

Assessment of Diet Quality and its Potential Cariogenicity among School Children during School Days in Cairo Governorate: A Cross-sectional Study

Yasmine H Mohamed^{a,*}, Osama El-Shahawy^b, Manal El-sheikh^c

^a *infection control manager, dental hospital, Future University in Egypt*

^b *Future university in Egypt*

^c *Cairo University*

Abstract

Aim of the study: The current study aims to assess the diet consumed by primary school children aged 9 to 12 years old during school days attending public and private schools, and reveal its potential cariogenicity.

Subjects and methods: The study included 456 primary schoolchildren from public and private schools. The researcher selected the age group from 9 to 12 years. Children in the current study were from both gender girls and boys. The investigator divided the food into three categories rather than the normally adopted two. The first category, highly cariogenic food that are high in sucrose, and the second category non cariogenic food. The second category medium cariogenic food is comprised of food items listed by some authors as highly cariogenic but not recognized as such by all authors and the third category non cariogenic food.

Results: The results showed, statistically significant difference was found between public and private schools in relation to the mean overall intake of highly cariogenic and medium cariogenic food, where the mean overall intake of highly cariogenic and medium cariogenic in public schools and among males was found unexpected higher than those of private with mean 1.4515 for the high cariogenic index and 1.3679 for the medium cariogenic index. Private school students are more likely to eat twice during school time than public schools, private schools 68.0% and public schools 51.2% almost half of the sample eat twice. The source of food differs significantly according to the school type. More than 40% of the public school students get their food from both the school itself and home. While, more than 55% of the private school students get their food from home.

Conclusions: The highest cariogenic potentially food intake was at public schools. The highest frequency of intake of cariogenic potentially food was at private schools more than public schools which might make them at the end similarly affecting children tooth. Boys tend to eat more cariogenic food than girls. The source of cariogenic food in public schools was largely attributable to the canteens food and their home snacks while the source of cariogenic food in private schools was largely attributable to food brought from home. The public schools are delivering education programs regarding dental health in the education more than private schools. Even though public schools are proving awareness but the majority of students in public schools are not following the recommendations in their food selection. Lack of Nutrition plans in both type of schools. Lack of school policies limiting candies use as incentive in both type of schools and lack of monitoring of the canteens to ensure healthy food delivery in both type of school.

Keywords: cariogenic food, caries, diet frequency

1. INTRODUCTION

Dental caries is a global public health problem and is the most widespread non-communicable disease. It is an expensive disease to treat, consuming 5–10% of healthcare budgets in industrialized countries, and is among the main reasons for hospitalization of children in some high-income countries (O'Mullane et al., 2016).

Sugars are the essential dietary factor in the development of dental caries because dental caries does not occur in the absence of dietary sugars. It develops when bacteria in the mouth metabolize sugars to produce acid that demineralizes the hard tissues of the teeth (enamel and dentine) (Moynihan and Kelly., 2014).

In the last ten years, evidence has demonstrated that dietary practices, particularly the consumption of free sugars, are of critical importance to the development of dental caries. High levels of dental caries occur in middle-income countries, where sugars consumption is high. In such countries, health systems are challenged to provide preventive population-wide strategies (Schwendicke et al., 2016).

The effect of diet on dental caries essentially refers to the carbohydrates involving a broad group of foods and those that are more easily fermented by bacterial species are monosaccharides (glucose and fructose) and disaccharides (sucrose, lactose and maltose), which have a low molecular mass and are designated sugars. Starch is a polysaccharide with a complex, voluminous molecule that hinders its diffusion in dental biofilm and its use in bacterial metabolism. Sucrose is especially cariogenic because it serves as substrate through the polymerization of glucose and fructose for the synthesis of extracellular polysaccharides in dental plaque which promote bacterial adherence to dental surfaces (Feldens et al., 2019).

The burden of dental caries has been increasing among children due to the unlimited consumption of sugary substances. Although, dental caries is more prevalent in school children. Extreme levels

of caries were lower in the school with the sugar restriction, compared with other schools without sugar restrictions (Mulu. Et al., 2014 and Thornley et al., 2017). Accordingly, this study will explore the food consumed during school days and its potential cariogenic.

SUBJECTS AND METHODS

1- Study Design:

The current study was an observational (cross-sectional) study.

