INTRODUCTION

Behaviours such as tobacco consumption, physical exercise, activities of daily life, alcohol use, diet, self-care behaviours, employment status and social relations are significant contributing factors to health status of the people and variations in health with age.1

Adolescence and young adulthood are exceptional periods in the life span that present opportunities and challenges in improving health and involve significant growth and development. During adolescence, people are increasingly independent, taking greater responsibility for habits in areas including diet and exercise.2

Body Mass Index (BMI) is widely used as a surrogate measure for obesity because it correlates to an individual's height in relation to weight, and is a commonly used indicator of nutritional status. Unwarranted weight issues in children are a major public health problem. Disproportionate weight complications on later stages of life are paramount worries.3 A study in the United States of America recognized that children were amongst the highest growing faction of the overweight and obese population.4 Estimation of BMI, according to age and gender, helps in assessing the child's weight situation. Children's dietary habits have changed increasingly, leading to the occurrence of overweight. Enhancement of obesity around the world is because of dietary habits like non-alcoholic beverages as well as fast food and decline in physical activity.3

BMI is a way of expressing an individual's physical and mental capacity in the maintenance of their well-being as a whole. Poor oral health has previously been related to high BMI.5 This has been attributed to impaired dietary pattern and plasma insulin, both of which could act as mediators. Limited exploration of the association between BMI and oral health has been undertaken, particularly among adolescents.

The objective of this study was to assess the impact of BMI on oral hygiene practices of adolescents in Bhopal city, India.

METHODOLOGY

This is an institute-based cross-sectional survey conducted in Arts College, Bhopal city from February to March 2014. The study population was chosen by
convenience sampling. The sample included all the subjects present on the day of the survey and were willing to participate in the age range of 17 - 23 years.

A pilot study was conducted involving 20 students who were not included in the main study, aiming to test the proposed methodology.

The sample size was calculated using the formula:

\[ n = \frac{Z^2 \times p \times q}{e^2} \]

Where, \( Z \) = standardized normal deviate (Z value), \( p \) = proportion or prevalence of interest, \( q \) = 1 - \( p \) and \( e \) = clinically expected variation. The final sample size was 310 subjects.

Ethical clearance was obtained from the College Ethical Committee (IEC/200/PHD/11). Permissions for conducting this study were taken from Director of College Education, College Authorities and the subjects. Students present on the day of survey and between the ages of 17 - 23 years were included in the study and those who were absent and not willing to participate, were excluded.

A self-designed, close ended, structured questionnaire was used for collection of data which included the following variables: (a) self-assessment of general health status, (b) self-assessment of oral health status, (c) self-reported oral hygiene practices, (d) general hygiene habits, (e) dietary habits, (f) lifestyles: smoking, use of alcohol and physical activity, (g) oral health knowledge and attitudes, (h) dental visits, (i) visits to physician, (j) school performances, (k) leisure activities, (l) relationship to friends, (m) family status and lifestyle of parents, and (n) parents’ levels of education and occupation. The questionnaires were formulated in English.

The collected data were coded, and a statistical analysis was carried out by using Microsoft Excel 2007 and Statistical Package of Social Science (SPSS 20). Analysis of the data was carried out by frequency distributions and descriptive statistics (chi-square test, level of significance=95%), wherever indicated.

**RESULTS**

The study participants consisted of 166 (53.54%) male and 144 (46.45%) female students. Majority of the study subjects were undergraduates [n=285 (92%)] while some [n=25(8%)] were postgraduate students. Nearly 54% (n=154) males and 46% (n=131) females constituted undergraduate students.

Based on the BMI classification (WHO 2012), subjects who were underweight (BMI ≤ 18.50) were (86) 27.74%, optimal weight (BMI= 18.50 - 24.99) were (206) 66.45% and overweight (BMI ≥ 25.00) were 14 (4.516%).

Majority of the study subjects who used toothbrush [n=307 (99.03%)] to clean their teeth had optimal weight (n=203, 66.12%). The total number of subjects with the habit of toothbrushing was 307, out of which optimal weight subjects comprised the highest with 66.12% (n=203), and overweight with only 4.56% (n=14). The daily frequency of toothbrushing, which included once and twice daily, was highest among optimal weight subjects who responded were 66.28% (n=116) and 66.56% (n=82), respectively while lowest among overweight subjects were 4.57% (n=8) and 4.72% (n=6), respectively. The habit of mouthrinsing and use of other cleansing aids was also highest among the optimal weight subjects when compared to underweight and overweight subjects.

