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Prevalence of Factors Predisposing and Association of Childhood Obesity and Dental Conditions in Indian Urban Preschool Children

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ABSTRACT

The prevalence of childhood obesity and dental conditions is rapidly increasing in low and middle-income. A cross-sectional study was carried out to assess the prevalence of obesity and dental conditions, such as dental caries, Traumatic Dental Injuries (TDI), and dental erosion and possible associations between obesity and dental conditions and predisposing factors for the same. A sample of 540 children was drawn from preschools in a recently urbanized city. Height and weight were recorded and categorized into obese, overweight, underweight and normal using BMI percentile calculator for specific age and gender by Centers of Disease Control and prevention (CDC). Dental caries were measured in terms of dmft (frank cavitations); other dental conditions i.e. dental erosion and TDI were measured as binary variables i.e. present or absent. Socioeconomic status was assessed using Kuppuswamy's 2014 modification; diet in terms of number of sugar exposures and physical activity was recorded as time spent in physical activity as reported by the parents. Prevalence of dental caries (59.2%), and obesity (13.46%) and overweight (9.79%). Linear correlation between BMI and dmft (dental caries) was weak but significant (r=0.089; p= 0.033). However, dmft in obese and overweight children (3.9) was significantly higher than that in underweight children (2.25). Dental conditions were significantly higher in children from higher SES (p=0.031).

Keywords

Body Mass Index (BMI); Childhood Obesity; Dental caries; Dental erosion; Dental Trauma.

Introduction

The spread of Non-communicable diseases (NCDs) is a rising global crisis [1]. Childhood obesity has been one of the earliest markers and an independent risk factor for cardiovascular diseases [2,3]. The problem of childhood obesity is dramatically increasing with more than 1% of all children becoming obese each year [4]. Obesity has risen by almost 47% according to data analysed from 1980-2013 [5]. A meta-analyses of about 450 nationally representative surveys form almost 144 countries stated that, the prevalence of overweight and obesity increased from 4.2% in 1990 to 6.7% in 2010 among preschool children [6]. According to WHO, almost 42 million children aged less than five years were obese or overweight in 2013 [7]. Amongst the high-income countries, the prevalence of Childhood obesity in UK and US is almost well above 20%. Likewise, the prevalence in Australia has almost doubled over 10 years (1985-95) [8] and in Canada; it has almost tripled over last 20 years [9]. Although childhood obesity has become an epidemic in high-income countries, it is a rising health concern in middle and low income countries as well [4]. Malnutrition and obesity coexist in many low and middle-income nations [10]. In India, one out of ten urban children from low-middle income families is obese or overweight [11]. A study in semi-urban population reported an overall prevalence of overweight and obesity was 18.2% as per the IOTF classification and 23.9% as per the WHO standards [12]. A meta-analysis of studies evaluating the prevalence across Indian subcontinent was done with data was searched from the year 1961 -2013 reported a prevalence of obesity and overweight to be 23% and 36% respectively [13]. The relationship between obesity and socio-economic status (SES) has been inconsistent in children in high- income countries [14]. As for the middle and low income countries, the prevalence has been lower, possibly due to non-availability of food and basic facilities. Nevertheless, among the obese individuals, in low and middle-income countries higher prevalence was seen in children belonging to higher SES. Literature suggests, SES groups with greater access to energy-dense diets (low-SES in industrialized

countries and high-SES in low and middle-income countries) are at increased risk of being obese than their counterparts [15]. In Indian population also, a definite socio-economic gradient has been observed in urban population, with higher prevalence in high-income groups [11].

Dental caries is one of the most prevalent chronic conditions in children worldwide and expensive to treat [16]. Although dental caries has been lower in high-income countries than low and middle income countries, in high-income countries the prevalence of caries ranges from 1-12%, whereas in low and middle income countries it is as high as, 70% in preschool children, among the disadvantaged groups [17]. In India, almost half of the population (rural as well as urban) below 5 years of age suffers from dental caries [18]. Other dental conditions like dental erosion and traumatic dental injuries (TDI) are also widely prevalent in young children and have been associated with obesity [19,20]. Dental erosion is known to be caused by frequent consumption of soft drinks and related acid-attacks on teeth. Erosions are more likely to occur in obese children according to a study conducted in children aged 7-15 years [21]. Evidence on association between TDI and obesity has been inconclusive. An Italian study showed significant inverse relation between obesity and trauma-predisposing behavior in children, thus suggesting that children frequently playing sports and lively games were not only less obese but also more skillful and, for this reason, less prone to trauma (traumatic dental injuries) when they fell or sustained impacts [22]. However, a study in Brazilian children did not show any significant association between the two [23]. A systematic review of observational studies reported that the risk of TDI among overweight/obese children is approximately 22% higher than among lean children and the causal association between these two conditions is plausible. The review further suggested that effective weight reduction programs in obese children could increase their postural stability, indicating that such programs could also be effective in reducing the risk for falling and consequent TDI in overweight/obese subjects [24].