2- Sample size calculation:

A multi-stage sampling technique was adopted during sample selection. At the first stage, the Cairo governorate schools were divided into two categories: public and private. Two schools from each category were then selected to draw our sample randomly. Students were then stratified again according to their gender and a representative sample was drawn from the primary schools in accordance with the reports published by Central Agency for Public Mobilization and Statistics, (CAPMAS., 2017).

Accordingly, the calculated total sample size was 400 students from 4 selected schools; 275 from two public schools which constitutes approximately 68.6% of the whole sample required and 125 from two private schools which constitutes approximately 31.4% from the whole sample required to be a representative sample as follows, **Table (1)**

Table 1: **The planned sample structure**

School type	Public		Private		Total
	275		125		
Gender	Boys	Girls	Boys	Girls	
Planned	143	132	64	61	400

The sample size specification procedures and power calculation have been done according to (Cochran., 1963 and Togoo et al., 2012) with assumed values.

The actual sample size attained was augmented by around 15% to assure that the researcher could make up for any missing data or incomplete questionnaire, the researcher had to confine the public-school sample to one school, the total number re-

*Corresponding author.

quired from the two public schools was attained from one public school with the same proportions due to the obstacles to get the appropriate permission.

The study sample included 456 Egyptian primary school children aged 9 to twelve years, from two private schools and one public school in Cairo governorate from 11/2018 till 4/ 2019.

3- Subjects selection:

A-School selection:

Three schools were selected by the researcher from which the random sample was drawn. The schools were selected by the researcher due to issues of accessibility as well as permissions to collect data inside the schools. The three schools were namely; Summit private school, Privilege private school and Tarek Ibn Ziad Mokatam public school.

B-Student selection:

In each school students were selected in a simple random manner the researcher had to be provided with the full lists of the school students. This was not approved by the school administration thus a Bernoulli toss procedure was adopted (**Forbes et al., 2010**) where the data collectors had a coin flipped whenever they meet a student, if the coin landed head the student is chosen, if tail he/she is not interviewed. This way each student in the school had an equal chance to appear in the sample to assure the randomization.

4-Ethical consideration:

-Informed written consent

Prior to interviewing the students, the study was explained to the Head of schools and an informed consent were obtained.

5- Eligibility criteria:

1.1. Inclusion criteria:

- 1-Children from 9 to 12 years old.
- 2-Both genders.
- 3-Positive child acceptance for participation in the study.

1.2. Exclusion criteria:

- 1-Uncooperative children.
- 2-Medically compromised children.

6- Bias:

1.3. Selection Bias:

The study population was selected randomly.

1.4. Information Bias:

All information was reported using standardized methods by a single investigator to avoid information inaccuracies.

1.5. Reporting Bias:

All outcomes were reported.

7)-Setting and Location: School children aged 9 to 12 years old, attending one public school and two private schools in Cairo Governorate, Egypt were included in this study.

-Subjects:

A total of 456 school children were selected to participate in the study. Two hundred and ninety nine of the participants were from one chosen public school and one hundred and fifty seven students from two chosen private schools.

2. School children questionnaire: Children were interviewed using fixed-choice questions

-The questionnaire was constructed to match the objectives of the study, the questionnaire included:

1- personal data:

-In this section, the investigator recorded child's name, gender and type of school.

2-Medical History :

-This section included recording of the child medical status, if he has any type of food allergy or any previous operations.

3- The type of food consumed :

In the questionnaire used in the current study, the type of food was categorized into three categories according to the quality of food intake during school times revealing its potential cariogenicity:

The 1st category “High cariogenic food” which contained the highest sucrose and starch-sucrose combination, comprised of:

3. Sandwich with jam filling

4. Cookies

5. Biscuits

6. Lollipops

7. Cereals

8. Ice cream

9. Jam with croissant

This category was agreed by (Togoo et al., 2012, Velvarde et al., 2014, Verma et al., 2016, Soliman et al., 2017 and Rad et al., 2017)

The 2nd category “Medium cariogenic food”, which contained starch alone that is not combined with sugar, which comprised:

10. Sandwiches with cheese fillings

11. Rice

12. Macaroni

13. Chips

14. Plain croissant

This category was agreed by some authors to be cariogenic as mentioned by (Halvusrud et al., 2019 and Canadian Institute., 2020) and non-cariogenic or low by others authors as discussed by (Crenby et al., 2009, Togoo et al., 2013, Barone et al., 2018 and Soliman et al., 2018).

The 3rd category “Low cariogenic food” which included only fruits as one item from the low-cariogenic food items.