The habit of toothbrushing among males and females was highest among optimal weight subjects who responded were 78.84% (n=122) and 66.56% (n=82), respectively when compared to underweight and overweight subjects. The association between toothbrushing habits among male and female subjects was statistically significant (p < 0.001).

Frequency of toothbrushing once daily, in males and females, was highest among optimal weight subjects who responded were 78.84% (n=122) and 56.25% (n=81 respectively) when compared to underweight and overweight subjects. The association between toothbrushing habits among male and female subjects was statistically significant (p < 0.001).

**Table I:** Association among sex, body mass index (WHO, 2012), and oral hygiene practices.

<table>
<thead>
<tr>
<th>Oral hygiene practices</th>
<th>Male (n=166)</th>
<th>Female (n=144)</th>
<th>Statistical Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Optimal weight</td>
<td>Underweight</td>
<td>Overweight</td>
</tr>
<tr>
<td>Tooth brushing once daily</td>
<td>122 (78.84%)</td>
<td>30 (18.40%)</td>
<td>11 (6.74%)</td>
</tr>
<tr>
<td>Tooth brushing twice daily</td>
<td>73 (73%)</td>
<td>21 (21%)</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>Mouth rinsing</td>
<td>48 (77.42%)</td>
<td>9 (14.52%)</td>
<td>5 (8.06%)</td>
</tr>
<tr>
<td>Use of other cleansing aids</td>
<td>89 (79.46%)</td>
<td>18 (16.07%)</td>
<td>6 (5.36%)</td>
</tr>
</tbody>
</table>

S = Significant; NS = Not significant

**Results:**

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who responded were 73% (n=73) and 57.33% (n=43) respectively when compared to underweight [male=21% (n=21) and female=40% (n=30)] and overweight [male=6% (n=6) and female=2.67% (n=2)] respectively subjects. This association was statistically significant (p=0.018). Frequency of brushing twice a day in males and females was also highest among optimal weight subjects who responded were 77.41% (n=48) and 52.30% (n=34) respectively as compared to the other two categories. This association was also statistically significant (p=0.001).

In male and female subjects, the habit of mouthrinsing was higher among optimal weight subjects who responded were 79.46% (n=89) and 54.32% (n=44) respectively when compared to the underweight and overweight subjects. The association between mouthrinsing and BMI was statistically significant (p=0.001).

Among male and female subjects, the use of other cleansing aid like dental floss was higher among optimal weight subjects who responded were 86.95% (n=20) and 44.44% (n=4) respectively as compared to underweight and overweight subjects. This association between body mass index and use of other cleansing aids was not statistically significant (p=0.056).

**DISCUSSION**

Diet and physical activity strongly influence the body mass index along with lifestyle habits like tobacco and alcohol consumption as well as parental influence which have a powerful impact on general and oral health. Adolescents with deleterious habits and improper lifestyles tend to have impaired general health status and poor oral health behaviours which track into later life as predictors of increased BMI and oral health problems resulting in occurrence of oral diseases in this group of population.5

In the present study, association between BMI and oral hygiene practices was evaluated. There was an association between the frequency of toothbrushing including brushing once daily and twice daily among the optimal weight male and female subjects. This is not in accordance with the study conducted by Polat et al. who suggested that there was no much difference between the oral health status among obese and healthy children who brush once daily (in the morning) using a fluoridated toothpaste. This is due to the similar socio-economic status of the parents of the two groups.6 In this study, the difference in oral health behaviour among the obese and optimal weight might be due to their different socio-economic backgrounds and the variations in oral health behaviours followed by the individual families. Narang et al. found in their study,7 that more number of males used toothpaste and brushed their teeth twice daily than females though there was no statistically significant difference. These findings are similar to the present study in which the frequency of toothbrushing once daily was more among females as compared to males. Oral hygiene practice of using toothbrush and paste and dental floss was not associated with the body mass index in the present study (p < 0.05). However, there was an association between mouthrinsing habit with optimal weight subjects. This could be because of the higher number of study subjects belonging to optimal weight category as per body mass index. Reeves et al. found an association between body mass index and periodontal disease among adolescents.8 This fact was attributed to psycho-social stress associated with overweight in adolescent period. This stress, related to teasing regarding body weight, may affect oral health behaviour leading to poor oral hygiene practices. These findings are not in accordance with the present study. Similar study by Tambelini et al. observed that caries rate increases with age because particularly during adolescence, oral health care is neglected.9 The use of BMI; as an indicator for assessing the nutritional status has its limitation as substitute measures for directly measured BMI, such as reports by oneself and parents regarding the height and weight are a lot less favoured as it has to be used with prudence and cognizance of the constraints, pre-conceptions, and qualms focussed on these measures.10

