

WEIGHT STATUS AND CONSUMPTION OF SUGAR - SWEETENED BEVERAGES AMONG AFFLUENT ADOLESCENT BOYS AND GIRLS

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Abstract: Obesity in relation to Sugar Sweetened Beverages (SSB) consumption, a worldwide problem has extensively documented in western countries. Still, Indian data on SSB consumption of adolescents is lacking. Therefore, nutritional assessment, SSB intake, dietary consumption and milk consumption (assessed through 24 hour dietary recall method) prevalence, locale of SSB (assessed through semi structured questionnaire) among adolescents was recorded. Study was conducted at private schools of Jodhpur city (Rajasthan, India) including (600) adolescent aged 13-15 years. Grading of nutritional status was compared with WHO (2007) classification. For selection of categories and classification of SSB'S, NHANES III and NHANES 1999-2004 was referred. Among 15 years obese (20.62%) boys and (24.60%) girls were consuming maximum dietary calories (i.e. 1887.5±67.17 k.cal/day vs. 1942.16±296.94 k.cal/day respectively). Prevalence of soft drink consumption on a daily basis was reported among all the age group (100%) adolescents. Most preferred place for SSB consumption was home and school. Girls aged 15 years, consumed lesser milk (165.49±128.34 ml/day) as compared to boys. With advancing age, the caloric intake from SSB has increased among adolescents.

Keywords: Sugar Sweetened Beverages(SSB), Obesity, Affluent adolescents, Soft drinks

Introduction

Obesity is a condition of abnormal or excessive fat accumulation in adipose tissue. Bell *et al.* (2005), suggested that excess fat should not be considered as a disease, but instead as a, —collective adoption to the pathological environmental pressure to eat too much and exercise too little.

This disease is now emerging to suggest that the prevalence of overweight and obesity is increasing worldwide at an alarming rate. Over the past few decades, globally percentage of overweight had increased by 3.3% in 2000 (Onis and Blossner, 2000). WHO, Obesity International Taste Force (IOTF), 2004 reported 155 million youngsters as overweight or obese. The problem of overweight and obesity is confined not only to adults but also reported among children and adolescents of developed as well as developing countries. Over the past 25 years rate of overweight and obesity was observed as doubled in children (6- 11 years) and tripled in (12 to 17 years) adolescents (Dietz, 2004). Projections made for overweight and obesity among European Union's children assumed a linear trend, the proportion of overweight children would increase by almost 17%, and over 19% obese children from 2006 to 2010 (Leach and Lobstein, 2006).

The secular trends in prevalence of overweight and obesity among urban Asian Indian adolescents in New Delhi aged 14-17 years, revealed that, the obesity increased significantly 9.8% in 2006 to 11.7% in 2009 (P<0.01), where as underweight decreased from 11% to 3.9% (P<0.001) (Gupta *et al.*, 2011). The emerging evidence suggests an increase in over-nutrition status among children as well as adults. The National Family Health Survey (NFHS-4) 2015-2016, data showed that Indian obesity doubled in past 10 years among adolescents and adults aged 15-49 years.

Adolescence is a period of transition from childhood to adulthood it assumes critical position in the life cycle of human beings, characterized by an exceptionally rapid rate of growth and physical changes. Even changes can be observed in their food choices which are influenced by surrounding social and physical environment. Urbanization related intake behaviors may promote obesity including frequent consumption of meals at fast-food outlets, consumption of over sized portions at home and at restaurants, consumption of high calorie, low fiber foods and intake of sugar sweetened beverages. Dramatic increase in the frequency and size of soft drinks consumption is thought to be as the modern world's culprit that may contribute in obesity epidemic.

Clarie (2008), stated that US children and adolescents derive 10-15% of total calories from Sugar Sweetened Beverages (SSB). The percentage of calories consumed as SSB and fruit juice from 1988 to 2004 were estimated and it was found that on average, kids 2 to 19 years old got 242 calories a day from these beverages in 1988-1994, and 270 calories daily in 1999-2004 intake of SSB increased from 204 to 224 calories daily. While fruit juices intake rose from 38 to 48 calories per day. The sharpest increases in SSB consumption, of 20% were seen among 6 to 11 years old. Among teens, the 84% who drank SSB consumed 30 ounces daily or 360 calories, representing 16% of their calorie intake.