15. Fruits

According to (Beighton et al., 2004, Verma et al., 2016 and Togoo et al., 2017).

The questionnaire included (others) to give the chance to write other items and decrease the bias, Appendix (3).

4- The frequency of intake:

-The frequency of food intake during school times, children were asked if they eat once or twice during school days.

5- The source of food:

-This section included inquiries regarding the source of food either from home or school outlets or both home and school outlets.

6-The school intervention to control the cariogenic food intake:

-Here the investigator asked whether there is presence of nutritionist or awareness programs. This question was answered by the school teachers at each school interviewed.

- Students were asked whether they received candies as incentive in classrooms.

-The questionnaire was conducted in a uniform manner by the same examiner to ensure consistency and quality of findings. The data concerning the subjects were entered into the database each subject with a numerical code only for the purpose of confidentiality.

-Only the main investigator who was in charge to distribute the questionnaire and explain it to the school children in both public and private schools.

-The questionnaire was translated into Arabic for public school students.

16. Statistical Analysis:

-The analysis has been carried out using version 23 and the graphs were drawn using Microsoft excel 2016, Z test is used to compare the difference between calculated proportions and Pearson Chi-test is used to assess the independence of the different variables. Furthermore, T tests are also used to depict the difference between the means of the independent samples of school students.

-An index was used named high cariogenic index and medium cariogenic index to calculate the average consumption of high and medium cariogenic food items. This index was calculated as follows; Medium cariogenic index= Sum of the number of medium cariogenic items in each child diet, index for medium cariogenic is 0-5, 5 is the number of medium cariogenic items listed on the

list. The index is 0 if there is no medium cariogenic items in his diet and 5 if he eats 5 medium cariogenic items in his diet.

17. RESULTS

18. Collected sample:

The data collection resulted in the following sample structure that covers all the planned structural counts, **Table (2)**:

Table 2:

School type	Public		Private		Total
Gender	Boys	Girls	Boys	Girls	
Attained	149	150	75	82	456

19. Data Analysis:

20. 1: Food consumption distribution in public and private schools:

21. 1a: The highly cariogenic food consumption by students in public and private schools, Fig (1 :

Examining the different highly cariogenic food items consumed by the students during the school day revealed a different pattern in each school type. In public schools the highest consumed food items were biscuits at 51% followed by cakes at 45%. While in private schools it was cookies at 26.1% followed by ice-cream at 22.9%. Moreover, other items mentioned by students in private schools were “Nutella” chocolate spread sandwiches showing 10% of the study sample.

22. 1b: The medium cariogenic food consumption by students in public and private schools, Fig (2 :

The highest consumed medium cariogenic food items were chips, sandwiches with cheese filling. The percentage was 65.6%, 43.5% in public schools and 36.3%, 19.1% in private schools respectively and other items were mentioned by

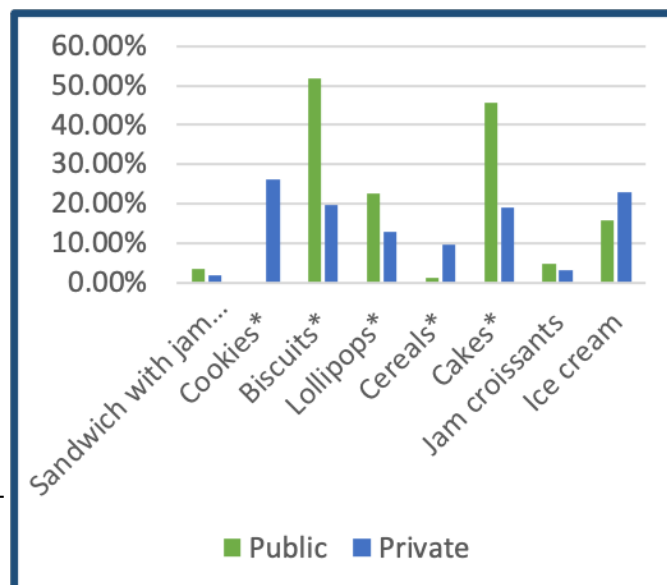


Figure 1: Bar chart for the highly cariogenic food consumption in both public and private schools.

