# Assessment of Oral Health and Nutritional Status of School Teachers in Dharamshala City, Himachal Pradesh

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## ABSTRACT

**Background**

Nutrition is associated with oral health and any changes in dietary habits have impacted nutritional profiles which in turn influences oral health status.

**Objective**

To assess the oral health and nutritional status among school teachers in Dharamshala city, Himachal Pradesh.

**Method**

A descriptive cross-sectional study was undertaken with interviews and documented using a structured and adapted WHO proforma. The oral health was assessed by using WHO oral assessment form 2013 (by tooth surfaces) and the nutritional status by using five day dietary recall and scored according to dental health dietary score. The dental health dietary scores included food group scores (FGS), nutritional evaluation score (NES), decay promoting potential scores (DPPS) for all five days.

**Result**

Almost, two third of the school teachers in both types of schools had an excellent Food Group Score (FGS) on all five days of dietary recalls. The mean total Decay Promoting Potential Score (DPPS) was $23.33 \pm 3.20$ (minute). Approximately one-third of the teachers in both types of schools had DPPS scores within the "watch out" zone of dietary recall, ranging 15 or more on each day. The mean DMFT was $3.79 \pm 2.52$ with mean total decayed teeth as $1.35 \pm 2.03$. Similarly, the mean DMFS was $9.68 \pm 7.95$ with the mean total decayed surfaces as $1.81 \pm 2.94$.

**Conclusion**

The frequency of essential food groups remained consistent throughout the five-day dietary recall period. Carbohydrates formed the primary component whereas proteins were frequently missing from the diets. Frequent absence of protein intake in diet increased loss of attachment.

## KEY WORDS

*Nutritional status, Oral health status, WHO oral assessment for adults*

## INTRODUCTION

Nutrition is associated with oral health.[1,2] The added sugars in food products are an important risk factor for dental caries and uncontrolled sugar level in the blood as a risk factor for periodontal diseases.[3-5] Evidence is suggestive of the amount and frequency of sugar intake affecting dental caries.[6] Halvorsrud et al. reported that various forms and type of sugars have different effect on the development of dental caries.[7] Bidinotto et al. reported that consumption of ultra-processed foods was associated with a higher DMFT (Decayed Missed Filled Teeth), while intake of processed foods was associated with lower DMFT, though the associations are weak.[3]

Moreover, contemporary dietary shifts have significantly altered nutritional patterns, consequently exacerbating the prevalent issue of overweight and obesity.[8] This has been reported due to the natural and artificial sweeteners used in foods and beverages though artificial sweeteners are considered to be less cariogenic and safe.[9] Giacaman et al. reported free fatty acids, dietary proteins, and polyphenols to have anticariogenic potentials.[10] So, diet and nutrition need to be considered together and holistically. A diet rich in sugar promotes plaque formation and leads to periodontal diseases.[11]

Further, the previous literature has focused much on knowledge, attitude, and behavior of teachers about oral or nutritional health in other region and around the world without much focus on oral health and nutritional status. So, the need arises for present study, to assess the oral health status and nutritional status of teachers in Dharamshala city, Himachal Pradesh.

The need also arises to consider a new region for the present study in Dharamshala city, where the oral health care facilities are less than existing capital city of Shimla in Himachal Pradesh. The changing growth pace essentially poses health and other socioeconomic challenges in such new city which could provide much needed baseline information for the present and future studies. This adequately justifies the selection of our study region in Dharamshala city of Himachal Pradesh, India.

## METHODS

A descriptive cross-sectional study took place among school teachers in Dharamshala city, located in Himachal Pradesh, India, spanning from December 2020 to December 2022. In 2015, Dharamshala was included as smart city under Union Ministry for Urban Development so as to create a replicable model which will act like a light house to other aspiring cities.[12] The ethical approval to conduct the study was obtained from the Institutional Ethical Committee of H.P Govt. Dental College and Hospital, Shimla, Himachal Pradesh with number HFW (GDC)B(12)50/2015-3361. The necessary permission to visit the schools was obtained from the competent higher authority and written informed consent was obtained from the subjects. The inclusion criteria were those subjects present on the day of the examination and exclusion criteria were any medical condition that limits their participation in the study.

