years of age, who referred to a behavioral diseases counseling center in Iran in 2018. Census sampling method was conducted, and 122 patients were selected. Anthropometric indices were measured using standard methods, and nutritional status questionnaire was used to assess patients' nutritional status.

Results: The mean body mass index in women and men were 25 and 22 kg/m2, respectively. Abdominal obesity was 0.89 and 0.87 cm in female and male patients, respectively. Furthermore, 64% of patients had poor eating habits. Among food groups, consumption of water (p = 0.05) and carbonated drinks (p = 0.034) were significantly different between men and women. Among dietary groups, only meat and legumes group had a significant association with CD4 level (p = 0.047).

Conclusions: Although 57% of patients with HIV infection were within normal range, abdominal obesity was higher than standard values, and two thirds of the participants presented poor eating habits. Therefore, nutritional interventions are of great importance in this group of patients.

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Introduction

Acquired immunodeficiency syndrome (AIDS) is considered as a chronic disease [1]. The global number of people infected with human immunodeficiency virus (HIV) and AIDS was 36.9 million by the end of 2016, while the number of new cases in 2017 was reported as 1.8 million. In 2016 in Iran, the number of these patients was estimated as 66 thousand people [2]. This virus is associated with biological and social factors, and changes the individuals' ability to consume foods. These biological and social factors lead to inadequate nutrition, malnutrition, and weight loss, which are among the leading causes of mortality in HIV patients. Weight loss is also an important predictor of death caused by AIDS [3]. For many developing countries, HIV incidence and malnutrition impedes the progress towards achieving the United Nations Millennium Development Goals [4].

Appropriate eating habits include taking a variety of foods at each meal, and this dietary diversity is widely recognized as a valid indicator of diet quality and food safety [5]. Reception and consumption of appropriate foods is of particular importance, but pose a challenge in many countries. For example, in the USA, 15.4% of the population received inadequate food in 2014 [6]. Studies showed that inappropriate nutrition and malnutrition were associated with increased mortality, augmented incidence of opportunistic infections, decreased adherence to antiretroviral therapy, and poor tolerance to treatment [7, 8]. Feldman *et al.* reported that lack of diet adherence and malnutrition increased viral load, lowered CD4 count, and caused HIV-related morbidity and mortality [9]. In this regard, HIV-positive people need 10% more nutritional energy than healthy people [3], but social consequences, such as stigma, discrimination, and lack of social support have reduced HIV-positive patients' access to appropriate nutrition [10]. In different countries, conflicting results exist regarding the impact of malnutrition on improving immunity at different periods after initiation of drug therapy. Paton *et al.* also showed that malnutrition reduced the survival rates in HIV-positive patients [11], whereas other studies indicated poor immune responses [12].

Therefore, the quote from William Kelly from the Food and Agriculture Organization may well justify the abovementioned ideas: "Food is not a magic bullet and does not prevent people from deaths caused by AIDS, but it helps the patients to live longer, more comfortable, and better lives" [13].

Protein-energy malnutrition is highly prevalent among HIV/AIDS patients, which in turn, worsens the disease progression by reducing weight, depleting cellular reserves, reducing subcutaneous and arm circumference fat as well as reducing micronutrients, protein, and carbohydrate intake in these patients [4]. In both malnutrition and HIV cases, the number of CD4 and CD8 cells is shown to be decreased [14]. Treatment of HIV-infected patients with antiviral drugs changes the immune system and increases the number of CD4 lymphocytes [15]. However, all patients do not show an optimal response to the treatment. Therefore, to achieve the United Nations Millennium Development Goals, aggressive interventions, such as paying attention to food intake of patients with HIV will prevent the development of HIV. However, few studies have extensively examined the nutritional status and eating habits of people with HIV, and most previous studies have focused on antiviral drugs adherence and clinical outcomes. In this present study, apart from assessing the nutritional status in HIV-positive patients, the relationship between dietary groups and CD4 level was investigated. The purpose of this study was to determine the anthropometric indices, dietary intake, and its association with CD4 level in patients with HIV/AIDS in Kerman City, Iran. These results can be used to determine the current problems, solve them, and design future intervention studies.

Material and methods

Study design and setting

This descriptive-analytical study was carried out on individuals with HIV/AIDS over 20 years of age, who referred to a behavioral diseases counseling center, Kerman, Iran in 2018.