In India on premise consumption (at the place of purchase), of soft drinks for e.g. railway stations, restaurants and cinemas, accounts for an estimated 80% of the total soft drink market with in-house consumption (soft drinks purchased for consumption at home) accounted for the remaining 20% of the market (Centre for Management Research, 2005). Corresponding to the consumption, soft drink sales were also growing which was 76% between 1998 and 2002 from 5670 million bottles to over 10,000 million and increased at least 10% per year through 2012 (PTI, 9/29/2004). India food and drink report Q3 (2011), showed that growth in sales of soft drink was +11.9% and +9.6% as compound annual average growth during 2015.

Well-described data on obesity are available in the adult population from developed countries but data about Sugar Sweetened Beverage (SSB) consumption and contribution in affluent adolescent obese from developing country is still lacking. Therefore right from the beginning that is from school age extensive work is required to be undertaken. Although the cause of this apparent obesity epidemic is likely to be multi factorial, the findings may suggest that SSB consumption could be an important contributing factor. Thus, keeping in view the above facts and for providing direction for further work the current study is structured in concern with consumption pattern of Sugar Sweetened Beverages and obesity among adolescents.

Methods

A cross-sectional study was conducted including all private public schools (catering affluent group of society) of Jodhpur (Rajasthan), India. With fee structure of >1000 rupees per month were listed and approached for their consent to carry out the research. The schools, those agreed to be part of the study, four of them were then randomly (every alternate) selected. The sample size consisted of 600 subjects comprising of 300 girls and 300 boys, studying in 8, 9 and 10 standards, aged 13, 14 and 15 years.

Nutritional anthropometry was used to assess the nutritional status. It includes the subject's height and weight. Height and weight of adolescents were taken, as per the guidelines given by Gibson, 2005. Weight was measured by taking bathroom weighing scale with a 125 kg maximum capacity to the nearest 0.1 kg. For measuring height in standing position, a wall fixed anthropometer was used. The ratio of height and weight was used to measure BMI. Therefore BMI was accurately calculated using the formula, $BMI = \text{Weight (kg)} / \text{Height (m}^2\text{)}$. The cut-off point, BMI classification system, helped in prediction of the magnitude of the underweight, overweight and obesity status. Grading of nutritional status has been expressed on the basis of BMI values, as suggested by WHO, 2007.

Sugar Sweetened Beverage (SSB) consumption pattern : Various beverages are available in the market and are prepared at home. For selection of categories and classification of SSB'S, NHANES III and NHANES 1999-2004 (NHANES, 2004), classification includes 5 mutually exclusive, Non alcoholic beverage categories (Wang *et al.*, 2008).

1. *Cola (Pepsi, thums up etc.)*
2. *Non cola (sprite, seven up etc.)*
3. *Non carbonated and fruit flavored (roohafza, tang etc.)*
4. *Fruit juices with added sugar (maaza, frooti etc.)*
5. *Other beverages (tea, hot coffee, cold coffee etc.)*

Quantity: The quantity consumed each time adolescent's drank SSB i.e. SSB consumption every instance in context with glasses, cans and bottles. The taken quantity was converted into ml and calculated to find out total SSB consumption. Thus individual's consumption of SSB was made easy to evaluate.

Prevalence of SSB: With the help of open ended questions the prevalence of SSB was carried out.

Preference of SSB: A list of SSB available in local market was listed down in questionnaire and it was categorized in different categories. For the purpose each category was individually ranked by subjects that indicated the preferences or choice.

Location of SSB consumption: To evaluate, locations for frequent SSB consumption, the categories and sub-categories identified were, home environment (own home/ other people's home), school, restaurants, juice centers and fast food centers.