Preschool children, especially in a country like India are relatively inaccessible, since preschool education is not compulsory. Additionally, since children below 5 years are not included in WHO index age groups, they are seldom included in epidemiological studies. Most of the chronic diseases including the oral diseases have modifiable common risk factors that are lifestyle related, dietary factors being predominant [1,16]. Childhood obesity can be regarded as a marker for several non-communicable diseases like cardiovascular diseases, etc. Similarly, dental conditions (such as dental caries and dental erosion) can also be considered as one of the earliest markers for these diseases [25]. Both obesity and dental conditions (dental caries and dental erosion) in children are preventable conditions. The importance of healthy beginning in early years from a life course perspective need not be overemphasized [26]. Few studies are available in Indian literature on the prevalence of obesity and associations with various dental conditions and related predisposing factors in the urban preschool children. Therefore, we planned a study to assess the prevalence of obesity and dental conditions, possible associations between the two and predisposing factors for the same, in urban preschool children.

Materials and Method

A cross-sectional study was carried out by a post-graduate student in the Department of Pediatric and Preventive dentistry of YMT Dental College and Hospital, Navi Mumbai. Ethical approval was obtained from institutional review board and research ethics committee.

Study was conducted from December 2015 to July 2016.

The sample frame considered was that of a relatively recently urbanized population of Navi Mumbai adjacent to the city of Mumbai, a Metro city. This population reflects the changing lifestyles which can be responsible for dental conditions and obesity; however, no studies so far have investigated the same. Navi Mumbai is been divided by the municipal corporation into 13 nodes or zones [27]. The nodes (townships) were designed to provide one primary school per 5,000 populations, one high school for 12,500 and one college for a population of 50,000. Each of the nodes was self-sufficient in terms of providing quality education [28]. The sample frame considered had a total population of 2.6 million [29]. About 22.5% of the total population was considered school-going children. School-going population was more than 3 million, enrolled in 228 primary, 141 secondary and 62 higher secondary schools in the area. There were about 367 pre-schools in the selected area. Preschools are of two types: those within schools (primary and high schools) and those existing as separate entities without attached schools i.e. independent preschools. There were 266 independent preschools and 101 pre-primary sections in regular schools [30]. Most preschools enroll children above the age of 2 years through 5 years or early 6years.Since the target population was children in the age group of 2-6 years (based on chronological age as mentioned in the school records), preschools in the study area were selected as study units. 3 nodes out of the 13 nodes i.e. 20% were randomly selected and 2 preschools within schools and 4 independent preschools were included in the study to achieve a sample of 540 children.

Permissions from school authorities were obtained for conducting the study which included interaction with parents and carrying out dental examinations. Information sheets were given to all the parents along with consent forms in three languages (Hindi, English and Marathi).

Selection criteria for participants

Inclusion criteria

- Preschools willing to participate/ providing permissions to carry out the study.
- Preschools having children of both genders.

Exclusion criteria

- Children whose parents did not/ were unable to provide consent.
- Children with any systemic disorders, physical or mental illness.

The study tool consisted of 3 parts: a questionnaire to be filled by parents, and a form for dental check-up and records of height and weight. The questionnaire had questions pertaining to demographic details, Information regarded SES was recorded using the Kuppuswamy scale (modification 2014) [31]. The Kuppuswamy scale was devised in 1976 and is based on a composite score considering the education and occupation of the head of the family along with monthly income of the family, which yields a score of 3-29. This scale classifies the study populations into high, middle, and low SES and is periodically revised owing to monetary inflation and All India Average Consumer Price Index for Industrial Workers (CPI-IW). The then recent modification was thus used to record the SES, which is categorized as the following: Upper class (I); Upper middle class (II); Lower middle class (III); Upper lower class (IV); and Lower class (V). A brief medical (of any recent illness, which might modify the data regarding the lifestyle) and dental history (for and past treatment) was also taken. Parents recorded oral hygiene habits i.e. brushing frequency, food diary of the previous day and time (minutes or hours) in involved physical activity. The teachers were briefed regarding the study tool and instructions were given for the same. Teachers along with school authorities collected the filled forms from the parents. The principal examiner addressed any further queries.