Sampling and sample size

The inclusion criteria for people with HIV were 20 years of age and over, consuming antiviral medication for six months, reading and writing literacy, and willingness to participate in the study. Since the statistical population included 183 members, the census method was used for sampling. A total of 122 people participated in the study, with a response rate of 66.67%.

Instruments and data collection

To collect the data, two questionnaires were used. The first questionnaire consisted of demographic and clinical information, including age, gender, marital status, educational level, occupation, income level, number of children, CD4 level, stage of the disease, viral load, history of the disease, and body mass index, which were reported in percentage and frequency. To assess the nutritional status in patients, the Iranian food habits questionnaire, designed by Bahrami *et al.* [16] was applied on 20- to 70-year-old people in Iran in 2014. After retesting of 25 HIV patients, its reliability was reassessed using Cronbach's α of 0.89, and its validity was confirmed by a panel of nutritionists, infectious specialists, and health educators.

A BMI device was also used to measure the participants' BMI, and a tape measure was applied to measure the hip and abdominal circumferences. Initially, the participants were informed about the dominant dietary habits, such as the type of drink used with food (water = 1, carbonated drinks = 2, fruit juice = 3, buttermilk = 4, beer = 5), breakfast consumption (yes = 1, no = 0), cooking method (boiled and

steamed = 1, roasted and barbecued = 0), type of consumed oil (olive, sesame, and liquid oil = 1, vegetable and solid oil, animal, and butter = 0), chicken skin removal (all = 1, some or no removal = 0), amount of fat in dairy products (1.5% low-fat = 1, 3% high-fat = 0), salting (no = 1, yes = 0), consumption of cake, cookies, chips, and snacks (no = 1, yes = 0), and consumption of pizza, hamburger, sausage, and kielbasa (no = 1, yes = 0). Later, the participants were asked about the frequency and percentage of consuming fruits and vegetables, dairy, meat and legumes, water, carbonated beverage, and sugar.

In order to complete the questionnaires more precisely, $ 2 was paid to each participant. Later, all questionnaires were collected by a female researcher and assistant. Sampling started at August 23, 2017 and lasted till March 11, 2018.

Ethical consideration

Ethics committee affiliated with the Yazd University of Medical Sciences approved this study as well as its consent procedure (IR.SSU.SPH.REC 1396.83). Therefore, we made a coordination in order to conduct the study. A cover letter explaining the purpose and procedure of the study was provided to all eligible participants for data collection. Then, verbal agreement of the participants was obtained, and they were ensured about confidentiality of the data and voluntary participation. Also, informed consent forms were obtained after they completed the questionnaires.

Statistical analysis

Descriptive statistics were used to describe the participants' characteristics and eating habits. χ^2 test was applied to determine the frequency of food groups in both genders. Furthermore, SPSS version 25 was used for data analysis.

Results

A total of 122 patients with HIV/AIDS with an average age of 41.88 ± 9.46 years participated in the study. We found that 53.3% of the participants were male, 46.7% were married, 36.9% presented with diploma or higher, 54.1% were unemployed, 33.6% had no children, and 41.8% had an income of more than 60 $. According to the results, the disease was transmitted through sexual contact in 37.7% of cases. The prevalence of emaciation was 10.7% among the patients, while overweight and obesity had a prevalence rate of 42.6%. CD4 levels were above 350 in 59% of cases. Of all participants, 93.4% had HIV. Viral load was less than 100 in 63.9% of the participants, and 41.8% of them did not mention risk factors, such as drug abuse (Table 1).

Waist-to-hip ratio is a measurement indicator for abdominal obesity and fat distribution in the body. Here, abdominal obesity was 0.89 cm in females and 0.87 cm in males (Table 2).