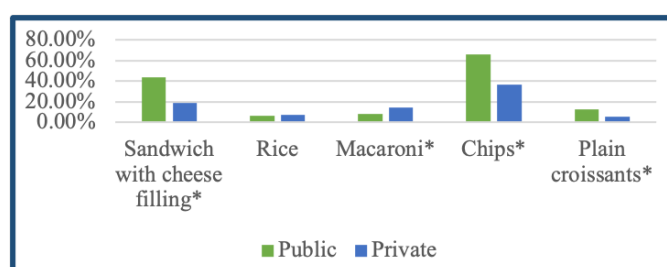


Figure 2: (2): Bar chart for the medium cariogenic food consumption in public and private schools.

public school students around 15% had cold cuts and beans sandwiches (Egyptian fava beans).

2.1.c: The low cariogenic food consumption by students in public and private schools, Table (6), Fig. (5):

Fruits consumption was relatively low in both types of schools. It was 21.7% in public schools and 30.6 % in private schools.

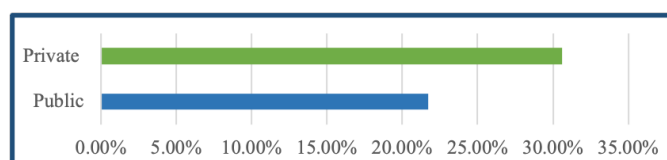


Figure 3: (3): Bar chart for the consumption of low cariogenic food in both public and private schools.

23. 2: Food consumption distribution in public and private schools in relation to gender preference:

2.2. a: The consumption of highly cariogenic food in public and private schools by students in relation to the gender preference, Fig.(4).

The only significant difference in the highly cariogenic food consumption among different gender was reflected in the consumption of lollipops; boys 23.7%, girls 15.1% and ice cream; boys 23.7% and girls 12.9% as boys seem to consume these items more than girls.

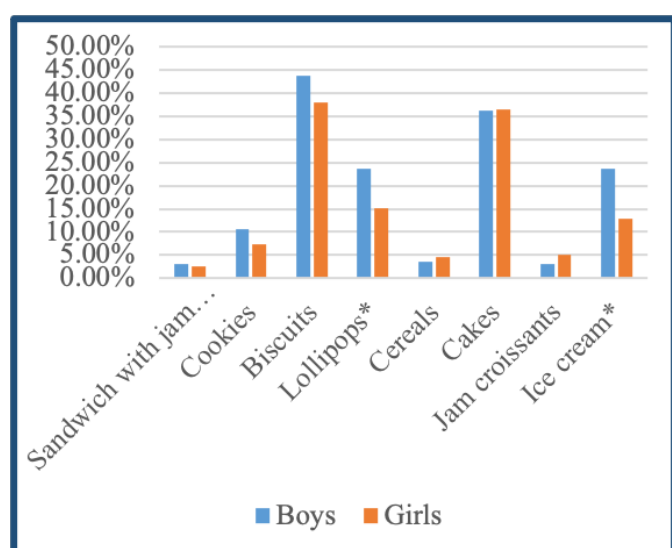


Figure 4: (4): Bar chart for the distribution of highly cariogenic food preferences by the student's gender.

2.2.b: The consumption of medium cariogenic food in public and private schools by students in relation to the gender preference, Fig.(5).

The only significant difference in the medium cariogenic food consumption among different gender was reflected in the consumption of rice as boys seem to consume these items more than girls, boys 9.4% and girls 4.3%.

2.2.c: The consumption of low cariogenic food in public and private schools by students in relation to the gender preference, Fig.(6).

There is no significant difference in the consumption of low cariogenic food between boys and

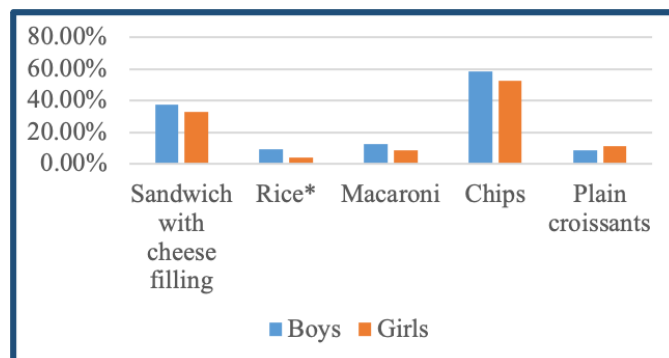


Figure 5: (5): Bar chart for the distribution of medium cariogenic food preference by the student's gender.

girls in public and private schools, it shows the following percentages boys 23.7% and girls 25.9

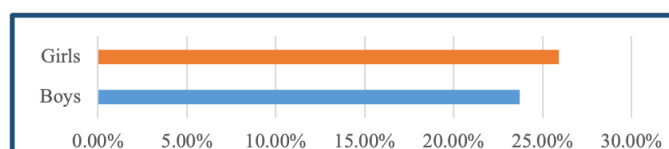


Figure 6: (6): Bar Chart for the distribution of low cariogenic food preference by the student's gender.

