

Relationship Between Undernutrition and Periodontal Diseases Among Yemen Population: a Cross-sectional Study

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Abstract

Background: Undernutrition is an inadequate supply of energy and nutrients. Periodontal diseases (PDs) defined as a broad form of chronic inflammatory diseases of the gingiva, bone and ligaments supporting the teeth. This study aimed to reveal the effect of undernutrition, using body mass index (BMI) and serum albumin level (Alb) on PDs and other risk factors as age, smoking and khat chewing.

Methods: This was a cross-sectional study conducted at the faculty of dentistry, Sana'a University. Of 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. Statistical analysis was used to present the association between categorical variables was assessed using Chi square test and Fisher-Exact test. ANOVA was used to assess the differences in the mean values of the quantitative outcomes. 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.

Results: Most of participants (58.5%) were males and most of the study sample (91.3%) was at the age group of (18-35). Among all subjects, (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. Regarding to habits, only (18.2%) of patients were smokers and more than half of participants (59.4%) were khat chewers.

Conclusion: There was a relationship between PDs and undernutrition which was obviously seen between gingivitis and mild undernutrition.

Background:

Malnutrition is considered as a state of nutritional disorder that can be caused by a conjunction of inflammation and nutritional imbalance. The deficiency of energy, protein and other nutrients is called a negative nutrient balance that leads to undernutrition. While the excessive intake of food is called positive nutrient balance that leads to overnutrition. 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 reply causing breakdown of tissues enclosing and uploading the teeth [2]. PDs are caused by the imbalance between environmental factors, systemic conditions and host defense [3]. Moreover, the main cause of PDs is the poor oral hygiene that initiates disposition of dental plaque, comprising microorganisms, which increase the risk of periodontitis nearly two-to-five fold in contrast to good oral hygiene [4].

There are multiple risk factors that play important roles in an individual's response to periodontal infection [5-6]. These risk factors can be defined as environmental, behavioral or biological factors. Moreover, the presence of these factors increases the rate of disease occurrence but not necessarily causing the disease. Risk factors are of two types: modifiable and non-modifiable. The common modifiable factors are smoking [7-8], diabetes mellitus [9-13], microbiome [14-15], obesity [16-17], tobacco, betel nut chewing [18-19] and nutrition [20]. Whereas the non-modifiable factors may include genetic factors [21], ageing [22], gender [23-24] and socioeconomic status (SES) [25].

Although oral microorganisms are responsible for the pathogenesis of PDs [26-27], nutritional status can affect the balance between oral microorganism and the host response which is a trigger of PDs commencement and progression [27-29]. Undernutrition, specifically the protein-calorie, shows a reduction in immune host resistance specially the cellular immunity that causes an impairment in resistance to infection [30].

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 [31]. Moreover, serum albumin level (Alb) can be used for identifying the inflammatory response and participating in the diagnosis of malnutrition [32].

The aims of this study were to provide a current evidence about the association between undernutrition and PDs and the relationship between undernutrition and other risk factors as age, smoking and khat chewing.

Methods:

Study subjects:

This cross-sectional study was conducted in Yemen, Sana'a. written informed consents were distributed to participants. Of 1290 patients who attended clinics of Oral Medicine, Oral Diagnosis and Periodontology department, faculty of dentistry, Sana'a University, Yemen, only 229 of patients matched the study criteria which includes undernourished patients with BMI < 18.5. Patients were collected randomly during the period from October 2018 to November 2019. Patients with systemic diseases, pregnant and lactating women and patients older than 45 years were excluded.

Baseline characteristics and data collection:

This study was 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. Sociodemographic data was collected through an interview including: age, gender, occupation, education 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 both inter- and 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: $BMI = \text{weight (Kg)} / \text{height (m}^2\text{)}$. 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).

Statistical analysis:

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 16). 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 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:

Of 1920 patients who attended oral medicine, diagnosis and periodontology clinic, Sana'a University, only 229 patients matched with the study criteria.

Most of the sample (58.5%) 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 subject 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 ($P=0.001$, $P=0.004$, $P=0.002$, respectively). Whereas, BMI, Albumin level and khat chewing were non-significant factors of PDs ($P=0.205$, $P=0.058$, $P=0.603$; respectively). While in females group, age, level of education, smoking and khat chewing were significantly associated with PDs ($P=0.014$, $P=0.000$, $P=0.002$, and $P=0.000$, respectively). In contrast, BMI and albumin level were non-significantly associated with the PDs ($P=0.327$, $P=1.000$), 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).

Discussion:

This study aimed to evaluate the association between PDs and undernutrition in Yemeni population and the correlation between undernutrition and other risk factors including age, gender, level of education and habits as smoking and khat chewing.

The results showed that there were non-statistically 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 may reveal that the reason of gingivitis presence in most of the study sample was the presence of mild undernutrition that may cause a little effect on the immune response.

BMI is the most common non-invasive tests to assess malnutrition [33]. Alb is also a well-known marker of nutritional status [34]. Low BMI and Alb in both genders were not significantly associated with PDs. The literature has reported that the severity of undernutrition has massive effects on the immune system which plays a role in progression of immunodeficiency [35]. There are many studies which clarified that the pathogenesis of periodontitis is significantly related to the host response with microbial factors [30, 36-38]. The Cytokines, which are chemical mediators of inflammatory response, can be influenced by nutrition as a related factor [39]. People with severe undernutrition are more susceptible to many microbial opportunistic infections [40]. Therefore, this may clarify why low BMI and Alb is not significantly associated with PDs as most of the participants were in a mild undernutrition conditions.