The study sample size was calculated using the formula N= z²pq/d² where N= sample size, z is the value for the selected alpha level, p is the estimated proportion of an attribute that is present in the population, q is 1−p, d is the acceptable margin of error for proportion being estimated. As there were no priorstudies to determine the oral health and nutritional status of school teachers'in the study population hence a conservative approach of p = 50% was considered. 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. Thus, a sample of 200 was recruited for each group, elementary and senior secondary teacher from both government and private school, making the total sample of 800.

The sampling method used was probability stratified random sampling technique. Two strata of government and private school were created and further stratified intoelementary and secondary teacher groups. The elementary teacher group consisted of primary and middle school teachers and the secondary teacher group consisted of high school and secondary school teachers. There were a total of 21 government Central Head Primary schools includingmiddle schools and a total of 20 Senior Secondary schools including high schools in Dharamshala. Teachers from seventeen elementary teacher group; as well as teachers from eleven secondary teacher groups were selected by lottery method using the simple random sampling. The same procedure was done for the selected nine private schools also.

The information were obtained through interview and recorded on a modified WHO proforma. The oral health was assessed by using WHO oral assessment form 2013 (by tooth surfaces).[13] The nutritional status was assessed using 5 day dietary recall and scored according to dental health dietary score. On the day of examination teachers were given 5 Day food diary sheet to keep the record of the detail items that were consumed in the breakfast, lunch, dinner, post breakfast, post lunch and post dinner with the necessary instruction for recording in the given five days and were collected from the respective school teacher in charge.[14] The dietary recordings were done for non-consecutive days inclusive of a weekend. A Pilot study was conducted on five teachers each from elementary and secondary groups of private and government schools. This was done to assess the feasibility in the understanding the instructions and calculation of the five-day diet chart. These subjects in the pilot study were excluded from the final study.

Dental Health Diet Score consists of Food Group Score (FGS), Nutritional Evaluation Scores (NES) and Decay Promoting Potential Scores (DPPS). The food items circled were listed, classified,andscored according to their respective food groups to obtain FGS namely: milk group (maximum of 3 servings in a daywiththehighest possible score of 24), meat group (maximum of 2 servings in a day with the highest possible score of 24), fruits and vegetables (maximum of 4 servings in a day with the highest possible score of 24) and Bread and Cereals (maximum of 4 serving in a day with the highest possible of 24). The maximum Food group score is 96 and the interpretation of 4 Food Group score was (72-96 Excellent, 64-72 Adequate, 56-64 Barely Adequate 56 or less Not Adequate).[14]

The food listed containing one or more of the ten nutrients essential for dental-oral health was assessed and nutritional evaluation score (NES). In each of the eight columns of foods, the intake of one or more of these foods as per the list was checked. If a food was eaten, the number 7 was encircled besides the nutrient that heads this column in the Nutrition evaluation chart. The same food was found in several columns and also more than one food was checked in a column. Only 7 points were assigned per nutrient (56 is the maximum score) regardless of food checked in the column.[14]

Sweet and sugar sweetened foods and their frequency of intake were classified into liquid, solid and sticky dissolving category for Computing Sweet Score/ DPPS It is also ensured in the frequency column for each item if they are eaten at least 20 minutes apart. Scoring is done as if the sweet is liquid, multiplied by 5, solid, multiplied by 10 and slowly dissolving, multiplied by 15. Total Score is interpreted as, 5 or less as Excellent, 10 and 15 or more as "Watch out" Zone.[14]

The computing 5 Day Food Score is based on the difference from the adult suggested daily amount in the 5-day diet chart and the difference was recorded in the modified proforma. The adult suggested daily amount includes:Milk group: 2 servings, Milk group: 2 servings or greater, Fruits and vegetable group: 4 servings or greater, Bread and Cereal group: 4 serving or greater.Similarly, the computing of 5 Day Decay Promoting Potential is based on the two forms of sugars consumed i.e., Liquid (sugar in beverages) and Solid (toffees, cookies, candies) consumed with meals and betweenthe meals. The total score is calculated by multiplying the total frequency of sugar intake with time of exposure for caries due to sugar consumption which is taken as 20 minutes.[14]

This was performed 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, One way ANOVA with post hoc bonferroni correction was used. The p value ≤ 0.05 was considered statistically significant and p value ≤ 0.001 was taken as highly statistically significant. Multiple linear regressions were used and the dependent variable was regressed for predicted independent variables. The interpretation of the parameter estimate was done considering the regression coefficient, for the unit change in predictor variables for the dependent variables in reference to the standard.

