Original Research Article

Sugar addiction and its role in obesity among adolescents residing in an urban field practice area of Bagalkot: A cross-sectional study

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A B S T R A C T

Background: Obesity, a multi-factorial process is showing an increasing trend among children and adolescents leading to increased prevalence of insulin resistance, paving the way for cardio-metabolic risk factors. It has been proposed that certain food items as well as eating habits are addictive in a way that is similar to substances of abuse. Thus, this study was conducted among adolescents to determine the frequency of sugar addiction, the influencing factors and its association with obesity.

Materials and Methods: A cross-sectional study was designed and 250 late adolescents (17–19 years old) chosen from colleges coming under urban field practice area of Bagalkot were enrolled in the study. A self-administered questionnaire which consisted of three sections - socio-demographic details, validated Modified Yale Food Addiction Scale (mYFAS) and Physical Activity Questionnaire for Adolescents (PAQ-A) was used to collect data regarding sugar addiction and physical activity in our study.

Result: Sugar addiction was found among 7.6% of adolescents and it was associated with overweight and obesity which was statistically significant (X^2=42.72, p<0.0001). Factors which significantly contributed to sugar addiction among adolescents were; adolescents staying in hostel (p<0.001), working mother's (p<0.0001) and socio-economic status (p=0.02). Univariate analysis (unadjusted odds ratio) showed that risk factors such as sugar addiction (Odds ratio 9.6, 95% C.I. 2.18-42.8, p=0.003) and reduced physical activity (Odds ratio 3.8, 95% C.I. 2.02-7.26, p=0.0001) were associated with overweight and obesity.

Conclusion: Incorporation of measures against hyper palatable sugary foods into public health policy recommendations and a further detailed evaluation regarding sugar addiction may provide a new insight and help in prevention and treatment of obesity.

1. Introduction

Sugar, an Indian invention is the most popular sweetener in the world. The army of Alexander the Great came to India in 327 BC and described sugar as a "reed that gives honey without bees" and thereafter it became well-known worldwide. Consumption of sugar is an intricate part of our Indian culture. It is a custom to sweeten the mouth after every meal or any joyous occasion, social gathering and dishes made of sugar is also considered mandatory as an offering to God on every religious occasion. Thus, sugar has considerable cultural and hedonic significance in India, but it is providing only "empty" calories (1 g of sugar gives 4 kcal). Nutritional point of view it is lacking the natural minerals which are known to be present in the beet root or sugarcane. Obesity was first included in the list of the Manual of the international statistical classification of diseases, injuries, and causes of death in the year 1948 by WHO.[1] Obesity is a multifactorial process and is been described as a global epidemic. There is a

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strong association between calorie intake and obesity. A better understanding of obesity as a disease is the need of the hour as it would not only help people be mindful about their calorie intake but also incline them towards having a balanced diet. This change at personal level would in-turn improve the efforts in curbing obesity at the national and global levels. Overweight and obesity is increasing at a breakneck pace in India reasons beings; an increase in energy intake owing to increased availability of food, purchasing power and reduction in the energy expenditure as a consequence of urbanization and mechanization.[2] The increase in the trend of per capita sugar consumption along with mechanization of work leading to decrease in the physical activity are important factors in view of the high tendency for Indians developing obesity and Non Communicable Disease (NCD). It is observed that of the 30% of obesity which begins in childhood 50-80% become obese adults.[3] This increase in the prevalence of obesity is of significance given the increased risk of chronic conditions associated with obesity such as insulin resistance, type 2 diabetes mellitus and heart diseases as well as some psychological implications like decrease in quality of life and stigma associated with weight issues.[4,5] Obesity is a heterogeneous condition and it has been proposed that addiction to certain foods could be a significant factor contributing to wrong eating habits like overeating and subsequent obesity. The dopaminergic brain circuits which are commonly associated with substance dependence are also known to be implicated in abnormal eating behaviours such as overeating in obesity according to a preliminary evidence from studies conduted.[6,7] A popular theory which is receiving increasing attention is that sugar acts as an addictive agent, eliciting neurobiological changes similar to those seen in drug addiction.[8,9] After Brazil, India is the second largest producer and consumer of sugar in the entire world according to the data collected from the Indian sugar trade industry (2013).[10] The gravity of this obesity pandemic demands extreme care and scrutiny into existing evidence and also the newer concepts such as sugar addiction as the scale and impact of obesity is unassailable. Despite of an elaborate literature search the data regarding sugar intake and its relationship with obesity among Indians and among adolescents is scarce and limited. Adolescent age group is of particular interest because it is a period wherein unhealthy eating behaviours or addictive tendencies are likely to develop. Moreover, adolescence is known to be a sensitive period for the development of psychosocial problems, being characterized by increased impulsivity and reduced inhibitory control. Along with increase in the risk of experimenting with alcohol and other substances of abuse, it may also give rise to unhealthy eating behaviour's and addictive tendencies towards food pushing them towards lifestyle related diseases.[11] Thus this study was primarily conducted to know the association between sugar addiction

and Body Mass Index (BMI) among adolescents and also to determine frequency and the factors which contribute to sugar addiction among them.