Rodrigues et al., (2014) [41] published a positive correlation between hypoalbuminemia and periodontitis. A meta-analysis of 63 studies (2125 patients) discussed the effect of starvation on Alb and notified that the level of Alb remains normal before the patients reach the ultimate stage of starvation where undernutrition became physically evident [42]. In other words, hypoalbuminemia requires a more destructive inflammation and severe undernutrition to occur. Therefore, this may explain the non-significant relation between low BMI and Alb with PDs.

The present study showed that most of participants are between late adolescence and early adult and the majority of the samples were males (58.5%) similar to Degarage et al., 2015 [43]. 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 ($P=0.001$, $P=0.004$, $P=0.002$; respectively). There is a high prevalence of khat chewing in Yemen 43.27% [44]. Khat chewing habits promote the development of other habits like cigarette

smoking [45-46]. Smoking is considered as one of the most or significant life style factors that is associated or linked to PDs. It is considered as a detrimental factor that influence the occurrence and progression of periodontitis [47-48]. This can be explained by the Yemeni society lifestyle of chewing khat which is a common practice among high schools, colleges and university students, since it is considered as a mild stimulant that promote energy during working or studying [49]. Most chewers get a good degree of concentration and raise energy levels and awareness, promote imaginative ability and capacity to incorporate ideas, and enhance the ability to communicate especially among Yemeni males [50]. khat chewing caused obvious CNS symptoms such as loss of appetite (anorexia) and may be associated with the mixed effect of the central amphetamine-like with 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 [51-52]. Moreover, cathinone promotes or elevates the sympathomimetic activity that results in a late discharge of food from stomach [53]. This may explain why khat chewing can lead to malnutrition.

Poor oral hygiene among males is another risk factor of gingivitis. This can be due to the masculinity behavior of thinking that oral hygiene is not connected to men strength [54]. In contrast, chronic periodontitis presented in the older age [55] and persons of age 40 and above were four times more probably to have periodontitis than younger ages [56]. 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 ($P=0.014$, $P=0.000$, $P=0.002$, $P=0.000$; respectively) due to the previous reasons that explained in males group.

Limitation was the lack of knowledge of patient about the importance of BMI and Alb in diagnosing undernutrition which was an obstacle during conducting sample.

Conclusions:

In conclusion, the relationship between PDs and undernutrition was proven between gingivitis and mild undernutrition. There was a slight relationship between periodontitis and mild undernutrition. Khat chewing habit showed to be the most probable cause of undernutrition in Yemen.

Abbreviation:

PDs: periodontal diseases; BMI: body mass index; Alb: albumin serum level; PI: plaque index; GI: gingival index; GR: gingival recession; PD: pocket depth; CAL: clinical attachment loss

Declarations:

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Author's contribution

MA and MA conceived and designed the study, analyzed the data and drafted the manuscript. SA contributed to drafting the manuscript. All authors have read, reviewed and approved the manuscript.

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Availability of data and materials

The datasets generated during and/or analyzed during the current study are not publicly available due to ethical reasons, but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by Ethical approval of the Human Ethics Committee of the medical faculty and health sciences of Sana'a University, Yemen was obtained. All subjects in this study provided written informed consent to participate.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Tables:

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 characteristics of the study sample.

Variables		Frequency	%
BMI	Mild	139	60.7%
	Moderate	59	25.8%
	Sever	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

The correlation of study variables with PDs in males and females groups

Variables		Gender																
		Males								Females								
		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

The correlation between BMI with age, smoking, khat chewing and PDs among males and females.

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%	
	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%	
	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.

Figures

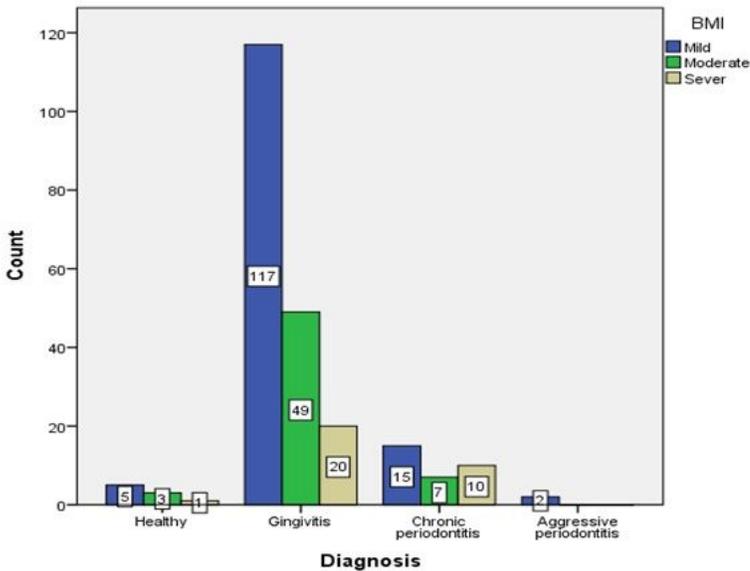


Figure 1

Distribution of undernutrition patients with periodontal disease.