## RESULTS

The mean DMFT were 3.79±2.52 and the mean DMFS were 9.68±7.95. The mean total decayed teethwere 1.35±2.03 and the mean total decayed surfaces were 1.81±2.94. The mean total decayed teeth were higher in private school teachers than government school teachers. The mean total decayed surfaces were higher in private school teachers than government school teachers in the study.

Almost 66% of all teachers had adequate FGS scores on all days and almost 33% of teachers had DPPS score in watchout zone on all days among school teachers as shown in table 1. The mean FG score was highest on day 4 (54.65±10.26) and the lowest on day 2 (53.96±9.98) of dietary recording as shown in the table 2. The mean NES score was highest on day 1 (38.72±7.86) and lowest on day 3 (38.20±7.91) of the dietary recording. The score of 15 or more/ watch out zone were high on all days and was highest on day 1 (33.1%) of the dietary recording as shown in the table 2. The mean DPPS score was highest on day 1 (9.24±8.09) and lowest on day 5 (8.37±7.55) of dietary recordings as shown in table 2. The DPPS score of 15 or more (watchout zone) was reported higher in private elementary teachers than teachers in other group in all 5 days of dietary recording and the difference was statistically significant though not shown in table.

The mean difference of 5-day FGS for meat group among all categories of FGS was high as (0.31±0.69), followed by fruit group (0.06±0.43), milk group (0.03±0.23) and bread group (0) respectively. The DPPS score for liquid sugar between meals was highest with ameanscoreof 4.85±3.70 and DPPS score for solid sugar with meals had lowest mean score of 0.17±0.94. The mean DPPS scores between meals were higher than with meals for both the liquid (4.85±3.70) and solid sugars (1.59±2.28) respectively. The mean total DPPS score (minute) was 23.33±3.20 as shown in table 3.

The mean BMI was 23.33±3.20. The 5 Day FGS difference for both meat and fruit group was comparable in all BMI categories and difference was statistically significant as shown in the table 4.

Multiple linear regression for the given predictors of 5 Day FGS difference for all food group scores (except bread group) and total DPPS score in minutes is statistically unexplained for the given dependent variables of DMFT, DMFS, LOA and BMI. Total decayed teeth and surface was

**Table 1.** Distribution of subjects according to Food Group Score (FGS) and Decay Promoting Potential Scores (DPPS) Scores on various day.

| FGS Score criteria | FGS Day 1 n (%) | FGS Day 2 n (%) | FGS Day 3 n (%) | FGS Day 4 n (%) | FGS Day 5 n (%) |
|---|---|---|---|---|---|
| 72-96 Excellent | 523 (65.4) | 530 (66.3) | 508 (63.5) | 502 (62.7) | 511 (63.9) |
| 64-72 Adequate | 196 (24.5) | 195 (24.4) | 210 (26.3) | 206 (25.8) | 207 (25.9) |
| 56-64 Barely Adequate | 38 (4.8) | 42 (5.3) | 46 (5.8) | 50 (6.3) | 40 (5) |
| 56 or less Not Adequate | 43 (5.4) | 33 (4.1) | 36 (4.5) | 42 (5.3) | 42 (5.3) |
| Score criteria | DPPS Day 1 n (%) | DPPS Day 2 n (%) | DPPS Day 3 n (%) | DPPS Day 4 n (%) | DPPS Day 5 n (%) |
| Zero | 205 (25.6) | 202 (25.3) | 219 (27.4) | 211 (26.4) | 219 (27.4) |
| 5 or less | 179 (22.4) | 195 (24.4) | 190 (23.8) | 189 (23.6) | 198 (24.8) |
| 10 | 151 (18.9) | 159 (24.4) | 157 (19.6) | 159 (19.9) | 162 (20.3) |
| 15 or more | 265 (33.1) | 244 (30.5) | 234 (29.3) | 241 (30.1) | 221 (27.6) |