Sugar Sweetened Beverage calorie: Data gathered from 3 day, 24 - hour dietary recall, (i.e. 2 weekdays and a weekend) was calculated. SSB caloric values were used through the information, related to calories on the brand of SSB's.

Calorie Comparison: Calorie of each subject, calculated from Sugar Sweetened Beverages was compared with BMI and weight status viz. underweight, overweight or obese to evaluate the impact of SSB consumption. The comparison of calorie output from SSB vis-à-vis calorie output from regular meals is pictured to describe the contribution of calorie from SSB in a day's diet.

Dietary assessment: For dietary assessment, 24 - Hour Dietary Recall methods is used. All the foods and beverages (including milk intake), a person consumes within 24- hour dietary recall method, during 3 day dietary survey was listed. Assessment included two weekdays and one weekend. The quantity of the cooked food ingredients was converted into raw quantity to calculate the calorie content of each, using nutritive values of Indian foods, ICMR, 2000. To calculate energy of ready to eat food i.e. biscuits, chips etc. and SSB consumed was referred to calculate nutritional information given on packets. Thus, total daily dietary energy and SSB calories intake was assessed. Dietary calorie intake was compared with RDA given by ICMR, 2000

Consumption of milk: It was computed by 24 hour dietary recall method and compared to examine the amount of milk displaced with SSB consumed from day's diet of the subject.

Development of tool: Tool was developed for the collection of data related to the parameters described above. The tool consisted of semi-structured questionnaire, it was pre tested on 30 non-sample subjects for the clarity and to elicit the complete required information. The tool was finalized after necessary modifications.

Statistical analysis: The data of all 600 subjects were compiled and transcribe on excel sheet. The tabulated data was than given codes to each different variable. Range, Mean, median, standard deviation was applied for significance of data.

Result

Nutritional status: The nutritional status of all the adolescents is presented according to age which reveals that in the age group of 13 years, highest number (69.85%) of boys and 36.36% of girls were underweight. Whereby, only 9.52% of boys but 28.19% girls were normal. This indicates that normal nutritional status was maintained by more girls as compared to boys. Slightly higher numbers of overweight boys (20.63%) were observed in comparison to girls (15.45%). In contrast, none of the boys were observed as obese than girls (20.00%). In the age group of 14 years, more boys (58.44%) than girls (35.93%) were found underweight. Nearly one fourth of boys (20.77%) enjoyed normal nutritional status and more than 40.62% girls had normal weight. The magnitude of overweight was less (11.68%) in boys in comparison with girls (14.06%), while nearly similar number of both boys (9.10%) and girls (9.37%) were pictured as obese. Among boys in the age group of 15 years, 37.5% were underweight against 26.19% underweight girls. Almost forty percent boys (40.62%) and girls (41.26%) had normal nutritional status. Among boys and girls, prevalence of overweight and obesity was 20.62% vs. 24.60% and 1.25% vs. 7.94% respectively. This age group was influenced by overweight and obesity with a pattern of upsurge, plateau and then decline

Sugar sweetened beverage consumption pattern: Diverse lifestyle conditions have been related to the rise in changing dietary habits in which recently, the rise in irrational and injudicious use of SSB came into lime light. In the age group of 13 years, 25.39% of boys and maximum 70.90% girls drank 200-400 ml. While more than fifty percent of the boys (52.38%) as compared to 16.37% girls consumed > 400-600 ml of SSB. Whereby, 19.05% boys and 12.73% girls had >600-800 ml consumption. Only 1.59% of the boys were observed as > 800-1000 ml and >1000 ml consumers while none of the girls fell under this category. Among 14 year aged, only 2.59% boys as compared to maximum 35.94% of girls drank 200-400 ml of SSB. In contrast, higher number of boys 63.65% while lesser number of girls 26.56% drank > 400-600 ml. Approximately similar number of the boys (23.38%) and girls (25%) consumed >600-800 ml. In addition, lesser number of the boys (6.49%) and girls (12.50%) drank >800-1000 ml. While only 3.89% boys consumed >1000 ml as none of the girls were observed as consuming the same quantity of SSB. In the age group of 15 years, 9.37% boys and 11.12% girls consumed 200-400 ml. Where, maximum 35% boys drank as compared to 23.02% girls > 400-600 ml of SSB. In contrast, 34.38% of the boys and a higher number of maximum 42.85% girls drank > 600-800 ml SSB. Approximately similar number of the boys (19.38%) and girls (20.63%) had > 800-1000 ml consumption. Likewise, the boys and girls consumed > 1000 ml of SSB were 1.17% and 2.38% respectively.