Table 1. Demographic information of the subjects

Variable	*n*	%
Gender		
Female	57	46.7
Male	65	53.3
Marital status		
Single	29	28.3
Married	57	46.7
Divorced/widow/widower	36	29.5
Education		
Illiterate	13	10.7
Elementary/middle school	64	52.4
Diploma and higher	45	36.9
Job		
Unemployed	66	54.1
Employed	56	45.9
Children		
1	31	25.4
< 2	50	41.0
Income		
< US $ 60	71	58.2
> US $ 60	51	41.8
BMI		
< 18.5	13	10.7
18.5-24.9	57	46.7
< 24.9	52	42.6
CD4 count		
< 100	11	9
101-200	16	13.1
201-350	23	18.9
< 350	72	59
Disease stage		
HIV	114	93.4
AIDS	8	6.6
Viral load		
< 100	78	63.9
100 and higher	44	36.1
Disease history		
Less than five years	37	30.3
5-10	37	30.3
10-15	20	16.4
15 and more	28	23.0

Overall, 64% of the patients presented inappropriate eating habits. The type of drink was appropriate in 73% of patients, 50.8% of people ate breakfast, and 82% of the food items

Table 2. Mean of anthropometric values in HIV/AIDS patients

Gender	BMI (kg/m²)	Middle arm circumference (cm)	Waist circumference (cm)	Total fat (%)	Muscle (%)	Stomach fat (%)	Hip circumference (cm)
Female	25	29	89	34	26	6	100
Male	22	26	82	17	38	5	94

Table 3. Dietary habits in HIV/AIDS patients

Variable	Appropriate habits		Inappropriate habits	
	n (%)	CI	*n* (%)	CI
Type of drink with food	89 (73.0)	64.8-80.3	33 (27.0)	19.7-35.2
Eating breakfast	62 (50.8)	42.6-60.7	60 (49.2)	39.3-57.4
Way of cooking foods	22 (18.0)	10.7-25.4	100 (82.0)	74.6-89.3
The type of oil used	61 (50.0)	41.0-59.0	61 (50.0)	41.0-59.0
Skinning chicken	38 (31.1)	23.0-38.5	84 (68.9)	61.5-77.0
Amount of fat in consumed dairy	27 (22.1)	14.8-29.5	95 (77.9)	70.5-85.2
Using salt	38 (31.1)	23.8-40.2	84 (68.9)	59.8-76.2
Cakes, cookies, and chips	13 (10.7)	6.2-18.0	109 (89.3)	82.0-93.8
Hamburgers, sausage, kielbasa, and pizza	46 (37.7)	29.5-46.7	76 (62.3)	54.1-70.5

were fried and grilled. Moreover, 50% of the participants used animal and solid oils, 68.9% have never skinned chicken, and 77.9% did not use high-fat and fat dairy products. Concerning application of salt, the results showed that 68.9% of the participants used salt at the table. Moreover, 89.3% of people consumed cakes, cookies, and chips, whereas 62.3% of people consumed sausage, kielbasa, and pizza (Table 3).

Examinations of the food groups between men and women showed that 68.8% of the participants did not consume or consumed less than one unit of fruit per day. Furthermore, 30.3% of the participants never consumed vegetables per day. The results showed that 0.8% of the patients did not use meat. Furthermore, 50.8% and 30% of the participants drank carbonated drinks 1-2 and 3-4 times a week, respectively. We found that 27% of the patients consumed 3 to 4 sugar balls, while 19.7% eat up 9 sugar balls and more per day. Among the food groups, only water consumption ($p = 0.05$) and carbonated drinks ($p = 0.034$) were significantly different between men and women (Table 4).

χ^2 test was applied to study the relationship between food groups and CD4 level. The findings showed a significant association between meat and legumes food group and CD4 level ($p = 0.047$) (Table 5).

Discussion

The findings of the study showed that only 36% of participated patients followed an appropriate diet. Among the food groups, only the meat and legumes group had a significant association with CD4 level, so that 75% of the partakers with CD4 of over 350 consumed meat, legumes, and eggs 4 to 5 times or more per week. Martinez *et al.* [17] investigated patients with cardiovascular diseases and diabetes. They found that 61% of patients followed a healthy diet. Furthermore, in a study by Nairi *et al.* [18], more than 50% of patients with stroke had a good diet. Given the present evidence, HIV-positive patients had poor nutrition, which could be due to the fact that HIV-positive patients suffer from high stigma and discrimination. Therefore, especial attention should be paid to the food reception and diet of HIV-positive patients.

In the present study, 42.6% of the patients were overweight or obese, but in Mirzaei *et al.* [19], the prevalence of overweight or obesity in HIV-positive adolescents was 10%. Tanzania [20] and Ethiopia [21] studies found that 14.9% and 17.6% of HIV-positive patients, respectively, were overweight or obese. Rapid urbanization, adoption of carbohydrate and fat diets, and sedentary lifestyle [22] exacerbate the consequences of this disease.