**Table 2.** Descriptive statistics of Dental Health Dietary Scores on various days for Nutritional Status.

| Dental Health Dietary Scores | | Mean | Std. Deviation (SD) |
|---|---|---|---|
| Food Group Score (FGS) | FGS day 1 | 54.06 | 10.26 |
| | FGS day 2 | 53.96 | 9.98 |
| | FGS day 3 | 54.06 | 10.54 |
| | FGS day 4 | 54.65 | 10.26 |
| | FGS day 5 | 54.46 | 10.37 |
| Nutritional Evaluation Scores (NES) | NES day 1 | 38.72 | 7.86 |
| | NES day 2 | 38.24 | 7.86 |
| | NES day 3 | 38.20 | 7.91 |
| | NES day 4 | 38.70 | 7.49 |
| | NES day 5 | 38.41 | 7.78 |
| Decay Promoting Potential Scores (DPPS) | DPPS day 1 | 9.24 | 8.09 |
| | DPPS day 2 | 8.68 | 7.43 |
| | DPPS day 3 | 8.49 | 7.58 |
| | DPPS day 4 | 8.75 | 7.78 |
| | DPPS day 5 | 8.37 | 7.55 |

**Table 3.** Descriptive statistics of 5 Day Food Group Scores (FGS) difference and 5 Day Decay Promoting Potential Scores (DPPS) during eating time based on type of sugar consumed.

| S No. | Category | Mean | Std. Deviation (SD) |
|---|---|---|---|
| 5 Day Food Group Scores (FGS) difference of various nutrition groups | 5 Day FGS difference meat group | 0.31 | 0.69 |
| | 5 Day FGS difference milk group | 0.03 | 0.23 |
| | 5 Day FGS difference fruits &Vegetable group | 0.06 | 0.43 |
| | 5 Day FGS difference bread group | 0 | 0 |
| 5 Day Decay Promoting Potential Scores (DPPS) during eating time based on type of sugar consumed. | Liquid sugar with meal | 0.47 | 1.24 |
| | Liquid sugar between meals | 4.85 | 3.70 |
| | Solid sugar with meal | 0.17 | 0.94 |
| | Solid sugars between meals | 1.59 | 2.28 |
| | Total 5 Day Decay Promoting Potential Scores (in minutes) | 142.13 | 104.96 |

**Table 4.** Distribution of subjects according to 5 Day FGS difference and BMI.

| 5 Day FGS difference (no difference) | BMI | | | | P value |
|---|---|---|---|---|---|
| Category | Under-weight. n(%) | Normal n(%) | Overweight n(%) | Obese n(%) | |
| Milk Group | 33(5) | 449(68.3) | 158(24) | 17(2.6) | 0.16 |
| Meat Group | 43(5.5) | 536(68.5) | 181(23.1) | 23(2.9) | 0.001** |
| Fruit and Vegetable Group | 43(5.5) | 533(68) | 181(23.1) | 27(3.4) | 0.02* |
| Bread Group | 43(5.4) | 545(68.1) | 185(23.1) | 27(3.4) | 0 |

* Significant at p value <0.05, ** Significant at p value <0.001

statistically explained by the predictor of the milk group only which was 0.07% and 1.1%respectively with a very weak effect size as shown in table 5.

## DISCUSSION

The nutritional assessment was done by 5-day dietary recall chart and was recorded as dental health dietary scores whichcomprehensively cover the information on food groups, specific nutrients, sugar in the overall diet with necessary food frequency times per day and week. Almost, two third of the school teachers both in private and government schools had an excellent FGS score in the range of 72 to 96 on all five days of dietary recalls. Food group scores are based on the recommended food frequency of the essential food group which did not vary for five-day dietary recall among the school teacher in the study. The possible lack of variability of FGS scores can attributed to the repetition of dietary habits as observed in low and middle income countries like India.[15] This potential confounder was restricted in the study by considering the dietary recording on non-consecutive days, inclusion of a weekend, adequate sample size to prevent inter-subject