The study tool was piloted in a 25 children from a preschool and children visiting the department of pediatric and preventive dentistry and was validated by and expert (i.e. the school principal).

The principal examiner along with three trained examiners carried out examinations and recorded the clinical findings. All the 4 examiners were trained to carry out dental examinations by a supervisor and carried out examinations in 30 children visiting the department of pediatric and preventive dentistry and pre-calibrated. Examination was carried out using methods described in WHO 1997 i.e. using a mouth mirror under natural daylight and a clean dry field [32].

Dental caries was measured as a quantitative variable in terms of dmft, with caries threshold set according to International Caries Detection and Assessment System (ICDAS). ICDAS is a 6 point scale and a score of ≥ 3 (i.e. cavitated lesions/ visible lesions) was considered as decayed [33]. Height and weight of the children were recorded using pre-validated scales. Body Mass Index (BMI) was calculated using online CDC calculator. The BMI values were then categorized on into age and gender adjusted BMI percentile using the calculator. The categories were as follows: Normal, underweight, overweight and obese [34].

Children were examined for TDI like avulsion (loss of tooth), tooth fracture, discoloration following a history of trauma (if reported by the parent in the dental history). This was reported as present or absent.

Although no specific, classifications are available for dental erosion, it is described as a smooth silky glossy lesion. The data was reported in terms of erosion present or absent.

Lifestyle assessment was done in terms of the time spent in physical activities of children that of the previous day, as reported by parents in minutes or hours. Diet assessment was done in terms of number of sugar exposures on the previous day as reported by parents. It was then converted into a binary categorical variable: low (<2) and high (>2).

The sample size of 540 was obtained for the estimated level (20%) [12] of overweight (including obese), incorporating standard values for confidence level (95%) and margin of error (0.05). Additional children were recruited to compensate for invalid entries based on the pilot study.

Data obtained was compiled using a Microsoft Excel sheet. Data was subjected to statistical analyses using Statistical Package for Social Sciences (SPSS, v 22.0, IBM).

Results

Out of the 582 children examined, 281 (48.3%) were females.
Table 1 shows distribution of population according to their SES, classified using Kuppuswamy modification 2014.
SES Class I, II, III and IV had 46.41%, 36.96%, 14.04% and 2.58% children, respectively. The lower class (V) had no representation.

Distribution	Category	Percentage
Kuppuswamy scale (349)	Upper class (I)	46.41
	Upper middle class (II)	36.96
	Lower middle class (III)	14.04
	Upper Lower middle class (IV)	2.58
	Lower class (V)	0

Table 1: Distribution as per socio-economic status.

Table 2 describes prevalence and distribution of BMI categories and dental conditions. Children were categorized according to BMI percentile into underweight, normal, overweight and obese. 10.87 percentage males and 11.82% females belonged to the underweight category. 10.51% males, 9.12% females were overweight, and 14.86% males and 12.16% females were obese. The overall prevalence of overweight was 9.79% and that of obesity, 13.46%.

	Prevalence		
	Females	Males	Total
Obesity	14.86%	12.16%	13.46%
Overweight	10.51%	9.12%	9.79%
Underweight	10.87%	11.82%	11.36%
Dental conditions			
Dental caries	54.2%	45.8%	59.2%
Mean	3.68	3.74	3.71
Dental erosion	1.33%	1.07%	1.2%
TDI	4.63%	5.98%	5.33%

Table 2: Prevalence of dental conditions and obesity.

Dental caries was recorded in terms of dmft. 55.87% of the males

had decayed teeth, 2.14% had teeth missing due to caries and only 1.78% had filled teeth. Among 301 females, 59.80%, 1.00% and 4.98% had decayed, missing and filled teeth respectively. Overall, 57.90% had decayed teeth, 1.55% had teeth missing due to caries and 3.44% had filled teeth. The prevalence of dental caries was 59.28%. 45.8% were males and 54.2% were females. The mean dmft in females was 3.74 and males, 3.68. Mean dmft for the study population was 3.71.

