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. (58.5%) of participants were males and most of the study sample (91.3%) was at the age group of (18–35). Regarding to habits, only (18.2%) of patients were smokers and more than half of participants (59.4%) were khat chewers. Among all participants, (81.2%) of cases were diagnosed with gingivitis. (60.7%) of study participants were mildly undernourished according to BMI. (93%) of participants showed normal Alb level. BMI and albumin level were non significantly associated with PDs. Mild malnutrition was the most frequent category in the patients diagnosed with gingivitis. In conclusion, There was a relationship between PDs and undernutrition which was clearly seen between mild undernutrition and gingivitis.

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]. Moreover, serum albumin level (Alb) can be used for identifying the inflammatory response and participating in the diagnosis of nutrient deficiency [31].

The aims of this study were to provide a current evidence about the relationship between undernutrition, using BMI and Alb, and PDs in a sample of Yemeni population.

Materials And Methods

This 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. The 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 which was undernourished patients with BMI < 18.5. Exclusion criteria were as follows: people who are older than 45 year-old or younger than 18 or had systemic diseases or pregnant and lactating women. Written informed consents were distributed to participants.

Sociodemographic data were collected through an interview 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 (m^2). 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).

A power calculation was used to determine the minimum sample size required to establish significance. Sample size was calculated by using OpenEpi Info software, version 3, with confidence level 95% and an estimated error 5%. Data Analysis was undertaken using the Statistical Package for Social Science

(SPSS version 21). Statistical analysis was used to present the demographic data of the study sample and diagnostic variables (IBM, Albumin level, and periodontal diseases) by frequencies and percentages. Association between categorical variables was assessed using Chi square test. Furthermore, Fisher Exact test was used when the assumptions of Chi square test couldn't not meet. Analysis of variance test (ANOVA) was used to assess the difference in the mean values of the quantitative outcomes (CAL). Chi square test was used to evaluate the association between BMI and age, gender, occupation, education level, smoking, khat chewing, as well as BMI with PDs. The significant level was set at $P < 0.05$. Figures (Bar charts) were used to present the descriptive data graphically.

Results

1290 patients attended the postgraduate dental teaching clinics at the faculty of dentistry, Sana'a University, Yemen; however, only 229 of patients matched the study's inclusion criteria. (58.5%) of the sample were males. Moreover, the majority of the sample (91.3%) was at the age group of (18–35). Most of the participants (60.3%) were students; furthermore, most of the sample's education level was bachelor degree (49.8%). Only (18.2%) of patients were smokers and more than half of the participants (59.4%) were Khat chewers. demographic data of the study subjects is shown in table (1).

The present study showed that most of cases had a mild undernutrition (60.7%) and normal albumin level (93%). Regarding the periodontal diagnosis, most of the patients were diagnosed with gingivitis (81.2%), as shown in table (2).

In males group, age, level of education and smoking were significantly associated with PDs ($P \leq 0.001$). Whereas, BMI, Albumin level and khat chewing were non-significant factors of PDs ($P > 0.001$). While in females group, age, level of education, smoking and khat chewing were significantly associated with PDs ($P \leq 0.001$). In contrast, BMI and albumin level were non-significantly associated with the PDs ($P > 0.001$), as shown in table (3).

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

Mild malnutrition was the most frequent category in the patients diagnosed with gingivitis. On the other hand, mild malnutrition was the least frequent category in patients diagnosed with aggressive periodontitis, as shown in figure (1).

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

Variables		Frequency	%
Age	18–35	209	91.3%
	35–50	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. Distribution of periodontal disease diagnosis and age, education level, smoking, khat chewing, albumin level and BMI categorized by gender.

Variables		Gender																
		Males									Females							
		Periodontal Disease Diagnosis																
		Healthy n= (0)		Gingivitis n= (111)		Chronic periodontitis n= (21)		Aggressive periodontitis n= (2)			Healthy n= (9)		Gingivitis (n = 75)		Chronic periodontitis (n = 11)		Aggressive periodontitis (n = 0)	
		F	%	F	%	F	%	F	%	P – value	F	%	F	%	F	%	F	%
Age	18–35	0	0.0%	106	95.50	15	71.43	1	50.0	.001*	9	100.0	71	94.7	7	63.6	0	0.0%
	35–50	0	0.0%	5	41.7%	6	52.38	1	100.0		0	55.6	4	5.3	4	36.4	0	0.0%
Education Level	Not educated	0	0.0%	17	15.32	9	42.86	0	0.0	.004*	1	11.1	9	12.0	9	81.8	0	0.0%
	Elementary	0	0.0%	2	1.80	2	9.52	0	0.0		0	0.0	8	10.7	1	9.1	0	0.0%
	Secondary	0	0.0%	25	22.52	4	19.05	0	0.0		1	11.1	20	26.7	0	0.0	0	0.0%
	Diploma	0	0.0%	3	2.70	0	0.00	1	50.0		0	0.0	3	4.0	0	0.0	0	0.0%
	Bachelor	0	0.0%	64	57.66	6	28.57	1	50.0		7	77.8	35	46.7	1	9.1	0	0.0%
	Master	0	0.0%	0	0.00	0	0.00	0	0.0		0	0.0	0	0.0	0	0.0	0	0.0%
Smoking	No	0	0.0%	94	84.68	11	52.38	1	50.0	.002*	9	100.0	66	88.0	5	45.5	0	0.0%
	Yes	0	0.0%	17	15.32	10	47.62	1	50.0		0	0.0	9	12.0	6	54.5	0	0.0%
Khat Chewing	No	0	0.0%	21	18.92	6	28.57	0	0.0	.603	9	100.0	55	73.3	2	18.2	0	0.0%
	Yes	0	0.0%	90	81.08	15	71.43	2	100.0		0	0.0	20	26.7	9	81.8	0	0.0%
Albumin Level	Normal	0	0.0%	106	95.50	19	90.48	1	50.0	.058	9	100.0	68	90.7	10	90.9	0	0.0%
	Low	0	0.0%	5	4.50	2	9.52	1	50.0		0	0.0	7	9.3	1	9.1	0	0.0%
BMI	Mild	0	0.0%	74	66.67	11	52.38	2	100.0	.205	5	55.6	43	57.3	4	36.4	0	0.0%
	Moderate	0	0.0%	26	23.42	4	19.05	0	0.0		3	33.3	23	30.7	3	27.3	0	0.0%
	Severe	0	0.0%	11	9.91	6	28.57	0	0.0		1	11.1	9	12.0	4	36.4	0	0.0%

