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Original Research Article

Assessment of body mass index and oral health status of school teachers in Dharamshala city, Himachal Pradesh: a cross-sectional study

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ABSTRACT

Background: The aim of the study was to assess body mass index (BMI) and oral health status of school teachers in Dharamshala city, Himachal Pradesh.
Methods: The cross-sectional study design with stratified random sampling was used. The data was collected through interview and recorded on a structured WHO proforma.
Results: The mean BMI of the population in the study was 23.33±3.20. The 545 (68.1%) school teachers had normal BMI, followed by 185 (23.1%) were overweight, 43 (5.4%) were underweight and 27 (3.4%) were obese respectively. The mean total decayed teeth and mean total decayed surfaces were higher in underweight school teachers and the difference was statistically significant. The underweight school teachers (1.51), normal BMI school teachers (1.35) and overweight school teachers (1.33) had higher odds for pocket depth of 4-5 mm (Score 1) than obese school teachers. Similarly, underweight school teachers had higher odds ratio of 2.28 (CI 1.43-3.65) for loss of attachment (LOA) for score 1 (4-5 mm) than obese school teachers.
Conclusions: The study found a very weak association of BMI with both periodontitis and dental caries. There was an increase of 7.1% in total decayed teeth and LOA of score 1 (4-5 mm) per sextant in index tooth 26/27 in the given age group of 41-50 years for each 1 kg/m^2 increase in BMI among the teachers though with a very weak effect size. Further, the study found that under-nutrition as the risk marker for the periodontal pocket and LOA.

Keywords: Body mass index, Oral health status, WHO oral assessment for adults (2013)

INTRODUCTION

Obesity is one of the biggest challenges due to its association with various systemic metabolic diseases. Lack of physical activity, increase in urbanization, and change in the dietary habits of food consumption are the major contributor to obesity, both in the developed and developing countries.[1] Body mass index (BMI) is a simple measure of body fat and the normal value ranges from 20-25 kg/m^2.

Ekuni et al study found an association between high BMI and high risk of periodontal disease.[2] There is an inverse relationship between high protein intake and periodontitis.[3]

Studies have reported, an increased risk of periodontitis for each increase in 1 kg/m^2 of BMI.[2,4,5] Further, some independent association of eating speed, number of missing functional teeth have also been found with BMI.[6,7] Larvin et al recently reported that obesity was associated with higher hospitalization and mortality rate in COVID and periodontal disease may exacerbate this impact.[8] The association of BMI with dental caries has not been consistent. Hamasha et al reported that BMI was more associated with DMFT in the presence of low education,

swollen gums, smoking and presence of systemic diseases.[9]

The food choices and preferences of the child are well correlated to unhealthy eating habits. The promotion of healthy eating practices in class rooms is influenced by teachers own self-perception and many studies do report of this lack of awareness among teachers influencing children's eating style and behavior associated with oral health.[10-12] Parker et al reported that for every one-unit increase in healthy eating practices, there was a significant improvement of 0.20 in nutrition score.[13] The need for the present study is based on limited studies on the present topic in our region. Further, the recent inclusion of Dharamshala city as smart city, which could provide baseline information of changing trends of health indicator in the present as well in the future.

The aim of the study was to assess the BMI and oral health status among teachers in Dharamshala city, Himachal Pradesh, India.

METHODS

Study design

This descriptive cross-sectional study was conducted among school teachers in Dharamshala city, Himachal Pradesh-India.

