Relationship between Undernutrition and Periodontal Diseases among a sample of Yemeni Population: A Cross-Sectional Study

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Abstract

Undernutrition is an inadequate supply of energy and nutrients. Periodontal diseases (PDs) are defined as a broad form of chronic inflammatory disease of the gingiva, bone and ligaments supporting the teeth. This study aimed to reveal the relationship between undernutrition, using body mass index (BMI) and serum albumin level (Alb), and PDs in a sample of Yemeni population. A cross-sectional study was conducted at dental teaching clinics at the Faculty of Dentistry, Sana'a University. Of the 1920 patients attended to clinics, only 229 matched the study criteria. Oral examination was performed to assess the periodontal clinical parameters measurements. BMI and Alb was measured. Participants of both genders were involved with slight increase in males (n = 134, 58.5%) and most of the study sample was at the age group of (18–35) (n = 209, 91.3%). Regarding to habits, only (n = 43, 18.2%) of patients were smokers and about half of participants (n = 136, 59.4%) were khat chewers. Most of cases had a mild undernutrition according to BMI (n = 139, 60.7%) and normal Alb level (n = 213, 93%). Regarding the periodontal diagnosis, most of the participants were diagnosed with gingivitis (n = 186, 81.2%). BMI and albumin level were non significantly associated with PDs. PDs were statistically significant with the participant's age, gender, level of education and smoking ($P \leq 0.05$). Whereas, BMI, khat chewing, and Albumin level were non-significant factors of periodontal diseases among Yemeni participants ($P > 0.05$). In both genders, variables such as age of the patients, smoking, khat chewing and PDs were non-significantly associated with BMI. This study showed that the majority of the participants had diagnosed with gingivitis but there was not an association between PDs and undernutrition

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Background

Human nutritional status is a prerequisite to maintain general health, including host recovery from different diseases. Undernutrition can be defined as a nutritional state resulting from a truly negative nutrient balance leading to a loss of body cell mass, including peripheral tissues (skeletal muscle, skin, adipose tissue), whereas malnutrition is often considered to consist of a combination of undernutrition and inflammatory activity. Malnutrition can cause an alteration in the body composition, function and clinical outcomes [1].

Periodontal diseases (PDs), including both gingivitis and periodontitis, are diseases induced by plaque and mainly affected by the immune and inflammatory response causing breakdown of tooth tissues [2]. Plaque is the main cause of PDs. Poor oral hygiene peoples with plaque deposition showed two-to-five-fold risk of periodontitis than good oral hygiene people [3].

There are multiple risk factors that play important roles in an individual's response to periodontal infection [4-5]. These risk factors can be classified as enviromental, behavioral or biological factors. Although the presence of these factors increases the rate of disease occurrence, their presence is not

necessarily causing the disease. Risk factors are of two types: modifable and non-modifable. The common modifiable factors are smoking [6-7], diabetes mellitus [8-12], microbiome [13-14], obesity [15-16], tobacco, betel nut chewing [17-18] and nutrition [19]. Whereas non-modifiable factors may include genetic factors [20], ageing [21], gender [22-23] and socioeconomic status (SES) [24].

Although oral microorganisms are responsible for the pathogenesis of PDs [25-26], nutritional status can affect the balance between oral microorganisms and the host response which is a trigger of PDs commencement and progression [26-28]. Undernutrition, specifically protein-calorie, showed a reduction in immune host resistance especially the cellular immunity that causes an impairment in infection resistance [29].

Body mass index (BMI) is the most commonly anthropometric method that is used as an indicator to assess the nutritional status in nutritional and epidemiological studies with or without other anthropometric methods to assess patients at nutritional risk [30]. According to World Health Organization (WHO), BMI interpretation is as following; underweight individual is who has a BMI <18.5 kg/m^3, while healthy individual has a BMI ranged between 18.5-24.9 kg/m^3. Moreover, an overweight individual is who has a BMI ranged between 25-29.9 kg/m^3, while obese individual has a BMI>30 kg/m^3 [31]. Underweight can be classified as following; mild undernutrition ranges from 17-18.5 kg/m^3, moderate undernntrition ranges from 16-16.9 kg/m^3 while severe underweight <16 kg/m^3 [32]. Moreover, serum albumin level (Alb) can be used for identifying the inflammatory response and participating in the diagnosis of nutrient deficiency [33]. According to recent studies, biomarkers can expect the presence of periodontal diseases. According to Zhang et al. 2021, the combination of IL-1β, ICTP, and Pg can be used to distinguish stage III periodontitis subjects from healthy subjects and gingivitis subjects [34]. Also, the combination of IL-1β and MMP-8 can be used to differentiate between gingivitis patients from healthy subjects [34]. Another study showed that periodontitis patients had higher serum and salivary NLRP3 concentrations in comparison to healthy controls which means that Periodontitis could be a significant predictor of both serum and salivary NLRP3 concentrations. [35]. In addition, another study demonstrated that periodontitis patients presented significant higher salivary IL-6 levels compared to healthy patients [36].

