

## Association between Milk versus Sugar-Sweetened Beverages, and Childhood Obesity in School Age Children

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### Abstract

**Background:** Childhood obesity is a worldwide phenomenon causing multiple morbidities. Globally, there will be 254 million obese children by 2030. Children are obese due to nutritional imbalances. The dietary patterns among Saudi children have shifted towards greater intake of sugary drinks and less milk intake. **Aim:** to assess the association between milk versus sugar-sweetened beverages, and childhood obesity in school age children. **Subjects and Methods:** Descriptive correlation study. **Sample:** 589 children selected by a multistage cluster sampling technique **Setting:** Eight schools in Al Ahsa Governorate. **Tools:** Children demographic information, milk and sweetened beverages consumption questionnaires developed by the researchers. Children BMI calculated by CDC BMI Calculator. **Results:** More than one third of children are overweight and obese. More than half of them consume sweetened/flavored milk, the majority drinks sweetened juices and about half of them consume soft drinks. More than one third of children drink coffee and nearly half drinks tea on daily bases. A significant relationship was found between children's BMI and high consumption of coffee and tea. **Conclusion:** Children low consumption of healthy milk and overconsumption of sweetened beverage, coffee and tea lead to obesity. **Recommendations:** Community outreach programs promoting health beverage choice, replacing sweetened beverage with adequate milk conception, can be an effective strategy for maintaining a healthy BMI in school age children.

**Keywords:** Milk, Obesity, School age children, Sweetened beverages

## Introduction

Obesity is a worldwide disorder during childhood. Increased prevalence of obesity among children from 0.7% to 5.6% in girls and from 0.9% to 7.8% in boys during the period from 1975 to 2016 was reported (**Di Cesare et al., 2019**). According to forecasts made by the Global Obesity Federation using data from the Non-Communicable Disease (NCD) Risk Factor Collaborative, there will be 254 million obese children and adolescents (aged 5 to 19) worldwide by 2030. Out of 43 million obese children worldwide, 35 million come from developing nations, with 17.5 million of these children residing in Asia (**Akter et al., 2022**). In the Kingdom of Saudi Arabia (KSA), childhood obesity prevalence in 2020 was 21.7% (**Al Shaikh et al., 2020**). A recent report from 14 districts of the Eastern Region of KSA found that about 25.7% of children were obese or overweight. Moreover, 14.6% of boys and 15.1% of girls were overweight and 11.1% of boys and 10.8% of girls were obese (**Albaker et al., 2022**). Additionally, a nationwide survey showed that obesity rate is higher in boys compared to girls (**Alhamed, et al., 2023**). Obesity reported to appear around age of 10 years, increased

significantly, and became more complex around 19 years. It results from many factors including genetic, low physical activity, nutritional imbalances and over consumption of sugar-sweetened beverages (SSBs).

Excessive consumption of SSBs causes a range of adverse health outcomes, including type 2 diabetes, cardiovascular disease, and obesity. While these chronic conditions typically present themselves in adulthood, it is vital to consider the potential impact of SSBs on the health of children during critical stages of development. Individuals who had one or more SSBs servings per day had a higher genetic risk of obesity and an elevated Body Mass Index (BMI); this risk was double that of individuals who consumed less than one serving per month (**Malik & Hu, 2022**).

Many SSBs contains caffeine, high-fructose corn syrup, and fruit juice concentrates which can lead to brain gene alterations and consequently causes many disorders such as attention deficit hyperactivity disorder (ADHD). Fructose, in particular damages brain cell communication, increases the presence of toxic molecules in the brain, and long-term

high-fructose diet can impair the brain's capacity to learn and remember information (**Kay, 2019**). Additionally, milk consumption has decreased with the rise in sweetened juice intake and lead higher calorie intake and obesity (**Grummon, 2019**).

Milk offers significant dietary benefit, it is rich in protein (3.6 g per 100 ml), Ca (124 mg per 100 ml), vitamin B12 (0.9 µg per 100 ml), riboflavin (0.24 mg per 100 ml) and iodine (31 µg per 100 ml). It is also a good source of potassium (160 mg per 100 ml), P (97 mg per 100 ml) and vitamin B5 (0.7 mg per 100 ml). Milk also contains calcium and insulin-like growth factor-1, which are essential for children's development and growth. Therefore, children's diets should include milk. It provides a good amount of calcium, promotes eye, nerve, and muscle health, and protects against obesity, all of which aid in physical development (**Kang, Sotunde, & Weiler, 2019**).