Dental erosion was recorded as present and absent. Prevalence in males and females was 1.07% and 1.33%, respectively. The overall prevalence was 1.2%.

Traumatic Dental Injuries (TDI) was also recorded as present or absent. 4.63% males had and 5.98% of the females had experienced at least one TDI. The overall prevalence was 5.33 %.

Table 3 shows differences in mean dmft across the BMI percentile categories i.e. underweight, normal, and obese and overweight. The mean dmft in underweight category was 2.25, normal, 3.91 and, obese and overweight 3.90; this was statistically significant (p = 0.025). There was no difference between mean dmft in normal, and obese and overweight category. The mean dmft in underweight children was lower compared to that in obese and overweight category and normal weight category; this was statistically significant (p=0.048 and p=0.021, respectively).

(Column I) Percentile coded	(Column II) Mean dmft	(Column III) Percentile coded	Mean difference Between column I and III (95% CI)	Significance
Under-weight	2.25	Normal	-1.668 (-3.12, -0.21)	p=.021*
		Obese + Overweight	-1.656 (-3.30, 0.00)	p=.048*
Normal	3.91	Underweight	1.668 (0.21, 3.13)	p=.021*
		Obese + Overweight	.012 (-1.09, 1.11)	p=1.000
Obese + Overweight	3.90	Underweight	1.656 0.01, 3.30	p=.048*
		Normal	-.012 (-1.11, 1.09)	p=1.000

Table 3: Mean dmft across 3 BMI percentiles categories. * Significant.

Table 4 describes categorization of dental conditions (Dental caries, Dental erosion and TDI) as per the Socio-Economic Status.

	SES				Total	Significant
	I	II	III	IV		
No conditions present	82	49	14	2	147	p=0.031*
Presence of 1 condition	75	78	32	7	192	
Presence of 1 or more conditions	5	2	3	0	10	
TOTAL	162	129	49	9	349	

Table 4: Categorization of all dental conditions (Dental caries, Dental erosion, TDI and All) with respect to socio-economic status. * Significant.

46.30%, children belonging to the upper class (I) had at least one dental condition and 3.09% had more than one dental condition. Similarly, in the children from the upper middle class (II), 61.24% had at least one dental condition and 1.55% more than one dental conditions. 65.32% of children from the lower middle class had at least one and 6.12% had more than one dental condition. 77.78% from the upper lower class (IV) had at least one dental condition. This comparison of frequencies between dental conditions and socio-economic status using Chi-square was statistically significant (p=0.031).

The correlation between BMI categories and dmft was weak but statistically significant (r=0.089; p= 0.033).

Table 5 describes the correlation on dmft and BMI in obese and overweight children and children with dental caries. The mean dmft in obese and overweight children was 3.9 and the mean BMI was 18.82. Weak inverse correlation (r= -0.027) between dmft and BMI in obese and overweight. However, this was not statistically significant (p= 0.757).The mean dmft in underweight children was 2.25 and mean BMI was 12.99 ± 0.81. A very weak inverse correlation (r=-0.1) between dmft and BMI in underweight children. Although this was not statistically significant (p=0.430). The mean BMI in children with dental caries was 15.92. The correlation co-efficient was 0.058 indicating a weak correlation between dmft and BMI. However, this was not statistically significant (p=0.286).

	Mean dmft	Mean BMI	Correlation of BMI with dmft
Obese and overweight children	3.90	18.82	r= -0.027 (p=0.757 #)
Underweight children	2.25	9.76	r= -0.100 (p=0.430 #)
Children with dental caries	6.26	15.92	r = 0.058 (p=0.286 #)

Table 5: Correlation between BMI and dmft (in children with dental caries and obese and overweight children). # Non- significant.