Prevalence of soft drinks consumption: In 13 year age group, 79.03% of the boys and 98.1 % girls consumed soft drinks daily. Whereas among both boys (20.97%) and girls (1.86%) did not have soft drinks on daily basis. Among 14 year aged, more than forty percent (44.15%) of the boys and surprisingly all of the girls (100%) were daily soft drink consumers. More than half of the (55.85%) boys and none among the girls did not consume soft drinks on daily basis. In the age group of 15 years, 60% of the boys and again, all girls (100%) consumed soft drinks daily. Only 40.63% boys reported as not consuming soft drinks daily, as shown in figure:1.

Preferences of SSB: Current study depicted that with age choice of SSB varied. Some of them were collectively disliked (least preferred) by adolescents viz. Fizzy and Sugarcane juice. In general, Carbonated beverages were found to be most popular and preferable among adolescents. Subjects reported that Carbonated beverages are refreshing and good in taste.

Place of SSB consumption: From figure :2, it is clear that among 15 year age group, maximum (49.07%) of boys and (52.76%) girls were frequently consuming any SSB at home environment. Followed by in- school, restaurants, juice centers and fast food centers. Results are consistent for rest of the groups

SSB calories and weight status: Age wise consumption of food and SSB intake showed that among 13 year aged underweight boy's, mean daily dietary calorie intake was found to be 1365.44± 160.46 k.calories and 190.19± 87.34 from SSB. In case of underweight girls consumed 1489.75± 301.99 calories in a day and out of

which 167.99 ± 46.69 calories were through SSB consumption. Among normal weight boys, dietary caloric intake was 1276.72 ± 206.48 and 181.44 ± 14.85 k.calorie through SSB. In case of girls, dietary caloric intake was 1409.77 ± 215.61 and 173.45 ± 30.81 k.calorie through SSB. In overweight boys total daily dietary and beverage consumption provided 1416.69 ± 143.53 and 215.47 ± 63.51 k.calorie respectively. In comparison to boys, overweight girls consumed more total dietary calories in a day 1495.5 ± 134.90 and 197.59 ± 26.54 calorie were contributed from SSB consumption. None of the boy in this age group was found to be obese. The obese girls had 1711.76 ± 502.54 calorie in a day and 312.48 ± 103.38 k.calories came from SSB source. It was noted that maximum SSB calories were consumed by obese girls as compared to boys and girls of other weight status. The 14 year aged, boys and girls consumed more calories through food and beverages, which suggests that with age caloric consumption also increased. Underweight boys consumed 1539.35 ± 205.37 calories from diet and 236.83 ± 81.18 through SSB calorie Whereas girls consumed more dietary and SSB calorie, which was recorded as 1632.97 ± 147.74 for dietary and 250.10 ± 78.80 for SSB calories respectively. Boys and girls categorized as in normal weight status consumed 1505.25 ± 202.86 and 1665.64 ± 249.46 dietary calorie respectively. Whereas, SSB calories was observed as, 236.98 ± 106.56 vs. 279.04 ± 127.35 for both boys and girls. Overweight boys (11.68%) had 1642.48 ± 292.60 dietary calorie and 260.51 ± 50.63 SSB intake. Whereby, as compared to boys, girls consumed, more calorie (i.e. 1669.44 ± 267.19) from diet and as well as through SSB intake (219.44 ± 267.19). Maximum dietary consumption was observed in obese boys and girls i.e. 1700.53 ± 309.62 and 1733 ± 178.26 k.calorie/day respectively. However, boys consumed less (342.06 ± 64.36) SSB calorie as compared to girls (397.72 ± 99.01 calories). In the age group of 15 year, underweight boys and girls dietary caloric intake was observed more (1937 ± 252.16 calorie/day) in boys than girl consumers (1795.21 ± 295.83 calorie). Similarly, SSB intake was more (340.81 ± 83.07) in boys than that of girls (275.68 ± 113.31). Surprisingly, normal weight boys consumed less (1834.22 ± 242.21) dietary calorie as compared to underweight boys and through SSB 343.17 ± 88.52 k.calories were consumed. Normal weight girls had more (1900.28 ± 345.31 calorie) total dietary calorie as compared to normal weight boys. On comparing SSB calorie consumption with boys, it was observed that girls consumed more (326.56 ± 97) calories. Overweight boys (20.62%) had mean caloric dietary intake of 1854.42 ± 266.44 and 375.34 ± 90.94 as SSB calorie. Comparatively girls had more (1861.87 ± 347.40) dietary and SSB (364.08 ± 128.71) calories than overweight boys. Boys those who were obese had 1887.5 ± 67.17 total dietary and 438.16 ± 12.02 SSB calorie consumption. Maximum total dietary (1942.16 ± 296.94 k.calorie) and SSB (443.86 ± 52.88 k.calorie) were observed in obese girl subjects. Results are given in Figure :3.