In an effort from Saudi Arabia Government to promote school age children health, the Saudi Dairy and Foodstuff Corporation (SADAFCO) initiated Saudi Milk-sponsored program introduced in 2020 for schools located in 16 different cities throughout the Kingdom with an emphasis on raising awareness of the

value of a nutritious diet. Although, a million Saudi primary school students have benefited from this educational program, continuous effort is needed to ensure children compliance with the recommended milk intake of two and half to three cups per day for children 5 to 18 years old (**Statista Research Department, 2022**).

### **Significance of the study:**

Saudi Arabia faces a growing obesity epidemic, with a reported prevalence of 27% among children aged 10 to 19 years. The consumption of SSBs, such as sodas and sweetened juices, has been consistently linked to increased Body Mass Index (BMI), higher waist circumference, and greater body fat percentage in children. A systematic review and meta-analysis encompassing 33 studies with over 121,000 participants revealed that higher SSB consumption was associated with a 0.75 kg/m<sup>2</sup> increase in BMI, a 2.35 cm increase in waist circumference, and a 2.81% rise in body fat percentage among children and adolescents (**Al-Jawaldeh et al., 2024**).

Conversely, replacing SSBs with milk particularly low-fat or fat-free varieties has demonstrated protective effects against weight gain. These findings underscore the importance of

beverage choices in childhood obesity prevention strategies and emphasize the need for public health initiatives promoting healthier drink options. In Saudi Arabia, where childhood obesity rates are alarmingly high, such studies are crucial for informing effective interventions and policies to combat this growing health crisis. (Collison et al., 2010). Therefore, the aim of the study is to assess the association between milk versus sugar-sweetened beverages, and childhood obesity in school age children.

### **Research question**

What is the association between milk and sugar-sweetened beverage consumption and the development of obesity among school-age children?

### **Subjects and Methods**

**Study Design:** A descriptive correlational study used to study school-age children pattern of sweetened beverages, milk Consumption and obesity. Using an effect size of 80, a confidence interval of 95%, and a significant level of .05, the calculated sample size was 589 children. The schools were selected using stratified sampling technique. A list of all governmental primary schools in the biggest two cities in Al Ahsa Governorate was obtained from the directory of education, four schools from each city were selected

randomly, then approval from the eight schools was obtained along with a list of all classes in grades 3 to 6. One class from each grade from each school was randomly selected using simple random method.

**Participants:** All children from selected classes in grades three to six were included in the study. However, children with any food allergies (lactose Intolerance, celiac disease), chronic diseases, physical or cognitive disabilities were excluded.

### **Data Collection and measurements**

After receiving IRB approval for the study (Approval no. IRB/21XX/23) dated 22 August 2023 from KAIMRC-ER along with schools' administrative approvals and children guardians' consent, data collection commenced. Children assent to participate in the study was taken orally in addition to take their parents' Approval.

Data collected from September 2023 to April 2024 using interview guided by a structured questionnaire. The questionnaire was developed by the researchers and revised by two content experts to ensure content validity. Minor corrections done accordingly. The questionnaire includes three sections.

The first section included sociodemographic information for the

child and his living condition. Second section included sweetened beverage and milk consumption information such age type, amount and frequency. The last section related to measurement of child's height in cm, weight in kg using SECA 769 Digital column scale (Seca Electronic Column Scales, N.D]. These measurements along with child gender, age in months entered in the BMI Percentile Calculator for Child and Teen (CDC, 2023). The resulted BMI, BMI- for-age category entered in the data collection sheet.

Four researchers trained to conduct the interviews, while another four trained to take measurements (height, weight and calculating the BMI for age). This training carried out during a pilot study of 20 subjects prior to the official start of the research. Interrater reliability checked by percent agreement among researchers and it was 96%. Data collection carried out in the morning period before children go to their lunch break. Two researchers filled in the questionnaire and two obtained the measurement for each child.

Statistical Analysis: Data summarized and analyzed using the SPSS statistical package, version 29 (IBM Corp, 2020). Data checked for normality then descriptive statistics (means, SD, Frequency distribution) used to

disrobe study participants the pattern of milk and sugar-sweetened beverages consumption. Inferential statistics (T-test and ANOVA) implemented to test the relationship between participants characteristics, consumption of milk and sugar-sweetened beverages and their BMI accordingly.