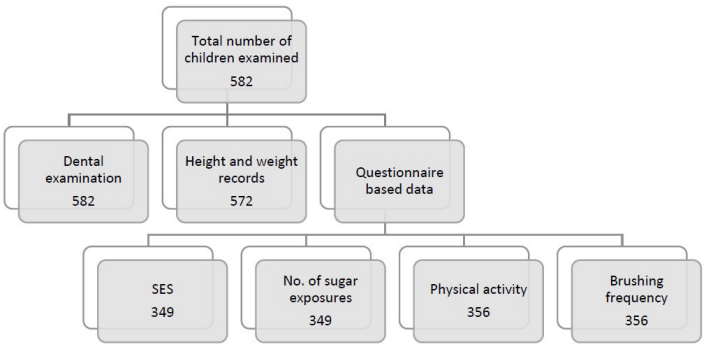

Figure 1: Distribution of children assessed for dental conditions, obesity and associated factors.

Discussion

Prevalence of obese and overweight was 13.46 and 9.79% respectively. Prevalence of obesity as well as overweight was higher

in males than in females. Obesity and overweight were converted into continuous variables to obtain the. Mean values since the health implications and risk factors have been interchangeable. Categories of obesity and overweight have been merged in many studies as the overweight individuals have a tendency towards obesity and vice-versa [35-37].

The prevalence of dental caries in our study was relatively high; i.e. 60% of children had at least one decayed, missing or filled tooth. Overall, the mean dmft was 3.71. National oral health survey 2003-2004, the only comprehensive survey in Indian population reports caries in children and adults along with other common dental conditions. The prevalence of caries is more than 50% in children below 5 years of age, which is lower than that reported in our study [19]. Another study in North-Indian population showed a lower prevalence of almost 32% in preschool children [38]. Studies in south India preschool children, also reported a prevalence ranging 19.2 -54%, which is lower than that in the current study [39-41]. The variations in prevalence of caries are reportedly due to differences in SES, dietary patterns, availability of preventive efforts [42]. The prevalence of caries in our study, was higher in females (54.2%) than in males (45.8%) which was similar to prevalence seen in study by Kuriakos et al, 2015 [42].

The prevalence of erosion in our study was 1.2%, which was much lower than prevalence reported in other studies [43,44]. However, study by Moimaz et al., 2013 [45], reported a lower prevalence (0.6%). Since dental caries may superimpose erosive lesions as reported by Wild et al, 2011[46] in case of doubt they were considered as caries only, which may have underestimated the prevalence. Specific dietary and systemic factors may be associated with erosion like consumption of juices or sugar sweetened beverages; and systemic conditions such as GERD; however, the same could not be assessed [47].

Furthermore, the component of treated teeth was very less compared to untreated i.e. missing or filled teeth (1.5 and 3.4%, respectively). This finding is often reported similarly in the low and middle-income countries [48]. In high-risk categories i.e. in children with caries, the mean dmft was 6.26. As per the definition by American Association of Pediatric Dentistry (AAPD), this can be classified as Severe Early Childhood Caries(S-ECC). AAPD defines Severe ECC as ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5) lesions apart from presence of any sign of smooth surface caries in children less than 3 years [49].

The prevalence of TDI in our study was 5.33%, which was almost half of the prevalence in a recent study by Chalissery et al. which included 3-5 year old children [50]. Another study, again in the same age-group evaluated prevalence of TDI across 5 North-Indian states reported a prevalence ranging from 9.5% to 24.4% which was again higher than the reported prevalence according to our study [51]. A possible explanation to this could be that, the mentioned studies were in different populations (North India) and settings. The facilities in preschools and amount of physical activity or other confounding factors such as lifestyle related, cultural and social factors, etc., could have possibly led to this variance in prevalence in our study.

The mean dmft was almost identical in normal and obese and overweight categories in our study, however, the mean dmft in obese and overweight was significantly higher than that in underweight. Granville-Garcia et al also reported significantly lower dmft index in non-obese i.e. underweight and normal preschool children [52]. On the contrary, a study by Sheller et al, 2009 reported no correlation between dmft and BMI percentile [38].