Milk vs. SSB: As indicated in Figure : 4, among 13 year age group, boys had 218.17 ± 226.23 ml/day milk and 530.15 ± 172.86 ml/day of SSB intake. Girls also had less milk consumption (133.33 ± 94.53 ml/day) then SSB intake (462.27 ± 146.39 ml/day). It was observed that though girls consumed less SSB than boys but in contrast, boys consumed more milk than girls did. Among 14 year aged boys, the consumption of milk was 226.28 ± 252.18 ml/day while SSB intake was noted to be 622.07 ± 183.26 ml/day. Girls also had less milk intake than SSB, 200 ± 0 vs. 557.03 ± 239.02 ml/day respectively. In 15 year aged boys milk intake was 265.11 ± 252.18 ml/day. While SSB consumption was 682.5 ± 180.33 ml/day. Again, girl's intake of milk was observed less (165.49 ± 128.34 ml/day) and SSB intake was more (694.44 ± 227.17 ml/day).

Discussion

In children and adolescents, BMI varies with age and gender. As children grow older, BMI increases (Pietrobelli *et al*, 1998). Present study also indicated that, BMI increased with age among males of 13-15 years and with girls no such trend could be observed. In the present study among the adolescents, 18.67% overweight and 7.83 % obese were determined using BMI. Where Kapil *et al*. (2002), reported a 7.4% obesity in affluent school children in Delhi. A higher prevalence of overweight girls has also been reported by Ramchandra *et al.*, (2002) and Marwah *et al.* (2006), from upper socioeconomic status (USES) school girls which was 19.01% compared to 16.75% boys.

The findings of the present study are also partially comparable with French *et al.* (2003), which indicated that between 1977 and 1998, the consumption of carbonated soft drinks by school aged children in United States aged (6-17 years) has increased from 5 fl. oz. (148 ml) to 12 fl. Oz. (355 ml) day(-1). Grimm *et al.* (2004),

reported that soft drink consumption was higher among boys compared with girls ($P=0.03$), and intake increased with age ($P<0.001$). Finding by Nielsen and Popkin (2004), suggested that the US large increase in soft drinks consumption is mainly driven by children aged 2 to 18 years and consumption increased by 50.25% (317- 476ml) and 32.5% (212-281ml) day⁻¹ for boys and girls respectively. Which is in consistence with current study , 13 year aged (52.35 %) boys, consumed >400 ml to 600 ml and 14 year aged (35.94%) girls had 200-400 ml SSB consumption.

According to Nylund (2002), a common problem associated with consumption of a large number of soft drinks is the increased acid levels throughout the body. All soft drinks are very acidic, but dark colas are much more acidic. Present study indicated that almost all adolescent's preference was dark cola.