**Table 5.** Model summary of Multiple Linear Regression results for DMFT, DMFS, BMI and LOA scores.

| Dependent variable DMFT | | | | |
|---|---|---|---|---|
| Independent Variables | R (Correlation coefficient) | R square | Adjusted R square | Standard Error |
| 5 Day FGS Difference (All Food Groups except bread group) | 0.57 | 0.003 | 0.001 | 2.52 |
| Total DPPS Score (minute) | 0.025 | 0.001 | -0.001 | 2.52 |
| **Dependent variable DMFS** | | | | |
| 5 Day FGS Difference (All Food Groups except bread group) | 0.081 | 0.007 | 0.003 | 7.94 |
| Total DPPS Score (minute) | 0.013 | 0.00 | -0.001 | 7.95 |
| **Dependent variable LOA (Score 1)** | | | | |
| 5 Day FGS Difference (All Food Groups except bread group) | 0.021 | 0.00 | 0.00 | 0.46 |
| Total DPPS Score (minute) | 0.020 | 0.000 | 0.000 | 0.46 |
| **Dependent variable BMI** | | | | |
| 5 Day FGS Difference (All Food Groups except bread group) | 0.07 | 0.006 | 0.002 | 3.19 |
| Total DPPS Score (minute) | 0.022 | 0.000 | -0.001 | 3.20 |
| **Dependent variable Total Decayed teeth** | | | | |
| 5 Day FGS Difference (Milk Group)# | 0.093 | 0.009 | 0.007* | 2.027 |
| Dependent variable Total Decayed Surfaces | | | | |
| 5 Day FGS Difference (Milk Group)# | 0.112 | 0.013 | 0.011* | 0.013 |

#Predicted for 5 Day FGS Difference (All Food Groups except bread group) and total DPPS Score (minute). *Significant at p value < 0.05 level and **Significant at p value < 0.001 level

variability and considering a balanced approach in selection of 5 day recall though the recommended dietary recalls are 24 hours, 3 or 7 days or for a month.[16-19]

Similarly, mean NES scores also did not change much on 5-day dietary recalls among the school teachers. This is possible due to the overlapping of scores of nutrients with common source in the study. The potential confounders to NES scoring were seasonality related to food availability and cultural familiarity with localdishes related eating styles. These confounders were well restricted in the study with adequate familiarity of local foods and considering two seasons of summer and monsoon for the study.[20] Despite of these restriction of confounders, the possibility for 'flat slope syndrome' of over-reporting low intakes and under-reporting high intakes among school teachers in the study cannot be ignored.[21]

Maximum variability was observed in meat group of 5 Day FGS difference and minimum in bread group, which indicates that bread group inclusive of carbohydrates, formed the staple diet and meat group inclusive of proteins were frequently missing in the diets among the school teachers. Five days difference of FGS for meat group was statistically significant for loss of attachment for score 1 (4-5 mm). Adegboye et al. reported that high protein intake was inversely associated with periodontitis.[22] The 5 day FGS difference of the meat and vegetable group was not associated with BMI. The present study also found that the liquid sugars are more consumed than solid sugars and both forms of sugars (solid and liquid) are consumed more between meals than with meals similar to Ismail et al.[6] This could be due to snacking habit and consumption of liquid beverages between meals.

The mean total DPPS score (minute) was reported to be 23.33 ± 3.20 in the study. Almost one third of the school teachers both in the government and private schools had DPPS scores for watch out zone in the range of 15 or more, on all five days of dietary recalls. Further, the watch out zone of DPPS was found to higher among private elementary schools than school teachers in other groups. The observed relationship is confounded by both the salivary buffering capacity and the rinsing habits of the participants in the study. It is also worth noting that rinsing after meals has been reported in over half of the Indian population by NOHS India (2002-03) and by various studies.[23,24] The 5 day FGS difference (for all food groups) and total DPPS (minutes) did not affect the DMFT, DMFS, LOA and BMI. Interestingly, the 5 day FGS difference for milk group significantly explained the total decayed teeth and decayed surface component of DMFT and DMFS, by 0.07% and 1.1% respectively for, though with a very weak effect size. So, the variability observed in the intake of the milk group demonstrates a correlation with buffering capacity in dental caries, albeit a very weak association as identified in the study, and thus warrants consideration without dismissal.[25]

The strength of the study is its novelty, sampling method and large sample size. Further, the WHO oral assessment form 2013, by tooth surface was used to assess the oral health status and dental health dietary scores was used to assess the nutritional assessment; which has not been used in previous studies to our knowledge. The primary limitation of the study lies in its cross-sectional design, which constrains the ability to establish causal relationships. Additionally, the study did not account for potential confounding factors, thereby limiting its comprehensiveness.

## CONCLUSION

Food group scores, aligned with the recommended frequency of essential food groups, remained consistent

throughout the five-day dietary recall period. The bread group encompassing carbohydrates constituted the staple diet while the meat group which provides proteins was often absent from the diets of school teachers. There was a weak association between the five-day Food Group Score (FGS) difference for the milk group and increased decayed teeth. Conversely, the five day FGS difference of meat group indicating higher protein intake was supportive of an inverse association with periodontitis as evident by a loss of attachment (score 1).

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