Study setting

Data regarding general information were age, gender, school type, socio-economic state (based on BG Prasad), oral health practices, were obtained through interview and type III examination was done recorded on a structured proforma adapted from WHO oral assessment for adult, 2013 (by tooth surface) form.[14]

Anthropometric parameters like height and body weight were measured to assess BMI. The height of the participants was measured in centimeters on the wall mounted height measuring scale. The vertical measurement was determined using a hard ruler placed horizontally at the level of top of the head with the participant standing straight on stable base with no shoes. A standardized weighing machine (Suvarna, ISO 9001-2008 and ISO 14001-2004, capacity 180 kg) was used to measure the weight in kg. The weights were measured with light clothing without shoes. The weight and height of participants were measured to the nearest 0.5 kg and 0.5 cm value for each participant. BMI was calculated using the Quetelet's formula

$$BMI = \frac{Weigh\ (kg)}{(Height)^2\ (m)^2}$$

BMI scores was categorized as underweight when score is less than 18.5, normal (18.5-24), Overweight (25-29.99) and obese (≥30.00).[15]

Ethical consideration

The ethical approval to conduct the study was obtained from the Institutional Ethical Committee of Tertiary institute in Himachal Pradesh. The necessary permission to visit the schools was obtained from the concerned authority and written informed consent was obtained from the subjects which was voluntary and anonymous. The study was conducted in accordance with the ethical standard given by 1964 Declaration of Helsinki, as revised in 2013.

Participants

The inclusion criteria were those present on the day of visit and were willing to participate in the study. Exclusion criteria were any medical condition affecting oral status and those not willing to participate in the study.

Study size

The sample size was calculated using the formula

$$N = \frac{z^2 pd}{d^2}$$

Considering conservative approach of p=50% and a sample size of 768 (384 each) was obtained. A sample size of 800 was selected to compensate for any kind permissible error, non-response of participant and to enhance the accuracy of the study. The subjects were be enrolled into the study using two stage stratified random sampling with proportionate allocation of government and private schools with further stratification into elementary and secondary group of teachers.

Statistical method

All the collected data was processed using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, version 22 for windows). Summarized data sets of nominal, ordinal scale, interval were described in frequency or percentage by descriptive statistics and inferential statistics like chi square, Mann-Whitney, Kruskal-Wallis was used. The p value≤0.05 was considered statistically significant and p value≤0.001 was taken as highly statistically significant. Multiple nominal logistic and multiple linear regressions were used and the dependent variable was regressed for predicted independent variables. The interpretation of parameter estimates in multiple nominal regression of pocket depth for score 1 and LOA for score 1 was based on odds ratio of various predictor variables with standard reference category. The interpretation of the parameter estimate in multiple linear regression of various dependent variables was done considering the regression coefficient, for the unit change in predictor variables for the dependent variable in the models.

RESULTS

The mean BMI of the population in the study was 23.33±3.20. The 545 (68.1%) school teachers had normal BMI, followed by 185 (23.1%) were overweight, 43 (5.4%) were underweight and 27 (3.4%) were obese respectively. On comparison of BMI with school type, elementary teachers of both government and private schools had normal BMI than secondary teachers. Most of the teachers (50.8%) had normal BMI in the age group of 41-50 years. The female teachers had a higher normal BMI than male teachers. The teachers belonging to upper class (23.9%) were overweight as shown in Table 1.

Teachers brushing their teeth twice once in morning before food and after food in night, had normal BMI (68.9%) and the difference was statistically significant as shown in Table 2. Similarly, teachers with normal BMI (67.3%) changed their brush before three months and the difference was statistically significant as shown in Table 2. The mean total decayed teeth were higher in underweight teachers and the difference was statistically significant as shown in Table 3. Further, the post hoc analysis showed that the mean difference of total decayed teeth of underweight school teachers with obese school teachers was statistically significant, though not shown here. The mean total decayed surfaces were higher in underweight school teachers and the difference was statistically significant as shown in Table 3. Further, the post hoc analysis showed that the mean difference of total decayed surfaces of underweight school teachers with obese school teachers was statistically significant, though not shown here. The teachers with loss of attachment (LOA) per sextant for score 1 in 17/16 and 26/27 sextant was comparable in all categories of BMI and the difference among sextants was statistically significant as shown in the Table 4. The multiple linear regression shows that the change in BMI is explained from model 1, model 2 to model 3 for the given predictors of age, LOA (26), total decayed teeth controlled for predictors of LOA, SES, frequency of changing brush, DMFT, DMFS, total decayed surfaces and total filled surfaces. The change reported from model 1 to model 3 was 7.1% for given predictor as shown in Table 5. The underweight school teachers (1.51), normal BMI schoolteachers (1.35) and overweight school teachers (1.33) had higher odds for pocket depth of 4-5 mm (score 1) than obese school teachers in the study as shown in table 6. Similarly, underweight school teachers had higher odds ratio of 2.28 (CI 1.43-3.65) for LOA for score 1 than obese school teachers as shown in Table 6.