Sharma (2008) from India reported that, in-home juice consumption has increased from 30 to 80% in last 3 years. Even Wiecha *et al.* (2006), also stated that homes and fast food restaurants are potentially greater source of soft drink consumption.

It was observed that, with advancing age, the calorie intake from SSB as a percent of total calorie increased. This study clearly suggests an uptrend in the consumption of SSB with advancing age among boys and girls. However, boys consumed more SSB as compared to girls. Overall data indicated negative correlation between SSB consumption and weight status among 300 boys and positive correlation among girls ($r^2 = -0.1298$ for boys and $r^2 = 0.1265$ for girls). But SSB consumption was high for boys and girls (i.e. 443.86 ± 52.88 k.cal/day vs. 443.86 ± 52.88 k.cal/day; i.e. $R^2 = 0.0238$ for boys; $R^2 = 0.0641$ for girls). Various workers found that an increase in the consumption of sugar drinks was significantly associated with greater weight gain and greater risk of obesity over time in both children and adolescents .Ebbeling *et al.* (2006), Welsh *et al.* (2005). On considering the dietary intake of overweight and obese adolescents included in the current study, it was observed that their average dietary intake was less. However, SSB calorie were much more, which indicates the larger portion size (i.e. 673.66 ml/day by overweight and 739.74 ml/day by obese) and hence contributing as extra calories per day. Gillis and Bar (2003), found that among children and adolescents (4-16 years) obese subjects consumed more sugar sweetened drinks and combination of sugar sweetened drinks and sodas than did non obese subjects. Where, Ludwig and colleagues (2001), observed an association between sweetened beverage consumption and children's weight with each 12 oz sugared soft drink accounting for a 0.18 kg/m² increase in BMI and a 60% increase in risk of being obese. Similar observations were noted in current study. Over the past 25 years, adolescents have changed their beverage intake and decreased their milk intake, (Bowman ,2002 and French *et al.*,2003). This shift had a negative impact on health by lowering nutritional quality and decreasing micronutrient intake. Present study also showed that in all the subjects milk consumption was much lower (203.49 ± 201.37 ml/day) than that of SSB intake (613.5 ± 210.79 ml/day). Consumption of high sugary drink intake may place children at risk for not getting the nutrient they need for optimal health. Mrdjenovic and Levitsky (2003) defined that this may contribute to increased risk of bone fractures and obesity. Blum *et al.* (2005), also found that change in milk consumption was inversely correlated with Sugar Sweetened Beverage consumption. Increase in diet soda consumption was significantly greater for overweight and subjects who gained weight as compared to normal weight status subjects.