24. 3: Overall cariogenic food intake analysis:

24.1. A: The average consumption of highly cariogenic food and medium cariogenic food items, Table (3)

There is a significant difference between the average intake of highly cariogenic food and medium cariogenic food items by students within public and private schools. Public school students seem to tend more towards cariogenic intake showing the mean of high cariogenic food index in public school to be 1.4 among 299 schools children interviewed. While, in private schools the index is 1.1 based on 157 schoolchildren interviewed. However, the mean of medium cariogenic index in public schools is 1.3 and 0.8 in private schools.

Table 3: The descriptive statistics for the average consumption of high and medium cariogenic food items

	Type of school	N	Mean	Std. Deviation
High cariogenic index	Public	299	1.4515	1.27449
	Private	157	1.1529	1.02636
Medium cariogenic index	Public	299	1.3679	.88903
	Private	157	.8280	.81002

25. 3b: Cariogenic food overall intake analysis clustered by their gender, table (4 :

There is a higher tendency to eat high cariogenic food items among boys in both public and private schools. It was also found that the mean of high cariogenic index in public schools for boys was 1.5 and girls 1.3 While, in private schools was found to be 1.3 for boys and 1.0 for girls.

In addition, the mean of medium cariogenic index in public schools for boys was 1.4 and for girls was 1.2. While, in private schools the mean was 0.9 for boys and 0.74 for girls.

Table 4: The average consumption of public and private school students high and medium cariogenic food consumed by students clustered by their gender.

	Type of school			
	Public Student gender		Private Student gender	
	Boys	Girls	Boys	Girls
High cariogenic index	Mean 1.56	Mean 1.35	Mean 1.32	Mean 1.00
Medium cariogenic index	Mean 1.44	Mean 1.29	Mean .92	Mean .74

26. 4: Beverage consumption:

26.1.

26.1.1. Beverage consumption by type of school:

The only significant difference between the two types of schools concerning the beverage consumption was in the usage of the canned juices

which was higher in public schools showing 20.7% in public schools and 10.2% in private schools.

26.2. B: Beverage consumption by gender:

Boys are found to be consuming more beverages than girls in general while girls depend more on drinking water. The significant differences among the boys and girls were in the consumption of soda, milk and water respectively with the following percentages, 44.6%, and 38.4% and 61.6% while girls 29.9%, 27.6% and 71.6%.

27. 5: Relationship between eating frequency and school type:

Private school students were found to be eating twice during school time with a percentage of 69.0% while in public schools, eating twice a day was recorded by 51.2% of the students.

28. 6: The relation between food source and school type:

The source of food differs significantly according to the school type. More than 40% of the public school students get their food from both the school itself and home. While, more than 55% of the private school students get their food from home.

29. 7: Evaluating the school role in preserving the students' dental health:

30. 7a-Relation between teachers offering sweet treats and type of school:

Private school teachers tend to offer sweet treats as rewards to students where 75% of students received sweets as incentive from their

teachers. While in public schools 62% of the schoolchildren received treats as incentive from their teachers.

30.1. B-Delivery of education awareness programs

The results showed that delegates from the Ministry of Health gave dental awareness sessions twice a year in each semester to students and staff of public schools. However, private schools do not hold such sessions.

30.2. C-The presence of nutritionist in schools

The study showed that public schools have an assigned general practitioner from the Ministry of Health who is not interfering with any nutrition plans for students. Also, in private schools, they have a resident general practitioner who is also not involved in any nutritional plan for students.

31. DISCUSSION

Dental caries is one of the most prevalent diseases globally; almost half of the world's population is affected by dental caries. Dental decay is highly prevalent amongst schoolchildren and the main cause is sugary foods. Evidence has shown that the consumption of carbohydrates is of great importance to the dental caries occurrence (**Shwendicke et al., 2016 and Ghasemi-anpour et al., 2019**).

The effect of diet on dental caries, principally refers to the confined impact of carbohydrates on dental tissue or metabolized by cariogenic microorganisms in the oral cavity. Carbohydrates involve a wide-ranging group of food and those that are more simply fermented by bacterial species monosaccharides, disaccharides which have low molecular weight and polysaccharide e.g starch (**Feldens et al., 2019**).