Anthropometric findings showed that weight, waist circumference, hip circumference, and arm circumference were significantly influenced by nutritional behaviors and physical activity. Moreover, body weight and circumference of individuals with regular physical activity and appropriate nutrition were significantly lower than others [23]. Results of our study showed that the rate of abdominal obesity was more than 0.85 cm in women and men. However, in the study by Azadbakht *et al.* [24], the abdominal obesity was less than 0.84 cm in both men and women. In the above-mentioned study, the sample size was 48, while 122 patients participated

Table 4. Frequency distribution of people based on the food groups and gender

Type of food consumed	Frequency of food intake	Male, *n* (%)	Female, *n* (%)	Total, *n* (%)	Test statistics *F*	*p*-value
Fruits (daily)	Never	24 (36.9)	13 (22.8)	37 (30.3)	3.03	0.38
	Less than 1 unit	23 (35.4)	24 (42.1)	47 (38.5)		
	1 unit	11 (16.9)	11 (19.3)	22 (18)		
	2-3 units	7 (10.8)	9 (15.8)	16 (13.1)		
Vegetables (daily)	Never	21 (32.3)	16 (28.1)	37 (30.3)	7.30	0.06
	Less than 1 unit	22 (33.8)	16 (28.1)	38 (31.1)		
	1 unit	10 (15.4)	20 (35.1)	30 (24.6)		
	2-3 units	12 (18.5)	5 (8.8)	17 (13.9)		
	1-2 glasses	18 (27.7)	21 (36.8)	39 (32)		
	3-4 glasses	33 (50.8)	27 (47.4)	60 (49.2)		
	5 times and higher	13 (20.0)	8 (14)	21 (17.2)		
Meat, eggs, and legumes (weekly)	Never	1 (1.5)	0 (0)	1 (0.8)	4.40	0.18
	1 time	12 (18.5)	17 (29.8)	29 (23.8)		
	2-3 times	41 (63.1)	27 (47.4)	68 (55.7)		
	4 times and more	11 (16.9)	13 (22.8)	24 (19.7)		
Water consumption (daily)	Never	2 (3.1)	1 (1.8)	3 (2.5)	8.80	0.05
	1-3 glasses	21 (32.3)	30 (52.6)	51 (41.8)		
	4-6 glasses	30 (46.2)	19 (33.3) 19	49 (40.2)		
	7 glasses and more	12 (18.4)	7 (12.3)	19 (15.6)		
Carbonated drinks (weekly)	Less than 1 time	12 (18.5)	11 (19.3)	23 (18.9)	9.60	0.03
	1-2 times	26 (40.0)	36 (63.2)	62 (50.8)		
	3-4 times	15 (23.1)	7 (12.3)	22 (18)		
	5 times and more	12 (18.4)	3 (5.3)	15 (12.3)		
Sugar consumption (daily)	Never	4 (6.2)	8 (14)	12 (9.8)	7.80	0.09
	1-2 average sized sugar balls	12 (18.5)	16 (28.1)	28 (23)		
	3-4 sugar balls	17 (26.2)	16 (28.1)	33 (27)		
	5-8 sugar balls	14 (21.5)	11 (19.3)	25 (20.5)		
	9 sugar balls and more	18 (27.7)	6 (10.5)	24 (19.7)		

in our research. Possibly, this larger sample size is one of the reasons for a discrepancy between the results. However, HIV-patients should be closely monitored for dietary habits and diversity. According to the dietary guidelines provided by Salvador's Ministry of Health and the World Health Organization for HIV patients, the results found in our study are very critical, because 76% of our patients consumed hamburgers, sausages, and kielbasa [25, 26]. Consistent with our results, Martinez *et al.* conducted a study on HIV-positive patients [18] and found that 84% of participants consumed sweet drinks, hamburger, sausage, and kielbasa. Deepika investigated HIV-positive patients and showed that although the knowledge level of participants was high with regard to appropriate nutrition, their nutritional performance and eating habits were poor [27]. On the contrary, Luara *et al.* [28] reported that a 20 to 59-year-old HIV-positive patients presented good eating habits. Family, cultural, and social influences are vital in shaping people's attitudes and beliefs, which affect individuals' interaction with their health behaviors [29].