## Results

Children characteristics presented in Table 1. The study included 589 children from eight governmental primary schools, 47.5% of children from Al Hofuf city and 52.5% from Al-Mubaraz city, 57.9% were boys and 42.1% were girls with a mean age of  $10.20 \pm 1.30$  years. Majority of the children live with both parents (95.1%) in medium family six family (71.6%) with most of the mothers are not employed (72.5%). Almost half of the children have unhealthy weight (43.3%). Children were either underweight (6.1%), over weight (17%), obese (12.9%), severely obese (7.3%) with a weight range from 15.4Kg to 140Kg.

Children reveal diverse preferences of milk and sugar-sweetened beverages consumption patterns (Table 2). A small percentage of children (7.8%) do not drink milk at all, while about one-third (33.6%) prefer plain milk, and more than half of them (58.6%) prefer

flavored or sweetened milk. In terms of preferred dairy products, 32.1% do not consume milk products (milk only), 14.8% prefer cheese, 39.9% prefer yogurt, 10.7% prefer ice cream, and 2.5% refrain from dairy altogether. The frequency of milk products consumption also varies, 5.6% consume milk products less than once a week, and 23.8% consume milk products once a week, 28.5% twice a week, and 42.1% consume milk products daily.

The results also indicated that of the majority of children consume artificially flavored, sweetened juices with 69.9% consuming at least one serving per day and 17.2% consuming two or more serving daily. Regarding soft drinks like soda, 44.5% of children drink a can of sweetened juices per day, and 6.9% take two or more cans per day.

In terms of other beverages, almost one third of children drink coffee on daily basis (35.7%), with 69.1% consuming

one cup, and 30.9% two cups or more. Also, almost half of the children drink tea (52.8%) out of them 68.2% drink one cup, and 31.8% drink two or more cups daily.

Table3 shows the relation between children's BMI and various characteristics, as well as their patterns of milk and sugar-sweetened beverages consumption. The data reveals that Children with higher BMIs tend to be male, older, from larger families and those living with grandparents. Additionally, children of less educated parents were having higher BMI. Higher BMI were also associated with consumption of flavored and sweetened milk, juice, and cheese. There was a statistically significant relationship between children age ( $t= 16.34$ ,  $p= .001$ ), consumption of coffee, ( $F=7.56$ ,  $P= .001$ ), and consumption of tea ( $F= 7.96$ ,  $P= .001$ ) and their BMI.

**Table 1. Distribution of the studied children Sociodemographic Characteristic**

Characteristics (N=589)	N	%
Gender		
▪ Male	341	57.9
▪ Female	248	42.1
Age (in years)		
▪ <10	248	42.1
▪ ≥10	419	71.1
(Range), Mean ± SD	(7-12). 10.22 ±1.287	
<b>Mother education</b>		
▪ Primary or less	46	7.8
▪ Elementary- Secondary	251	42.6
▪ University and up	292	49.6
Mother employment		
▪ No	427	72.5
▪ Yes	162	27.5
Father education		
▪ Primary or less	35	5.9
▪ Elementary-Secondary	249	42.3
▪ University and up	305	54.8
Living with		
▪ Both parents	560	95.1
▪ Either mother/father	24	4.1
▪ Grand parents	5	0.8
Family size (members)		
▪ Small (< 5)	70	11.9
▪ Medium (5-7)	422	71.6
▪ Large (> 7)	97	16.5
BMI level		
▪ Under-weight	36	6.1
▪ Healthy weight	334	56.7
▪ Over-weight	100	17
▪ Obesity	76	12.9
▪ Severe Obesity	43	7.3

**Table (2): Distribution of milk and sweetened beverages consumption (N=589)**

<b>Milk and Beverages Consumption</b>	<b>N</b>	<b>%</b>
Preferred type of milk		
▪ Plain Milk	198	33.6
▪ Sweetened/ Flavored milk	345	58.6
▪ I do not drink milk at all	46	7.8
Preferred dairy products		
▪ Milk only	189	32.1
▪ Cheese	87	14.8
▪ Yogurt	235	39.9
▪ Cream	63	10.7
▪ I do not take any	15	2.5
How often child consume milk products		
▪ Less than once a week	33	5.6
▪ Once a week	140	23.8
▪ Twice a week	168	28.5
▪ Daily	248	42.1
No of sweetened drink/juices/day		
▪ None	76	12.9
▪ One	412	69.9
▪ Two or more	101	17.2
No of soft drink/ day		
▪ None	286	48.6
▪ One	262	44.5
▪ Two and more	41	6.9
Child drink coffee		
▪ No	379	64.3
▪ Yes	210	35.7
No of coffee cups child drink (n=210)		
▪ One	145	69.1
▪ Two or more	65	30.9
Child drink tea		
▪ No	278	47.2
▪ Yes	311	52.8
No of tea cups child drink (311)		
▪ One	212	68.2
▪ Two or more	99	31.8