According to the World Food Program (WFP), recent survey showed that almost one third of families have gaps in their diets, and hardly ever consume foods like pulses, vegetables, fruit, dairy products or meat. Malnutrition rates among women and children in Yemen remain among the highest in the world, with 1.2 million pregnant or breastfeeding women and 2.3 million children under 5 requiring treatment for acute malnutrition [37]. up to our knowledge there is no study that showed the relationship between periodontal disease and undernutrition. For this reason, this study aimed to provide a current evidence about the prevalence of periodontal disease among undernutrition participants and analyze the association between PDs and undernutrition, using body mass index (BMI) and serum albumin level (Alb) in a sample of Yemeni population.

Materials And Methods

This descriptive cross-sectional study was designed following STROBE guidelines and conducted in adherence to the Declaration of Helsinki. Ethical approval of the Human Ethics Committee of the Medical Faculty and Health Sciences of Sana'a University, Yemen was obtained. This study was conducted during the period from October 2018 to November 2019. Of 1290 patients attended the postgraduate dental teaching clinics at the Faculty of Dentistry, Sana'a University, Yemen, only 229 of patients matched the inclusion criteria. The inclusion criteria were determined as following; undernourished patients with BMI < 18.5 kg/m^3 (mild undernutrition 17-18.5 kg/m^3, moderate undernntrition16-16.9 kg/m^3, severe underweight <16 kg/m^3), both genders and their ages from 18-45 year-old and free of systemic diseases. Exclusion criteria were as follows: people who has healthy weight or overweight or obesity, people who are older than 45 year-old or younger than 18 year-old or had systemic diseases or pregnant and lactating women. Written informed consents were distributed to participants.

Sociodemographic data were collected through interviewing participants including: age, gender, occupation, educational level, teeth cleaning frequency, smoking and khat chewing. Oral examination was performed on the dental chair by using a sterile dental mirrors and Williams' probes by a single calibrated examiner (MA). Assessment of periodontal clinical parameters measurements were done including plaque index (PI), gingival index (GI), gingival recession (GR), probing pocket depth (PD) and clinical attachment loss (CAL). Kappa scores higher than 0.9 were attained for intra-examiner calibration exercises for identifying periodontal clinical parameters.

The undernourished patients' weights were measured in Kilograms by using a mechanical scale while participants wore light clothes and without shoes. Moreover, the height of the participants was measured in Centimeters by using a measuring tape while a hard ruler was positioned horizontally over the head of the participant to ensure a stable base. BMI was calculated by using the following formula: BMI=weight (Kg)/height (m²). Blood samples were taken from each participant by a laboratory technician on the day of evaluation; samples were placed in special container then sent to the laboratory to measure Alb level. Standard Alb is from 3.5 to 5.5 gram per deciliter (g/dl).

Data Analysis was undertaken using the Statistical Package for Social Science (SPSS) (Version 23.0). Several statistical tests were used as descriptive Statistics using frequencies and percentages to present the sociodemographic data, habits and other diagnostic variables as IBM, Albumin level, and periodontal diseases. Categorical variables was assessed using Chi square test. Furthermore, Fisher Exact test was used when the assumptions of Chi square test couldn't not be met. Ordinal logistic regression model was used to identify the predictors for periodontal disease in the undernutrition young adult participants by finding the association between periodontal diseases and IBM, Albumin level, age, gender, level of education, khat chewing and smoking. A P-value of less than 0.05 was considered statistically significant.

Results

A convince sample of undernourished participants (n=229) were enrolled from the dental teaching clinics at the Faculty of Dentistry, Sana'a University between October 2018 to November, 2019. Participants of both genders were involved in the study with slight increase in males' numbers (n=134, 58.5%) and most of the study sample was at the age group of (18-35) (n=209, 91.3%). Regarding to habits, only (n=43, 18.2%) of patients were smokers and about half of participants (n=136, 59.4%) were khat chewers. Demographic data of the study subjects is shown in table (1).