Owing to the fact that there is little data concerning the diet consumed by schoolchildren and its potential cariogenicity in Egypt, the current study was carried out to assess the diet consumed by primary schoolchildren attending public and private schools during school days and reveal its potential cariogenicity.

The study included 3 schools despite the fact that the sample size was 400 schoolchildren from 4 schools; 2 private and 2 public schools. It was hard to obtain the government permission to access the two public schools.

The study included 456 primary schoolchildren from public and private schools, the total sample size calculated was 400 but the actual sample size attained was augmented 25% to assure the researcher could make up for any missing data or incomplete questionnaires.

The researcher selected the age group between 9 to 12 years so they can fill the questionnaire, understand and answer the questions properly.

According to many studies, the tendency to cariogenic food was linked to socioeconomic status (**Kamate et al., 2019**). Students enrolled in private schools were found to be coming from higher socioeconomic level than students enrolled in public schools (**Velvarde et al., 2014**). Accordingly, in this study both types of schools were investigated to evaluate the different types of consumed food in schools during the school day.

Children in the current study were from both genders, the food choices are different between them as referred by **Verma et al., 2016** in his study among schoolchildren in India.

Medically compromised children are sometimes restricted to certain type of diet such as diabetic children (**Gray et al., 2019**). That is why medically compromised children were excluded from this study. The foregoing is implemented using the Bernoulli toss which ensures that each student had an equal chance to appear in the sample to assure randomization.

The literature divides food into two categories, highly cariogenic and non-cariogenic food as agreed upon by most authors such as **Togoo et al., 2012, Verma et al., 2016 and Rad et al., 2017**. However, this study divided food into three categories rather than the normally adopted two. The first category, highly cariogenic food that is high in sucrose, the second category medium cariogenic food comprised of food items listed by some authors as highly cariogenic but not recognized as such by all authors, and the third category, low cariogenic food such as fruits.

According to **Grenby et al., 2009** the starch in its natural state is of low cariogenicity. However, cooking it, processing it or eating it frequently increase its cariogenic potential. Nevertheless, sucrose still poses a high level of cariogenicity. In another study, Gelatinized starch are susceptible to enzymatic breakdown. However, they are considered low cariogenic such as backed potatoes, rice and pasta (**Decker and Iovari, 2003**).

Additionally, evidence has shown that not all starch are associated with increased risk of caries. Some are of low cariogenicity such as the slowly digested carbohydrates compared to rapidly digested starch which is higher in cariogenicity than slowly digested starch (**Halvorsrud et al., 2019**). Although, all complex carbohydrates found in wholefoods such as potatoes, rice and bread are considered less cariogenic than sugary food which are high in sucrose. Nevertheless, starch that is retained on the teeth long enough (e.g. potato chips) may be hydrolyzed by salivary amylase and could be broken down to monosaccharides and disaccharides and later metabolized by bacteria (**Mirajkar., 2014**).

The results showed that in public schools the highest consumed cariogenic food items were biscuits at 51% followed by the cakes at 45.5%. While in private schools it was cookies at 26.1% followed by ice cream at 22.9%. Biscuits were significantly high in public schools while cookies were significantly high in private schools. Results regarding public schools are in line with the results reached by **Verma et al., 2016**. The latter found that biscuits were the most commonly consumed items in public schools in Bangalore, India representing under developed countries. While in Madrid, Spain, a study found that the most commonly consumed cariogenic foods were confectionery such as cakes, biscuits, cookies, ice cream and lollipops in both public and private schools (**Velvarde et al., 2014**) which is representative of more developed countries.

The higher consumption of biscuits in public schools may be due to its low cost followed by cakes that are prepared at home due to the low cost of their ingredients. In private schools, we

find cookies followed by ice cream. This is justified by the high impact of television and marketing campaigns on different types of cookies and ice cream as well as the availability of resources and the affordability of these items in private schools.

In public and private schools, the highest consumed medium cariogenic food items were respectively 65%-36.3% chips, sandwiches with cheese filling 43%-19% and around 15% of public-school students had cold cut meats and beans sandwiches (Egyptian Fava beans). The sandwiches with cheese fillings and chips were significantly higher in consumption compared to private schools, respectively. The results were similar to the results published by **Ishak et al., 2013** in Malaysia where private schools children usual consumed snacks were white bread with spread as a sandwich and they were also similar to the results **Conway et al., 2002** in California where most lunch bags components in public and private schools were sandwiches and chips. This may be justified as sandwiches are easy to be prepared and less costly while chips are always on the TV marketing programs and most children crave it.