Table 1: Distribution of BMI according to demographic variables among subjects in the study.

Variables	BMI [N(%)]				
School type	**Underweight**	**Normal**	**Overweight**	**Obese**	**P value**
Government elementary teachers	4 (2)	144 (71.6)	47 (23.4)	6 (3)	0.02*
Private elementary teachers	14 (6.9)	143 (70.4)	42 (20.7)	4 (2)	
Government secondary teachers	8 (4)	138 (69.7)	47 (23.7)	5 (2.5)	
Private secondary teachers	17 (8.6)	120 (60.6)	49 (24.7)	12 (6.1)	
Age (years)					
21-30	13 (30.2)	37 (6.8)	2 (1.1)	0 (0)	0.001**
31-40	14 (32.6)	138 (25.3)	57 (30.8)	11 (40.7)	
41-50	14 (32.6)	277 (50.8)	91 (49.2)	12 (44.4)	
51-60	2 (4.7)	93 (17.1)	35 (18.9)	27 (3.4)	
Gender					
Female	36 (83.7)	381 (69.9)	150 (81.1)	20 (74.1)	0.001**
Male	7 (16.3)	164 (30.1)	35 (18.9)	7 (25.9)	
Socio-economic status					
Upper class	29 (4.7)	417 (67.5)	148 (23.9)	24 (3.9)	0.001**
Upper middle class	10 (5.9)	122 (71.8)	35 (20.6)	3 (1.8)	
Middle class	0 (0)	6 (7.5)	2 (25)	0 (0)	
Lower middle class	4 (100)	0 (0)	0 (0)	0 (0)	

Note:*-significant at p value<0.05, **-significant at p value<0.001.

Table 2: Distribution of BMI according to oral health practices among subjects in the study.

Variables	BMI [N (%)]				
Timing of brushing	**Underweight**	**Normal**	**Overweight**	**Obese**	**P value**
Before food	14 (5.5)	177 (69.1)	54 (21.1)	11 (4.3)	0.1
After food	0 (0)	4 (25)	12 (75)	0 (0)	0.001**
Before food in morning and after food in night	29 (5.5)	364 (68.9)	119 (22.5)	16 (3)	0.001**
Frequency of changing brush (months)					
≤3	37 (6.7)	370 (67.3)	120 (21.8)	23 (4.2)	0.01*
>3	6 (2.4)	175 (70)	65 (26)	4 (1.6)	

Note: *-significant at p value<0.05, **-significant at p value<0.001.

Table 3: Mean DMFT and DMFS according to BMI of the study subjects.

Category	BMI (mean±SD)				
DMFT and DMFS	**Underweight**	**Normal**	**Overweight**	**Obese**	**P value**
Total decay	1.98±2.65	1.39±2.06	1.22±1.82	0.41±1.21	0.02*
Total missing	0.84±1.47	0.94±1.53	0.94±1.43	1.04±1.72	0.85
Total filled	1.67±2.27	1.48±2.10	1.31±1.98	2.78±3.71	0.18
Total DMFT	4.49±3.09	3.82±2.43	3.47±2.43	4.22±3.65	0.135
Total decayed surfaces	2.56±3.64	1.92±3.05	1.53±2.51	0.41±1.21	0.02*
Total missing surfaces	4±7.02	4.66±7.61	4.70±7.18	5.19±8.60	0.84
Total filled surfaces	3.72±5.34	3.37±6.01	2.41±4.26	6.56±9.53	0.05*
Total DMFS	10.28±7.34	3.82±2.43	8.63±7.37	12.5±11.02	0.15

Note: SD= Standard deviation, *-significant at p value<0.05, **-significant at p value<0.001.