With regard to the food groups studied in the present research, 30% and 38.5% of the patients did not or consumed less than one unit of fruit per day, respectively. However, Martín-Cañavate [25] reported that 61% of HIV-positive children and adolescents have eaten fruits daily. Discrepancy in the results can be due to the fact that Martín-Cañavate investigated younger people and conducted his study in a different geographical environment. In our study, the consumption of vegetables was also inappropriate among HIV-positive patients; 61% of them consumed less than one unit of vegetable and 30% did not eat vegetables. Similar to our study, Martín-Cañavate found that only 28%

Table 5. Frequency distribution of people based on meat, egg, and bean food group and CD4

Parameter		Meat, egg, and bean food group					*p*-value
		Never, *n* (%)	Once a week, *n* (%)	2-3 times a week, *n* (%)	4-5 times a week, *n* (%)	Total, *n* (%)	
Dependent variable CD4 level	< 100	1 (100)	1 (3.4)	7 (10.3)	2 (8.3)	11 (9) 11	0.047
	101-200	0 (0)	3 (10.3)	11 (16.2)	2 (8.3)	16 (13.1)	
	201-350	0 (0)	3 (10.3)	18 (26.5)	2 (8.3)	23 (18.9)	
	< 350	0 (0)	22 (75.9)	32 (47.1)	18 (75)	72 (59)	
	Total	1 (100)	29 (100)	68 (100)	24 (100)	122 (100)	

of HIV-positive patients consumed vegetables [25]. However, in the study by Mirzaei *et al*., 52.3% to 77.3% of healthy people aged 20-70 years used fruits and vegetables [19]. Studies among healthy people and patients showed that HIV and poverty were two major causes of poor consumption of fruits and vegetables. Numerous studies indicated that bone abnormalities, such as low bone density were particularly at a dire situation among HIV-positive patients, and played an important role in preventing dairy osteoporosis. Dairy consumption in the present study was 20% higher than that reported by other authors [30, 31]. Our findings revealed that patients over 20 years of age were more likely to consider dairy consumption, and geographic differences were among other causes of higher dairy consumption.

In the present study, sweet and carbonated drinks were consumed more than 5 times a week in 30% of the participants, but Martín-Cañavate reported that 84% of HIV-positive children and teenagers consumed sweet drinks and chocolate more than 3 times a day [25]. Low income was one of the reasons for lower consumption of sweet drinks. However, 67% of the participants consumed more than 4 sugar balls per day. This rate was also reported by Mirzaei *et al*., where 37.4% of healthy participants consumed 4 or more sugar balls per day [19]. In the present study, 68.9% of patients used saltshaker from the table, which increased the risk of cardiovascular diseases. Consistent with our research, a study on Mexican adolescents showed that sodium intake was high [32]. Poverty, lack of knowledge, and poor economic status of HIV patients can be mentioned as the causes of high salt intake. We found that more weekly intake of meat, legumes, and eggs increased the CD4 level up to above 350. The results reported by Hussen *et al*. and Engsig *et al*. [33, 34] were also in agreement with our study. However, these outcomes were not significant among the food groups in a study by Karimi *et al*. [24]. Application of a validated questionnaire among healthy individuals may not be valid for evaluation among HIV-positive patients. In addition, it can be estimated that increased protein intake is an effective factor in promoting CD4 in HIV-positive patients. The main limitations of this study: 1) data were collected at the time of sanctions against Iran and economic pressure reduced the purchasing power of patients; 2) the study was cross-sectional in nature; 3) self-report tools were used to collect data and the patients may not responded accurately.

Conclusions

The results of the present study showed that dietary habits in HIV-positive patients are of great concern. Inappropriate dietary habits in 64% and a prevalence of overweight and obesity in 42.6% of the patients indicate frequent consumption of high-fat foods and low intake of fruits and vegetables, which causes cardiovascular diseases, stroke, and digestive diseases. Consequently, more accurate and comprehensive nutritional assessments are required in HIV-positive patients, and better nutritional counseling should be provided by caregivers. Health caregivers should seriously follow-up the consumption of local dietary options and their preparation processes to ensure maximum micronutrient intake and appropriate eating habits among these patients.

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Conflict of interest

The authors declare no conflict of interest with respect to the research, authorship, and/or publication of this article.

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