2. Materials and Methods

A cross-sectional study was undertaken among 250 late adolescents both boys and girls aged 17–19 years chosen from colleges coming under urban field practice area of SNMC, Bagalkot over a period of 6 months (June – November). Sample size was calculated using the formula $n = Z_{(1-a)}^2 \, p \, q \, / \, d^2$, where p = 20.2% (prevalence of sugar addiction among adolescents), precision = d = 5% and at Confidence level (1-α) = 95%. Equal number of adolescents with normal BMI and overweight/obese were enrolled in the study using a simple random sampling technique. Adolescents diagnosed with Hypothyroidism, Growth hormone deficiency and Cushing syndrome or any other metabolic disorders were excluded from the study. A verbal assent (from adolescent below 18 years) and consent was obtained from each participant after taking permission from the head of the institution. This study has been approved by the Institutional Ethics Committee for Human Subject's Research.

2.1. Study parameters

The enrolled participants were subjected to measurement of their weight in kilograms and height in centimetres (measured to the nearest 0.1 cm), using a digital scale in minimal clothing and a portable stadiometer respectively. The body mass index (BMI) was calculated as per the formula weight (kg)/height (m)^2. Obesity was defined as BMI> 2 standard deviations and overweight as BMI >1 standard deviation for age and sex as the recommendations of the WHO.[12] The Yale Food Addiction Scale (YFAS) has been developed and validated to identify individuals who show signs of addiction to hyper palatable foods. YFAS measures 'food addiction' by translating the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) criteria for substance dependence into criteria for 'food addiction'. Till date, this scale has shown adequate to good consistency and reliability in both clinical and non-clinical groups. In this study it was used to assess sugar addiction. A pre designed and tested, self-administered questionnaire consisting three sections - socio-demographic details of the participants, validated Modified Yale Food Addiction Scale (mYFAS)[13] and Physical Activity Questionnaire for Adolescents (PAQ-A) was used in the study to assess sugar addiction and intensity of physical activity respectively. It took around 20-30 minutes for the study participants to fill the questionnaire. The questionnaire was translated into their local language (Kannada) and verified by the subject experts and necessary instructions were provided to the participants before the distribution of proforma.

Assessment of sugar addiction was done using Modified Yale Food Addiction Scale (mYFAS) which is a validated 9-item, self-report measure of addictive eating behavior for particular type of food and here it was used to assess addiction towards sweet items like ice cream, chocolates, traditional sweets, cookies, cake, candy and sugar-sweetened beverages (SSBs) which includes the full spectrum of aerated drinks, fruit drinks, and energy water drinks containing added sugars etc. Answer options for first section ranged from 0-4 (0 – Never, 1 - Once per month, 2 – 2-4 times per month, 3 - 2-3 times per week, 4 - 4+ times per week) and other section (question 8 and 9) was Yes/No. To meet the addiction threshold people need to meet the threshold for either question 6 or 7 and meet the threshold for 3 or more of these questions (1-5, 8-9).

2.2. Statistical analysis

The collected data was checked for completeness and then coded and entered into Excel sheet. SPSS 21.0 software was used for analysis of the data. Numerical variables were analysed as means and standard deviations. Categorical data were summarized using frequencies and percentages. Chi-square test was used to test the association between various study variables. Differences between groups were considered significant with p value of <0.05.

3. Result

The study included 250 late adolescents, 123 (49.2%) participants among them were boys and remaining 127 (50.8%) were girls. Their mean age (±SD) was 18.1 (±1.09) year and ranged from 17–19 years. Maximum 72 (28.8%) of study participants belonged to class I socioeconomic followed by 61 (24.4%) from class III and 58 (23.2%) from class II, 42 (16.8%) and 17 (6.8%) from classes IV and V respectively according to the modified B.G. Prasad classification. Of the total 250 adolescents studied, majority 228 (91.2%) were Hindus, followed by Muslims 14 (5.6%) and 8 (3.2%) belonged to Christian and Jain religion. Majority 174 (69.6%) of adolescents were residing in their homes whereas, 76 (30.4%) of them stayed in hostel. In our study, 202 (80.8%) of the mothers of late adolescents were housewives, 37 (14.8%) were working either in private sector or were in government service and few were self-employed and the rest 11 (4.4%) mothers were daily wage workers.