Table 4: Distribution of BMI of the study subjects according to bleeding on probing, pocket depth and LOA per sextant for score 1.

Category	BMI				
Bleeding on probing	**Underweight**	**Normal**	**Overweight**	**Obese**	**P value**
Score 0 (absent)	1154 (83.9)	14852 (85.2)	5041 (85.2)	711 (82.3)	0.07
Score 1 (present)	222 (16.1)	2588 (14.8)	879 (14.8)	153 (17.7)	
Periodontal pocket					
Score 0 (absent)	1089 (79.1)	14530 (83.3)	4937 (83.4)	745 (86.2)	0.001**
Score 1 (pocket of 4-5 mm)	287 (20.9)	2906 (16.7)	983 (16.6)	119 (13.8)	
Score 2 (pocket of 6 mm or more)	0 (0)	4 (0)	0 (0)	0 (0)	
LOA per sextant for score 1					
LOA 17/16	17 (9.4)	126 (69.6)	34 (18.8)	4 (2.2)	0.001**
LOA 11	2 (6.7)	26 (86.7)	2 (6.7)	0 (0)	0.09
LOA 26/27	17 (9.3)	127 (69.8)	34 (18.7)	4 (2.2)	0.001**
LOA 36/37	19 (6.7)	195 (68.4)	67 (23.5)	4 (1.4)	0.28
LOA 31	34 (6)	382 (66.9)	136 (23.8)	19 (3.3)	0.54
LOA 47/46	19 (6.7)	193 (68.4)	66 (23.4)	4 (1.4)	0.09

Note: *-significant at p value<0.05, **-significant at p value<0.001.

Table 5: Model summary of multiple linear regression results for BMI.

Dependent variable (BMI)	R (correlation coefficient)	R square	Adjusted R square	Standard error
Model 1	0.213	0.045	0.044**	3.131
Model 2	0.254	0.065	0.062**	3.101
Model 3	0.272	0.074	0.071*	3.087

Note: Controlled for LOA (47, 11, 36, 31, 47), socio-economic status, frequency of changing brush, total decayed surfaces, timing of brushing and total filled surfaces. Model 2: adding age, LOA (27). Model 3: adding age, LOA (27), total decayed teeth. *-Significant at p value<0.05 level and **-significant at p value<0.001 level.

Table 6: Parameter estimate for presence of pocket (score 1) and LOA for score 1 based on multiple nominal logistic regression analysis among teachers in Dharamshala city, Himachal Pradesh (N=800).

Variables	Presence of pocket (score 1)				
	Category	**B**	**P value**	**OR**	**95% CI**
BMI	Underweight	0.41	0.001**	1.51	1.189-1.93
	Normal	0.30	0.003*	1.35	1.10-1.65
	Overweight	0.29	0.006*	1.33	1.08-1.65
	Obese	0[b]			
	LOA score 1				
BMI	Underweight	0.82	0.001**	2.28	1.43-3.65
	Normal	0.54	0.007*	1.71	1.15-2.54
	Overweight	0.49	0.10	1.63	1.08-2.45
	Obese	0[b]			

Note: β= regression coefficient, OR=Odds Ratio, and CI= Confidence Interval, * Significant at<0.05 and ** Significant at≤0.001.