In our study, children from higher socio-economic class reported higher prevalence of dental conditions (at least one of the three conditions), which was statistically significant. WHO has reported presence of socio-economic gradient across all countries (high, middle and low income), which implies that low-income groups are more affected [53]. However, our findings contradict this view. We did not come across any study that evaluated the association of all the three dental (cumulative) conditions with SES. However, a systematic review by Reisine and Psoter, 2001 [54] reported an inverse association between dental caries and SES in children less than 6 years of age. Similar findings were reported in a review by Kumar et al, 2015, however this study was done 6 -12-year old children [55]. Another study in 3-6-year South Indian children also showed a higher prevalence of caries in children with low SES [56]. In terms of studies for TDI, a study by Cortes et al reported a significant association between the two factors in 9-14 year old children; it further stated that children from higher SES were at a 1.4-fold risk of experiencing TDI [57]. The indicators of SES included questions regarding possessions, full time domestic servant and income of head of the family. Furthermore, a study in preschool children also reported a higher prevalence of TDI in children with mothers who were well educated [58]. Conversely, studies reporting inverse association stated that, more the supportive environment provided by the parents from higher SES, makes it less likely for the children to experience TDI [59]. Most studies used varied criteria for indicators of SES. A systematic review assessing the association was inconclusive due to heterogeneity among studies predominantly due to variability of indicators of SES [60]. Some used education status, family income, education status of parents. Finally, studies evaluating dental erosion with respect to SES reported both positive and negative association between the two [61,62]. A study by Luo et al, 2005 [62] in Chinese preschool children, reported a higher prevalence of erosion among parents with high SES. It further stated that, these parents might have adopted to a westernized lifestyle with increased consumption of sugar-sweetened beverages, juices etc. as opposed to lower SES who may have adhered to traditional drinks and diet. Similar results were obtained in study in 4-year old children [63]. Studies by Jones and Nunn et al. [62] and Walker et al. [64]; however have reported inverse associations. A study in Brazilian preschool children reported a non-significant association between the two [65].

There was very weak or almost no correlation between BMI and dmft in children with caries and children who were obese and

overweight in our study. Studies have reported positive association [36,66-74] as well as inverse correlation [75-79]. Some studies have also reported non-significant [80,81] or no correlation [38,53,82-85]. Based on the current literature, evidence on association or correlation of BMI and dental caries is inconclusive. The only Indian study reported in preschool children, a positive correlation was established, which is a contrasting finding to that in our study [86]. In case of underweight children, a weak inverse correlation was seen between the two in our study. Other studies have also shown a reverse gradient [76-80]. The possible reason may be inability to receive adequate nutrition due to pain and discomfort associated with caries [87]. A case-control study in children with S-ECC in preschool children in India revealed that, there was a negative impact on quality of life of the children [88]. Additionally, children with protein-energy malnutrition are more susceptible to dental decay. Studies have shown this association specifically in primary than the permanent dentition [89].

We could identify following limitations: Since preschool education is not mandatory in India, children from deprived populations may not be attending any preschools and were not included in the sample. Scales or indices to measure dental erosion are not available in the literature and hence it had to be measured arbitrarily by means of visual examination. Additionally erosion cavities may often superimposed by caries and hence the prevalence may be underestimated. TDI such as luxation injuries and concussions, which were not apparent at the time clinical examination could have been missed out in assessing prevalence, unless promptly reported by parents in the history. Relationship of modifying factors like dietary sugar exposure, brushing frequency and physical activities with caries or BMI categories could not be established as only a one-day record was obtained. This was because, the pilot study showed little or no compliance of parents for diaries to be filled for a longer duration. Also, the authenticity of the responses by parents on the food diary could be questioned as stating ideal responses owing to a response bias is commonly observed in questionnaire based surveys [90]. Self-reported assessment of physical activity, too has limitations. Cut-offs used for obesity and overweight are stated for the American population, however, the same have been recommended by the Indian Academy of Pediatrics (IAP) as one of the means to estimate the BMI percentiles. Likewise, age and gender-specific standard population means for Indian population are unavailable.

This study focuses on assessing the prevalence of obesity and overweight and dental conditions (dental caries, TDI and dental erosion), the relationship between obesity and overweight, dental caries, and the effect of modifying factors. This is the only study for the said population exploring these parameters. The findings of the present study could help generate further hypotheses to be tested.

Conclusions

- The prevalence of obesity and overweight was 13.46 and 9.79% respectively in urban preschool children.
- The prevalence of dental caries, TDI and dental erosion was 59.28, 5.33 and 1.20% respectively in urban preschool children.
- We found a very weak or non-existent correlation between dental caries and obesity and overweight in urban preschool children. However, the mean caries status recorded in terms of dmft was significantly higher in obese and overweight children than underweight.

More studies on the prevalence of and association between, dental conditions and obesity in different study populations with larger and representative samples are needed. Both (obesity and overweight, and dental conditions) being widely prevalent, effective common risk based preventive measures are essential.

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