Our study found that sugar addiction was present among 19 (7.6%) late adolescents. Out of 89 overweight adolescents 6 of them fulfilled the criteria for sugar addiction and out of 19 obese adolescents 11 of them had sugar addiction (Table 1). Sugar addiction was seen among only 2 (1.6%) adolescents with normal BMI and 17 (13.6%) adolescents who were overweight or obese showing that the sugar addition was associated

with overweight/obesity which was statistically significant. Majority (75.6%) of our adolescents had high/moderate level of physical activity. 73.8% of adolescents with low level of physical activity were overweight/obese when compared to 42.3% of adolescents with moderate/high level physical activity were overweight/obese and the difference was statistically significant.(Table 2) Socio-demographic factors like adolescents residing in hostel (p<0.001), adolescents having working mother's (p<0.0001) and increase in the socio-economic status (p=0.02) contributed to sugar addiction among adolescents and were statistically significant. It was seen that girls 13 (10.2%) had a slightly higher addiction towards sugar when compared to boys 6 (9.8) but the difference was not statistically significant. (Table 3).

A univariate analysis (unadjusted odds ratio) showed that risk factors such as sugar addiction (Odds ratio 9.6, 95% C.I. 2.18-42.8, p=0.003) and reduced physical activity (Odds ratio 3.8, 95% C.I. 2.02-7.26, p=0.0001) were associated with overweight and obesity (Table 4).

The most addictive items were chocolate, ice-creams followed by carbonated drinks, pastries and chocolates. Only 13% craved for traditional sweets (Figure 1).
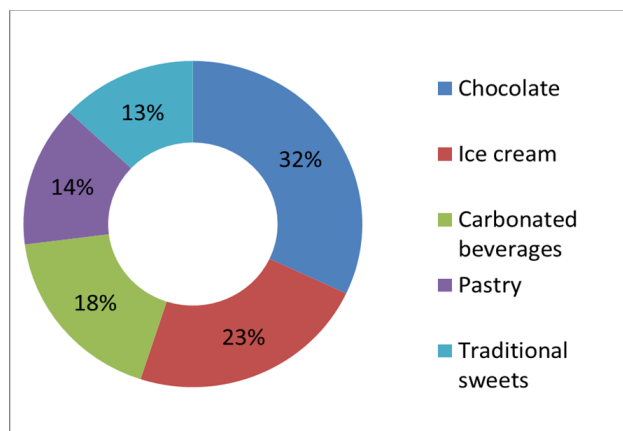

Figure 1: Most addictive food items

4. Discussion

Our study results showed that the frequency of sugar addiction was 7.6% among late adolescents which was much lower when compared to a study conducted in Iran[14] which showed the prevalence of overall food addiction of 17.3% and inability to cut down, withdrawal, and tolerance were the most common symptoms associated with food addiction. Girls (10.2%) had a slightly higher addiction towards sugar when compared to boys (9.8%) which was similar to meta-analysis showing similar findings[15] whereas another similar study conducted in Iran[14] showed that the females and students under 8 years were less likely to have food addiction when compared to the males

Table 1: Frequency of sugar addiction among Adolescents according to their Body Mass Index (BMI)

Sugar addiction	BMI		
	Normal	Overweight	Obese
Present	02	06	11
Absent	123	89	19
Total	125	95	30

Table 2: Association between BMI of adolescents with sugar addiction and physical activity

Variable	BMI		Total (%)	P value
	Normal	Overweight/Obese		
Sugar Addiction				
Present	2 (10.5)	17 (89.5)	19 (100)	X2= 12.82;
Absent	123 (53.2)	108 (46.8)	231 (100)	df= 1,
Physical Activity				p< 0.0001
Low level	16 (26.2)	45 (73.8)	61 (100)	X2= 18.25;
Moderate/High level	109 (57.7)	80 (42.3)	189 (100)	df= 1, p< 0.0001

Table 3: Association between socio-demographic factors of adolescents and sugar addiction

Variable	Sugar Addiction		Total (%)	p value
	Present (%)	Absent (%)		
Gender				
Boys	6(4.8)	117 (95.2)	123 (100)	X^2= 2.55; df = 1, p =
Girls	13 (10.2)	114 (89.8)	127 (100)	0.11
Residence				
Home	8 (4.6)	166 (95.4)	174 (100)	X^2= 7.347; df=1, p=
Hostel	11 (14.5)	65 (85.5)	76 (100)	0.007
Mother's Occupation				
Housewife	9 (4.5)	193 (95.5)	202 (100)	X^2= 7.347; df = 1,
Working	10 (20.8)	38 (79.2)	48 (100)	p<0.0005
Socio-economic status				
Upper class	16 (12.3)	114 (87.7)	130	X^2= 8.54; df= 1, p =
Lower class	3 (2.5)	117 (97.5)	120	0.0017
Physical activity				
Low level	3 (4.9)	58 (95.1)	61(100)	X^2= 0.826; df = 1, p=
High/moderate level	16 (8.5)	173 (91.5)	189 (100)	0.18