Lifestyle habits like tobacco and alcohol consumption can also result in poor oral health behaviours. Perera et al. found an association between body mass index and lifestyle habits of alcohol, tobacco and illegal drug use.11 Dupuy et al. in their study, suggested that smoking and alcohol consumption were not associated with overweight;12 but, in turn, may have an impact on oral health. Duffrin et al. determined an association between alcohol consumption and overweight.13 In the study by Cinar et al. there was a significant association between lifestyle habits and obesity among adolescents.14 The reasons that can be attributed to the non-significant association between body mass index and the lifestyle habits of using tobacco and alcohol may be because of the under-reporting by the adolescents since tobacco and alcohol are considered to be an undesirable behaviour by the society. Therefore, the results derived from self-reported surveys are likely to be distorted by social desirability bias. In the literature review by Australian social trends,15 the lifestyle habits such as tobacco smoking and risky alcohol consumption and obesity were analysed and it was found that these prominent health risks have an intense impact on the oral and overall health status and social and community activities among people of all ages. Chiolero et al. crucially evaluated the relationship among smoking, body weight, body fat distribution, and resistance to insulin as accounted in the literature, and opined that heavy smokers are inclined to have greater body weight.
when compared to light smokers or non-smokers.\textsuperscript{16} This likely reflects a clustering of risky behaviours (e.g. decreased physical activity, poor dietary habits, and tobacco consumption) that contribute to weight gain. Other factor like weight cycling can also be implicated.

Hellqvist was of the opinion that tobacco users had less frequent dental visits and poorer oral hygiene habits than non-tobacco users.\textsuperscript{17} Singh \textit{et al}. in their study viewed that nicotine habits such as Gutka\textsuperscript{a} (flavoured tobacco) and “Gul Manjan” (a dentifrice), and “Bidi” (unfiltered tobacco wrapped in dried “Tendu” leaf) have negative effect on oral health and showed marked association between lack of scientific dental awareness and high prevalence of tobacco habits.\textsuperscript{18} Irigoyen-Camacho \textit{et al}. found a significant association between oral hygiene and tobacco consumption among Mexican adolescents, which is in accordance with this study.\textsuperscript{19} Petersen \textit{et al}. suggested a close association between lifestyle habits of smoking or other tobacco usage oral hygiene practices,\textsuperscript{20} which is in unison with this study. General health and along with it dental health, mirror a person's health habits and common health behaviour in many ways. Alterations in lifestyle and active living can affect oral health habits and subsequently dental health. There are many biological, social and psychological variables working in unison that effect the oral hygiene knowledge, attitude and practices and its connection to lifestyle factors, which affects Body Mass Index among adolescent population.

Shakya \textit{et al}. suggested that dental caries among children with malnutrition may be associated with poor oral hygiene behaviour.\textsuperscript{21} In the present study, there was no association between dental hygiene habit of brushing once daily among overweight males and females. This is in contrast to the results observed by Frisbee \textit{et al}. in which they found a significant association between the dental hygiene habits and obesity.\textsuperscript{22}

The impaired nutritional status among adolescents, which can be a root cause for impaired BMI, can be a contributing factor in their inability to give appropriate care to oral health when their overall health is itself compromised. Hence, screening for common general and oral health problems and the assessment of nutritional status should be included as an essential part of educational health services. Improvement in dental health and general well-being of adolescents require active collaboration between dental and general health care providers, and the implementation of health promotion strategies targeting management of both impaired BMI and oral hygiene habits for young people using a holistic approach.

Limitations of this study can be attributed to the self-reported questionnaire survey procedure as followed. The reporting of lifestyle habits by the study population could have been limited by the social desirability bias.

Clinical evaluation of dental caries and periodontal status of the adolescents could have improved the result outcome. The study population included more undergraduate students when compared to postgraduate students. An equal inclusion of students of different educational cadre could have had an impact on the results.

**CONCLUSION**

Oral health behaviours of adolescents are influenced by their body built as determined by Body Mass Index. There was a relationship between oral hygiene practices like the frequency of toothbrushing (brushing once daily and twice daily) and the BMI, mainly with the subjects in optimal weight category. The oral health of adolescents is a public health concern and education regarding the maintenance of oral and systemic health and proper dietary habits and regular physical activity should be imparted to this population. Regular dental and oral check-up should be made a priority for this group. Continuous monitoring and regular review of this population is mandatory for betterment of general and oral health of these adolescents in the future.

**REFERENCES**


10. Himes JH. Challenges of accurately measuring and using BMI