**Table (3): Relationship between Children BMI, their characteristics, milk, and beverages consumption**

Characteristics	BMI Mean $\pm$ SD	F/t <i>P</i>
Age (in years)		
▪ <10	18.19 $\pm$ 3.784	16.34
▪ $\geq$ 10	19.91 $\pm$ 4.982	.001*
Gender		
▪ Male	19.57 $\pm$ 4.955	0.927
▪ Female	19.19 $\pm$ 4.401	.336
▪ Living with Both parents	19.37 $\pm$ 4.687	
▪ Living with Either mother/father	20.59 $\pm$ 5.552	0.98
▪ Living with Grand parents	21.00 $\pm$ 9.475	.403
Family size		
▪ Small (< 5 members)	19.59 $\pm$ 4.500	0.86
▪ Medium (5-7 members)	19.26 $\pm$ 4.603	.423
▪ Large (> 7 members)	19.94 $\pm$ 5.397	
Mother education		
▪ Primary or less	21.38 $\pm$ 5.534	1.58
▪ Elementary-Secondary	19.98 $\pm$ 4.481	.178
▪ University and up	18.94 $\pm$ 4.480	
Preferred type of milk		
▪ Preferred Plain milk	19.156 $\pm$ 4.474	2.46
▪ Preferred Flavored/Sweetened	19.824 $\pm$ 5.269	.117
sweetened drinks/juices/ day		
▪ One	19.42 $\pm$ 4.891	0.47
▪ Two or more	19.26 $\pm$ 4.447	.707
Coffee cups child drink/day		
▪ None	18.82 $\pm$ 4.391	7.56
▪ One	20.12 $\pm$ 5.101	.001*
▪ Two or morre	22.71 $\pm$ 5.824	

**Cont. table (3):**

Tea cups child drink/day	18.91±4.149	7.96
▪ None	19.62±5.214	.001*
▪ One	22.96±6.239	
▪ Two or more		

\* Statistically significant at level  $P < 0.05$

**Discussion**

The current study was the first in the region, offers valuable insights into the pattern of sugar-sweetened beverages and milk and their relationship with school age children' BMI at a randomly selected eight primary schools in Al Ahsa Governorate, Eastern Region of Saudi Arabia. Among the 589-studied children, more than third were overweight and obese. This is an alarming figure of the increasing rate of childhood obesity compared to previous reports from the different studies in the country as well as in the same region. For instance, a study conducted from 2015-2016 on school age children across different regions of KSA, estimated the prevalence of overweight and obesity of school age children at 21.5%, which increased to 25.7% in 2016-2017 (Albaker et al., 2022).

Moreover, the prevalence estimates of overweight and obesity among children in KSA continued to increase from 20% in 1990 to 60% in 2019 signifying a persistent trend of obesity among children (Almubark &

Alqahtani, 2023). Consequently, obesity-related morbidities is escalating and significantly leading to cardiovascular (Aljaadi & Alharbi, 2021) and cardio-metabolic risks (Albaker et al., 2021). During adolescents and early adulthood. In response to this growing concern, the kingdom has implemented multiple strategic objectives through the Ministry of Health to address the escalating obesity rates, aligning with the goals of Saudi vision 2030 (Ibrahim, Albwardi, Alzaher, Nahhas & Alabdulkareem, 2021). To achieve the strategic goal of the lowering obesity among Saudi children, factors causing such phenomena mandates an investigation.

The Profile of obese children among school age children in the current study indicated a varied pattern and relationship between children BMI and their demographic characteristics, and the consumption pattern of sugar-sweetened beverages and milk. Older boys tend to have higher BMI. Obesity rates increase as children get older. Kraft, 2023, explained that significant

weight gain is normal during preadolescent ages, early in girls and late in boys, between 9 -12 years old, because the body store fat preparing child for the rapid growth during puberty (Kraft, 2023). Understanding if a child's weight gain is healthy or unhealthy is about more than just numbers. However, developing healthy habits during childhood including diet and exercise can prevent continuation of weight gain and its unhealthy consequences during adulthood. This also emphasized by a recent study conducted in the Eastern Province, Saudi Arabia, evaluating the prevalence of adiposity among university students. The study indicated that male students were obese with higher adiposity compared to female students (Albaker et al., 2021).