DISCUSSION

BMI is a simple anthropometric method for the assessment of nutrition. Infection, chronic inflammation, genetic predisposition and nutrition are potential mediator of periodontal disease.[16,17] This indirect relationship of BMI with oral diseases is attributable to unhealthy dietary habits with inadequate nutrition, excess sugar and fat consumption.[18] Majority (68.1%) of teachers had normal BMI which was also reported by Bhardwaj et al, Aoyama et al, Rahmawan et al which was in contrast to Shrestha et al, Hamasha et al and Larvin et al study.[4,7,8,16,17,19] The overweight teachers was reported higher among female teachers similar to Fadupin et al.[20]

The present study found an increase of 7.1% in LOA for score 1 per sextant in index tooth 26/27 in the given age group of 41-50 years for each 1 kg/m^2 increase in BMI though with a weak effect size. Previous studies by Bhardwaj et al, Shrestha et al have reported an increased risk for periodontitis by 56% and 39% respectively for each 1 kg/m^2 increase in BMI with age.[4,16] The public health relevance to the above findings in the study is the reversal of the condition as the association between BMI and periodontitis is bidirectional. Further, early nonsurgical periodontal intervention can reverse the above periodontal condition in younger overweight and obese groups. This adequately justifies the intervention urgency of prompt treatment including scaling in the half of the teachers in the study. Altay et al and Duzagac et al have reported that nonsurgical periodontal surgical intervention was associated with lower serum TNF-α level in obese.[21,22]

The BMI was significantly associated with periodontal pocket in the study which was in contrast to Hamasha et al.[9] Both bleeding on probing and periodontal pocket are important risk predictors for periodontitis and the present study found undernutrition as the risk marker for the periodontal pocket and LOA. The odds of both LOA of 4-5 mm and pocket depth of 4-5 mm were higher for underweight teachers than obese teachers. The LOA indicates the destructive and degenerative periodontal status and lack of nutrition as predictor of this phase as supported by the above findings. The other possible explanation could be due to lack of protein in undernutrition as high protein intake has inverse relationship with periodontitis.[3] The mean total decayed surfaces and total decayed teeth were reported higher in the underweight teachers than obese teachers. This is attributable to impaired chewing ability that leads to preferential selection of food and cooking methods that affects the nutrient absorption.[23] There was no significant association of missing teeth with BMI which was similar to Sonoda et al and Pilotto et al and was in contrast with Bernardo et al.[6,24,25] The association of BMI with total decayed teeth was similar to Hamasha et al.[9] The association of total decayed surfaces and total filled surfaces of DMFS with BMI, was due to better sensitivity of DMFS than DMFT. These confounders were adequately controlled in the final regression model and the study found an increase of 7.1% in total decayed teeth for each 1 kg/m^2 increase in BMI among the teachers though with a very weak effect size. The study found a very weak association of BMI with both periodontitis and dental caries which was in contrast to Kim et al and Hamasha et al.[1,9] The study also found some association of BMI with socioeconomic status which was similar to Tyrrell et al.[26] The possible reason is due to better physical health, nutrition, accessibility and affordability to general and oral health care among higher socio-economic class.[27] Further, there was significant association of BMI with timing of brushing which was in contrast to Rahmawan et al.[19] This finding is possible due to dental practices modifying host and bacterial interactions in oral diseases. These confounders were adequately restricted and controlled in the present study, though their association with BMI cannot be ignored which was also reported by Prpic et al and De Campos et al and requires further studies in this regard.[28,29]

The strength of the study is its novelty, sampling method and large sample size use of WHO oral assessment form 2013, by tooth surface. The main limitation of the study is its cross-sectional design that limits the causal relation.

CONCLUSION

The study found a very weak association of BMI with both periodontitis and dental caries. There was increase of 7.1% in total decayed teeth and LOA of 4-5 mm score 1 (4-5 mm) per sextant in index tooth 26/27 in the given age group of 41-50 year for each 1 kg/m^2 increase in BMI among the teachers though with a very weak effect size. The odds of both LOA of 4-5mm and pocket depth of 4-5 mm were higher for underweight school teachers than obese school teachers and undernutrition as the risk marker for the periodontal pocket and LOA.

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