The presented study showed that most of cases had a mild undernutrition according to BMI (n=139, 60.7%) and normal Alb level (n=213, 93%). Regarding the periodontal diagnosis, most of the participants were diagnosed with gingivitis (n=186, 81.2%), as shown in table (2).

The bivariate results of the ordinal logistic regression showed that PDs were statistically significant with the participant's age, gender, level of education and smoking ($P \leq 0.05$). Whereas, BMI, khat chewing, and Albumin level were non-significant factors of periodontal diseases among Yemeni participants ($P > 0.05$), as shown in table (3).

In both gender, variables such as age of the patients, smoking, khat chewing and PDs were non-significantly associated with BMI, as presented in table (4).

Table (1). Sociodemographic characteristics of the study sample.

Variables		Frequency	%
Age	18-35	209	91.3%
	35-45	20	8.7%
Gender	Male	134	58.5%
	Female	95	41.5%
Occupation	Student	138	60.3%
	House wife	32	14.0%
	Retired	0	0.0%
	Farmer	0	0.0%
	Teacher	1	0.4%
	Doctor	0	0.0%
	Merchant	0	0.0%
	Livestock breeder	0	0.0%
	Craftsman	2	0.9%
	Others	41	17.9%
	Cannot find a job	15	6.6%
Education Level	Not educated	45	19.7%
	Elementary	13	5.7%
	Secondary	50	21.8%
	Diploma	7	3.1%
	Bachelor	114	49.8%
	Master	0	0.0%
Smoking	No	186	81.2%
	Yes	43	18.8%
Khat Chewing	No	93	40.6%
	Yes	136	59.4%

Table (2). BMI, Albumin level, and periodontal diagnosis of the study sample.

Variables		Frequency	%
BMI	Mild underweight	139	60.7%
	Moderate underweight	59	25.8%
	Severe underweight	31	13.5%
Albumin level	Normal	213	93.0%
	Low	16	7.0%
Diagnosis	Healthy	9	3.9%
	Gingivitis	186	81.2%
	Chronic periodontitis	32	14.0%
	Aggressive periodontitis	2	0.9%

Table (3) : Association between periodontal diseases and age, gender, level of education, smoking, khat chewing, BMI and albumin level.

The variables		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Dependent variable	Gingivitis	-3.80	1.41	7.24	1	0.01	-6.56	-1.03
	Chronic periodontitis	2.30	1.32	3.04	1	0.08	-0.29	4.89
	Aggressive periodontitis	5.73	1.55	13.76	1	0.00	2.70	8.76
Independent variables	Age	1.41	0.56	6.30	1	0.01	0.31	2.50
	Gender	-1.13	0.46	6.09	1	0.01	-2.03	-0.23
	Level of education	-0.36	0.13	7.56	1	0.01	-0.61	-0.10
	Smoking	1.11	0.49	5.18	1	0.02	0.15	2.06
	khat chewing	0.41	0.51	0.64	1	0.42	-0.59	1.40
	Albumin level	0.07	0.57	0.02	1	0.90	-1.04	1.18
	BMI	0.30	0.25	1.48	1	0.22	-0.18	0.79

Table (4). Distribution of body mass index with age, smoking, khat chewing, and PDs categorized by gender.

Variables			BMI						P-value
			Mild		Moderate		Severe		
			N	%	N	%	N	%	
Male	**Age**	18-35	79	90.8%	28	93.3%	15	88.2%	0.814
		35-50	8	9.2%	2	6.7%	2	11.8%	
	Smoking	No	71	81.6%	24	80.0%	11	64.7%	0.303
		Yes	16	18.4%	6	20.0%	6	35.3%	
	khat Chewing	No	19	21.8%	5	16.7%	3	17.6%	0.855
		Yes	68	78.2%	25	83.3%	14	82.4%	
	Periodontal Disease Diagnosis	Healthy	0	0.0%	0	0.0%	0	0.0%	0.205
		Gingivitis	74	85.1%	26	86.7%	11	64.7%	
		Chronic Periodontitis	11	12.6%	4	13.3%	6	35.3%	
		Aggressive Periodontitis	2	2.3%	0	0.0%	0	0.0%	
Female	**Age**	18-35	50	96.2%	26	89.7%	11	78.6%	0.062
		35-50	2	3.8%	3	10.3%	3	21.4%	
	Smoking	No	44	84.6%	25	86.2%	11	78.6%	0.854
		Yes	8	15.4%	4	13.8%	3	21.4%	
	khat Chewing	No	36	69.2%	21	72.4%	9	64.3%	0.824
		Yes	16	30.8%	8	27.6%	5	35.7%	
	Periodontal Disease Diagnosis	Healthy	5	9.6%	3	10.3%	1	7.1%	0.327
		Gingivitis	43	82.7%	23	79.3%	9	64.3%	
		Chronic Periodontitis	4	7.7%	3	10.3%	4	28.6%	
		Aggressive Periodontitis	0	0.0%	0	0.0%	0	0.0%	
Chi Square test, Fisher-Exact Test.									