Children who live in big families, with grandparents and less educated mothers, tend to be overweight and obese. In Saudi culture, it is common to live in big families with grandparents in same house. In addition, gathering with other family members on regular basis, which can have both positive and negative effects on children's nutritional habits. On one hand, family gatherings often involve preparation and sharing of delicious traditional foods, which can enhance

children's enjoyment of meals and promote a sense of cultural identity. On the other hand, family gatherings can also lead to unhealthy eating habits and excess as well as consuming excessive calories, unhealthy snacks, sweets and sugary drinks. This can negatively affect their nutritional well-being and lead to obesity. To ensure that family gatherings have a positive impact on children's nutritional intake, it is important for parents and caregivers to promote healthy eating habits and moderation by offering a variety of nutritious options, encouraging portion control, and providing guidance on making balanced food choices.

Moreover, the study results indicated that, children of less educated parents tend to be overweight and obese. In a longitudinal study, it explained the mediation effect of parents' education and the child's weight. The study indicated that parenteral education level was significantly associated with a higher BMI in children and 5 years later during late adolescents. The socioeconomic statues of the family, leading to behavioral and psychological risk factors for a higher BMI on the long term (Seum, Meyrose, Rabel, Schienkiewitz, & Ravens-Sieberer, 2022).

A well-balanced diet for children should include milk and its products. Milk and its products are crucial nutrients for children's healthy growth and development. Research studies reported that those children who consume milk regularly might have lower risk of obesity (Dror, 2014). This is because of the nutritional profile of milk and its role in balanced diet and its ability to promote a feeling of fullness and satiety.

More than half of the studied children do not follow the dietary recommendation of milk and its products' daily intake. Balanced Approach of dietary intake and encouraging children to consume milk as part of a balanced diet while limiting sweetened beverage intake can support healthy growth and weight management. When children do not consume the recommended amount of milk, they tend to consume other beverages with high Sugar Content including sodas and sugary juices, which are high in added sugars and calories but low in nutritional value.

The study results indicated that children who consume more sugar-sweetened beverages have higher BMI. Similarly, Gan, and associates, 2022 reported that more sugar-sweetened beverages intake is associated with higher prevalence of

overweight and obesity among children (Gan et al, 2021). High rate of SSBs are increasing worldwide. The rapid growth of beverages production and supply with the attractive marketing strategies aiming young children and youth contributed significantly to the over consumption of SSBs. High consumption of SSBs. can displace the children's healthier options like milk or water, leading to nutrient deficiencies and increased caloric intake without essential nutrients.

Moreover, the study showed a statistically significant relationship between children's BMI and the consumption of coffee and tea. Children who drink tea and coffee are more likely to be overweight and obese. In Saudi Arabia, the consumption of coffee and tea by children linked to cultural and social factors. Coffee, an integral part of Saudi heritage and culture, is often associated with hospitality and social interaction. Traditionally, Saudi families serve coffee at social gatherings and celebrations, where children observe adults drinking coffee and develop curiosity and a desire to participate in this practice. When children see family members regularly drinking coffee, they may also wish to

imitate them and feel included in these social moments.

Although, the practice of children drinking coffee and tea in Saudi Arabia is deeply rooted in the cultural norms and social practices of the community, adults should be aware of its unhealthy effects on children. Coffee and tea can affect children in several ways due to the caffeine content causing; increased alertness, difficulty concentrating, and potential sleep disturbances and poorer sleep quality, consequently, increased risk of obesity in children, as it can disrupt appetite-regulating hormones and affect metabolism (Rogers, Banks & Jenkins, 2024). As well as consuming high-calorie, caffeinated drinks regularly contribute to an overall increase in calorie intake leading to weight gain and obesity (McCormick, Reyna & Reifsnider, 2020). In addition, caffeinated beverages may replace healthier options such as water or milk with these drinks that offer little to no nutritional value. This can lead to a lack of essential nutrients and an imbalanced diet, which can contribute to weight gain.

### **Conclusion**

The current study was the first in this region to assess the association between milk versus sugar-sweetened beverages, and childhood obesity in

school age children. The low consumption of healthy milk and overconsumption of sweetened beverage, coffee and tea lead to obesity.

### **Recommendations**

Based on the study finding we recommend that further research studies; to include parents for more detailed report of the child daily dietary intake; to include other behavioral and psychological factors associated with obesity such as physical activity, screen time, family history and genetic predisposition. Additionally, develop outreach school and community programs about appropriate consumption of milk and beverages for children's health focusing on school age children with less educated parents. Promote awareness among teachers and school administrators about the importance of restricting marketing of sugar-sweetened beverages at school and improving access to water and healthier drinks such as milk.

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