Fruits consumption was relatively low 21.7% in public schools and 30.6% in private schools. These results are consistent with **Rad et al., 2017** who found that there is little percentage of children who consumed fresh fruit in Iran amongst schoolchildren from public and private schools. Since, fruits are not sweet in taste and not appealing for children like any confectionary. This makes the consumption always low.

In the current study, statistical significant difference was found between public and private schools in relation to the mean overall intake of highly cariogenic and medium cariogenic food, where the mean overall intake of highly cariogenic and medium cariogenic in public schools and among boys was found unexpected higher than those of private with mean 1.4 for the high cariogenic index and 1.3 for the medium cariogenic index. Thus, children belonging to the low socio-economic status had higher caries prevalence than those belonging to the high socio-economic status and the boys have more caries prevalence compared to girls.

This could be due to the low socioeconomic class, their parents are less educated and less aware of the dietary habits which affect dental caries. In addition, the number of siblings is high so their mother give less care to each child.

As regarding the boys' tendency to eat more cariogenic food rather than girls, the reason is unknown and might be due to the sample size was higher among the boys. This was supported by **Velvarde et al., 2014** who stated that boys have higher cariogenic risk than girls and opposed by **Rad et al., 2017** who agreed that gender has no relation with the dietary habits.

Private school students were found to be more likely to eat twice daily 68.0%, while 51.2% of public school students recorded eating twice daily. The results were consistent with **Rad et al., 2017**. In approximately 31.0% of schoolchildren ate sweet foods (chocolate/cake/biscuit/chips), and in 39.4% they drank soft drinks (sugared tea, coffee, or milked/soda/syrup) more than once a day. The tendency at private schools to eat twice that is because they spend longer hours at schools and in private schools school children get more food from home so they have the option to eat their lunch box and to buy from the canteens also.

Regarding beverage consumption in this study, the significant difference between the two types of schools concerning the beverages consumption was in the usage of canned juices which was higher in public schools 20.7% while in private schools it was 10.2%. However, **Velvarde et al., 2014** the most commonly consumed cariogenic foods were sweetened soft drinks with higher consumption in public and private schools. They are offered frequently to children because of their high acceptance, low cost, and the belief by parents that they are nutritious.

Although the juices at public schools are almost all with added sugars because they are of low quality while in private schools they consumed juices 100% without added sugars. One hundred percent fruit juice has also been associated with caries, but the relationship is less clear (**Mirajkar et al., 2014**).

Data from children aged 2 to 10 years who participated in National Health and Nutrition Exam-

ination Survey ("NHANES") suggest that children who consume more than 17 oz pure juice without added sugar are more likely to have caries than those who are high water or milk consumers (**Sohn et al., 2006**).

Thus, canned juices are offered frequently to children because of their high acceptance, low cost, and the belief by parents that they are nutritious.

In the present study the source of food differs significantly according to the school type. More than 40% of the public school students get their food from both the school itself and home. While, more than 55% of the private school students get their food from home. These results are opposite to the study done by **Togoo et al., 2012** in his study in Saudi of Arabia public schools, the majority of children get food from home.

So it has been cleared that, in public schools we found that children has the tendency to eat more cariogenic food than in private schools. Public school children tend to get sandwiches from school canteens and which were sold in low price as well as juices locally prepared and sweets. Their moms give them the easy prepared food like cake and biscuits. While, in private nowadays moms are aware of the lunch box preparation but not all of them stick to healthy food they do so because the canteens are expensive as well.

The intervention/awareness programs provided through schools were evaluated in this study as well. The results showed that delegates from the Ministry of Health gave dental awareness sessions twice a year in each semester to students and staff of public schools. However, private schools in this study doesn't have such sessions.

Moreover, the study showed that public schools have an assigned general practitioner from the Ministry of Health who is not interfering with any nutrition plans for students, while the private schools have a resident general practitioner who is also not involved in any nutritional plan for students.

Nevertheless, it should be noted that despite of the awareness sessions delivered in public schools the rate of intake of highly cariogenic food was higher than private schools. While, teachers in

private schools gave more sweets as incentive to students 75% than do public schools 62.9%.

32. Conclusions

From this study we concluded that:

1-Consumption of food with high cariogenic potential was more in public schools.