Discussion

This study aimed to assess the prevalence of periodontal disease among undernutrition participants and analyze the association between PDs and undernutrition, using body mass index (BMI) and serum albumin level (Alb) in a sample of Yemeni population. The presented study showed that most of cases had a mild undernutrition according to BMI (n=139, 60.7%) and normal Alb level (n=213, 93%).
The results showed that there were a non-statistically significant association between PDs and undernutrition participants ($P \leq 0.05$). Gingivitis was diagnosed in (n=186, 81.2%) of study participants.

BMI is the most common non-invasive tests to assess malnutrition [38]. Moreover, Alb is a well-known marker of nutritional status [39]**.** The use of biomarkers showed a valuable results in many recent stuides that showed a relation between the level of biomrakers and diagnosis of periodontal diseases [33-36].

Low BMI and Alb in both genders were not significantly associated with PDs. Severe undernutrition has massive effects on the immune system which plays a role in progression of immunodeficiency [40] and the pathogenesis of periodontitis is significantly related to the host response in association with microbial factors [29,41-43]. Cytokines are chemical mediators of inflammatory response that influenced by nutritional status [44] so people with severe undernutrition are more susceptible to many microbial opportunistic infections [44]. In addition, literature showed a positive correlation between hypoalbuminemia and periodontitis [46]. However, hypoalbuminemia requires a more destructive inflammation and severe undernutrition to occur [47]. Therefore, this may explain the non-significant relation between low BMI and Alb with PDs.

The presented study showed that most of participants are between late adolescence and early adult with slight increase in male numbers that have PDs which was similar to Degarage et al., 2015 [48]. This can be explained by the neglect behavior and the inability of males to take care of themselves specially those who are studying away from their families and cannot cook food. Another explanation is poor oral hygiene. This can be due to the masculinity behavior of thinking that oral hygiene is not connected to men strength [49]. Regarding the occupation, most of participants were students (60.3%) and most of their education level was bachelor degree (49.8%). In this study, age, gender, education level and smoking were significantly associated with PDs ($P \leq 0.05$). Smoking is considered as one of the most significant life style factors that is associated or linked to PDs and considered as a detrimental factor that influence the occurrence and progression of periodontitis [50-51]. There is a high prevalence of khat chewing in Yemen 43.27% [52]. Khat chewing habit is usually associated with the development of other habits like cigarette smoking [53-54]. Khat chewing, which is a common practice among high schools, colleges and university students, is considered as a mild stimulant that promote energy during working or studying [55]. Khat chewing can raise the concentration and energy levels at the beginning and it can cause obvious CNS symptoms such as loss of appetite (anorexia) and may be associated with the mixed effect of the central amphetamine-like delaying of gastric empty and insomnia that leads to late waking up in the morning and a reduced activity performance caused by the central release of noradrenergic neurotransmitters [56-58]. Moreover, cathinone promotes or elevates the sympathomimetic activity that results in a late discharge of food from stomach [59]. This may explain why khat chewing can lead to malnutrition. Most of the study sample age was from 18-35 while chronic periodontitis is presented in the older age [60] and people of age 40 and above who were four times more probably to have periodontitis than younger ages [61].

Limitation of this study was the difficulty in convincing patients to participate in the study due to lack of education. Recommendation a further study in the future can be done with increasing sample number.

Conclusions

Within the limitations of this study, most of the participants were diagnosed with gingivitis. Undernutrition is one of the health problems in Yemen society. However, after using BMI and measuring Albumin level, it has been found that there was no association between PDs and undernutrition.

Declarations

Data availability

Data can be accessible to the interested researchers by the corresponding authors on reasonable request

Conflicts of Interest

Authors declare that they have no conflicts of interest.

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