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Appendix

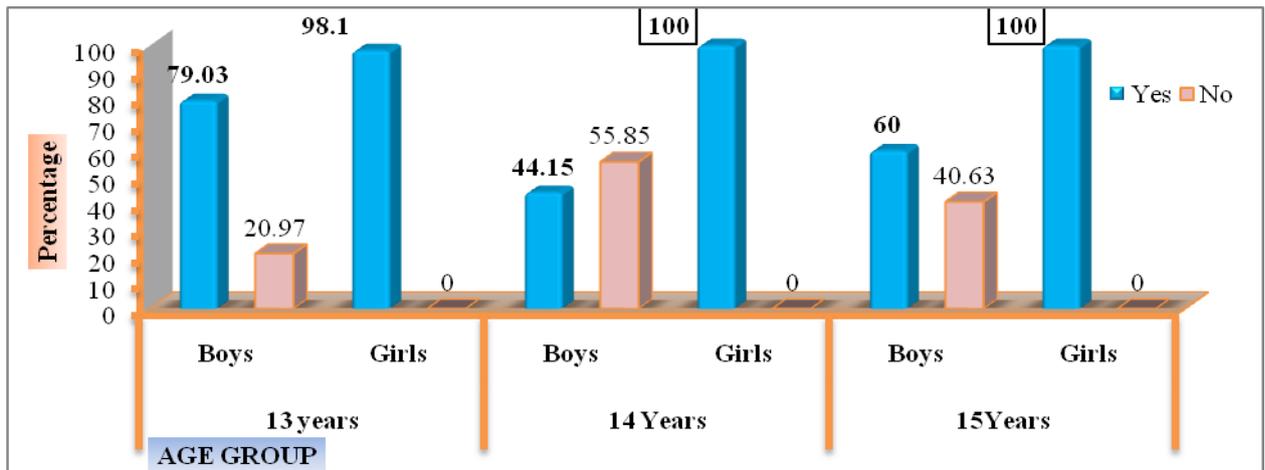


Figure:1 Prevalence of Soft Drink consumption

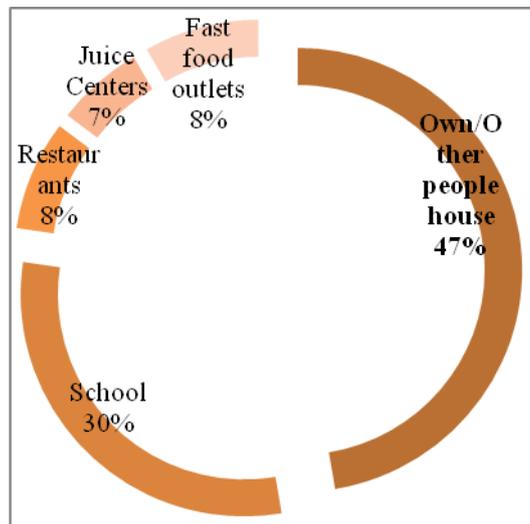


Figure:2 Locale and source of SSB consumption

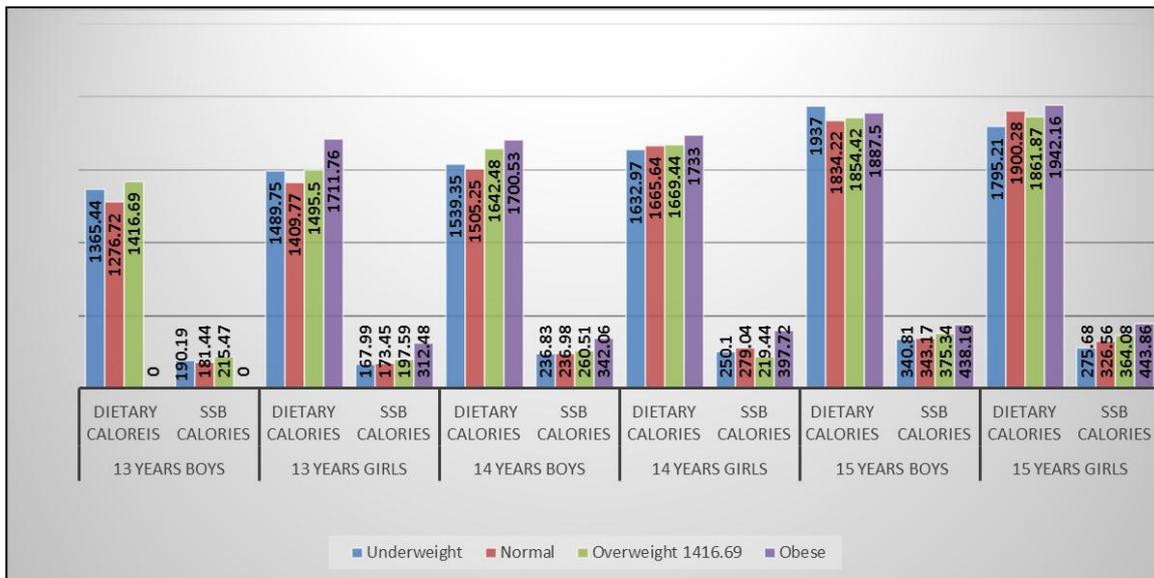


Figure: 3 Mean total dietary and SSB consumption



Figure:4 Per day milk and SSB consumption