Chi Square Test; Fisher-Exact Test. * significant differences

Table (4). Distribution of body mass index and age, smoking, khat chewing, and periodontitis 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 evaluate the relationship between undernutrition and PDs in a sample of Yemeni population. The results showed that there were a non-statistical significant association between PDs and undernutrition participants. Mild undernutrition was found in (60.7%) of study participants and gingivitis was diagnosed in (81.2%) of study participants. This association can be explained as the mild undernutrition can affect the immune response which subsequently affecting the gingival health.

BMI is the most common non-invasive tests to assess malnutrition [32]. Moreover, Alb is a well-known marker of nutritional status [33]. 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 [34] and the pathogenesis of periodontitis is significantly related to the host response in association with microbial factors [29, 35–37]. Cytokines are chemical mediators of inflammatory response that influenced by nutritional status [38] so people with severe undernutrition are more susceptible to many microbial opportunistic infections [39]. In addition, literature showed a positive correlation between hypoalbuminemia and periodontitis [40]. However, hypoalbuminemia requires a more destructive inflammation and severe undernutrition to occur [41]. 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 which was similar to Degarage et al., 2015 [42]. 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. Regarding the occupation, most of participants were students (60.3%) and most of their education level was bachelor degree (49.8%). Among males group, age, education level and smoking were significantly associated with PDs ($P \leq 0.001$). There is a high prevalence of khat chewing in Yemen 43.27% [43]. Khat chewing habits promote the development of other habits like cigarette smoking [44–45]. 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 [46–47]. Chewing khat, 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 [48]. Khat chewing can raise concentration and energy levels at the beginning but 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 [49–51]. Moreover, cathinone promotes or elevates the sympathomimetic activity that results in a late discharge of food from

stomach [52]. This may explain why khat chewing can lead to malnutrition. Another risk factor of gingivitis among males is poor oral hygiene. This can be due to the masculinity behavior of thinking that oral hygiene is not connected to men strength [53]. Most of the study sample age was from 18–35 while chronic periodontitis presented in the older age [54] and people of age 40 and above who were four times more probably to have periodontitis than younger ages [55]. This may explain why the majority of the sample was diagnosed with gingivitis.

Among females group; age, level of education, smoking and khat chewing were significantly associated with the PDs ($P \leq 0.001$) due to the previous reasons that explained in males group.

Conclusions

There was a relationship between PDs and undernutrition which was clearly seen between mild undernutrition and gingivitis.

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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Figures

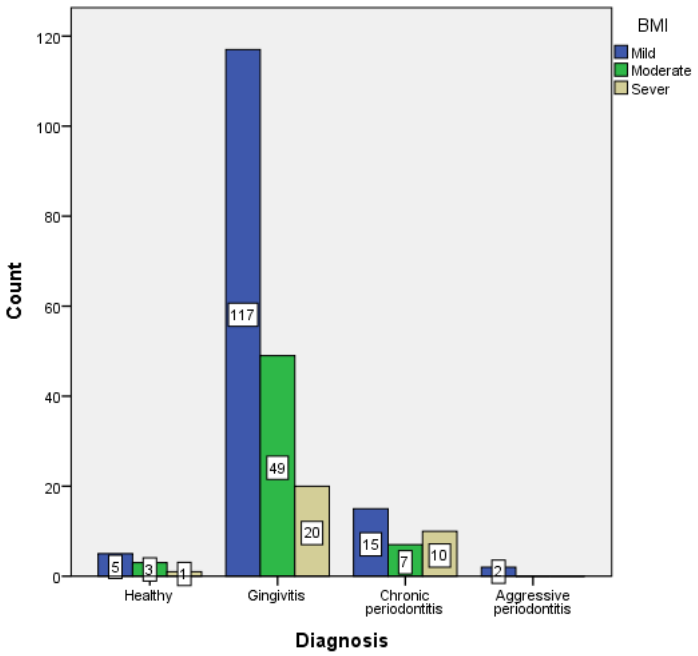

Figure 1

Distribution of undernutrition patients with periodontal disease.