Table 4: Analysis of factors related to overweight/obesity

Variable	Odds ratio	95% C.I.	p value
Sugar addiction	9.6	2.18 - 42.8	0.003
Low level physical activity	3.8	2.02-7.26	0.0001

and students older than 8 years (p<0.05). Among female respondents a significant positive correlations was found between anthropometric measurements and food addiction score including body mass index and body mass index z-score, (p<0.01).[14]

A study conducted among adolescents in Damanhur City, Egypt showed 34.7% of adolescents meet the diagnostic criteria for food addiction which is much higher compared to our study.[16] The reason for dissimilarity in results in other studies showing higher prevalence may be because they took into account all the food items unlike our study which focused only on sugars. A meta-analysis by Pursey et al (2014) showed that prevalence of food addiction was higher among subjects over 35 (adults aged) than subjects less than 35 years (those younger).[15] On the other hand a study found that found the highest prevalence rates of food addiction was among 18-29 years age group.[17] Although speculative, it is possible that sugar addiction often develops at a younger age (during childhood and adolescence) when there is a greater preference for sweetness and has a tendency to decrease again with older age. Studies found higher prevalence of food addiction among overweight than underweight or participants with normal BMI and in girls compared to boys which is in line with the finding of our study which showed a statistically significant association between BMI and sugar addiction.[15]

Factors like adolescents residing in hostel (p<0.001), adolescents having working mother's (p<0.0001) and increase in the socio-economic status (p=0.02) showed significant association with sugar addiction among adolescents in our study whereas, Addictive-like eating was not associated with education level sex, or place of residence in a similar study conducted among German population. [17] Unlike the results of our study which showed traditional sources as least preferred, the data from a study conducted showed an increase in sugar consumption among Indians both from traditional sources and from Sugar Sweetened Beverages. [1]

Our findings showed the odds of being obese or overweight increased 9.6 times with sugar addiction which was similar to a study conducted in Greek which concluded that the predicted probability of becoming obese among youth was significantly associated with higher total and added-sugar consumption. The high consumption of added sugars increases the probability for overweight and obesity among youth, irrespectively of their other dietary or macronutrient intakes. [18]

Study limitations include, the cross-sectional design of the study wherein the temporal relationship cannot be established. Given the relatively smaller sample size cautious should to be drawn towards generalizability of the results.It is also important to note that in general the validity of the YFAS and food addiction diagnosis is still debatable. For instance, though there are similarities in compulsive food and substance abuse, there is no evidence of an addictive agent for food unlike the substances of abuse. And unlike the behavioral addiction that is gambling disorder there is only limited neurobiological and genetic evidence for overlap in food and substance abuse. Also, the sample selection method used in this study is different when compared to other studies thus there may be non-similarity in the findings.

5. Conclusion

Sugar as we know is a naturally-occurring food substance and is an integral component of many unprocessed foods. It is indeed necessary for healthy living until the rate at which it is consumed is going in the right direction. It is important to note that our brain cells utilize the monosaccharide glucose. Therefore, we cannot single out sugars as the enemy which is to be avoided at all costs as our brain depends on sugars as a primary energy source, in the same time it is necessary to be watchful and mindful about their consumption with the increase in the prevalence of obesity and its implications on health. The results of this study reflect upon the recommendation of World Health Organization for a reduction in consumption of free sugars. WHO further emphasizes on reducing the intake of free sugars to less than 10% of the total energy intake for preventing and controlling overweight and obesity. A

further detailed evaluation regarding sugar addiction may provide a new insight and help in prevention and treatment of obesity. Adolescents should try and limit the amount of time spent being sedentary. It has been proved beyond doubt that replacing sedentary time with any mild, moderate or vigorous intensity of physical activity provides health benefits. To help reduce the detrimental effects of high levels of sedentary behavior on health, adolescents should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.

Incorporation of measures against hyper palatable sugary foods into public health policy is recommended. Children and adolescents need to inculcate healthy eating habits from early childhood to prevent development of obesity and micro-nutrient deficiencies in adolescence and beyond. Effort should be made to reduce added sugars by imparting health education on nutrition. Opting for fresh fruits/nuts for snack time, as a dessert or rewards instead of sugar and fat-loaded sweets needs to be considered.

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