2-The highest frequency of intake of potentially cariogenic food was at private schools as compared to public schools. This means that at the end there is similar impact in both cases.

3-Public schools intake of canned juices is higher than private schools. These juices are of a higher cariogenic potential.

4- Boys tend to eat more cariogenic food than girls do.

5-The source of cariogenic food in public schools is largely attributable to canteens and home snacks. While the source of cariogenic food in private schools is largely attributable to food brought from home.

6-Public schools are delivering dental health awareness sessions provided by the Ministry of Health. However, private schools don't offer such awareness sessions.

7-Whilst public schools are providing awareness, the majority of students in public schools are not following recommendations in their food selection.

8-In both types of schools lacked of nutrition plans and canteens monitoring to deliver healthy food.

References

- [1] A. Barone, M. Giannoni, E. Ortu, A. Monaco, D. Pietropaoli, Short-term and long-lasting effects of hypo-cariogenic dietary advice and oral care on oral flora: A randomised clinical trial, *Oral Health Prev Dent* 16 (4) (2018) 315–340.
- [2] D. Beighton, S. R. Brailsford, S. C. Gilbert, D. T. Clark, S. Rao, J. C. Wilkins, E. Tarelli, K. A. Homer, Intra-Oral Acid Production Associated with Eating Whole or Pulped Raw Fruits, *Caries Research* 38 (4) (2004) 341–349. doi:10.1159/000078180. URL <https://dx.doi.org/10.1159/000078180>
- [3] Capmas (2017). [link]. URL <http://emis.gov.eg/Site/%20Content/book/016017/pdf/ch2.pdf>
- [4] W. G. Cochran, *Sampling techniques*, John Wiley and Sons, Inc, 1963.
- [5] T. L. Conway, J. F. Sallis, R. L. Pelletier, H. S. Powers, S. J. Marshall, M. M. Zive, J. P. Elder, What Do Middle School Children Bring in Their Bag Lunches?, *Preventive Medicine* 34 (4) (2002) 422–427. doi:10.1006/pmed.2001.0987. URL <https://dx.doi.org/10.1006/pmed.2001.0987>
- [6] C. A. Feldens, P. F. Kramer, F. Vargas-Ferreira, The role of diet and Oral hygiene in dental caries, in: *Pediatric Restorative Dentistry*, Springer, 2019, pp. 31–55.
- [7] C. Forbes, M. Evans, N. Hastings, B. Peacock (2010).
- [8] A. Gray, R. J. Threlkeld (2019).
- [9] T. H. Grenby, Summary of the dental effects of starch, *International Journal of food sciences and nutrition* 48 (6) (2009) 411–416.
- [10] M. Ghasemianpour, S. Bakhshandeh, A. Shirvani, N. Emadi, H. Samadzadeh, N. M. Fatemi, A. Ghasemian, Dental caries experience and socio-economic status among Iranian children: a multilevel analysis, *BMC Public Health* 19 (1) (2019) 1569–1569. doi:10.1186/s12889-019-7693-1. URL <https://dx.doi.org/10.1186/s12889-019-7693-1>
- [11] K. Halvorsrud, J. Lewney, D. Craig, P. J. Moynihan, Effects of Starch on Oral Health: Systematic Review to Inform WHO Guideline, *Journal of Dental Research* 98 (1) (2019) 46–53. doi:10.1177/0022034518788283. URL <https://dx.doi.org/10.1177/0022034518788283>
- [12] S. I. Z. S. Ishak, S. Shohaimi, M. Kandiah, Assessing the children's views on foods and consumption of selected food groups: outcome from focus group approach, *Nutrition Research and Practice* 7 (2) (2013) 132–132. doi:10.4162/nrp.2013.7.2.132. URL <https://dx.doi.org/10.4162/nrp.2013.7.2.132>
- [13] W. Kamate, N. Vibhute, R. Baad, U. Belgaumi, V. Kadashetti, S. Bommanavar, Effect of socioeconomic status on dental caries during pregnancy, *Journal of Family Medicine and Primary Care* 8 (6) (2019) 1976–1976. doi:10.4103/jfmnc.jfmnc_283_19. URL https://dx.doi.org/10.4103/jfmnc.jfmnc_283_19
- [14] P. J. Moynihan, S. A. M. Kelly, Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines, *Journal of dental research* 93 (1) (2014) 8–18.
- [15] D. M. Mullane, R. J. Baez, S. Jones, M. A. Lennon, P. E. Petersen, A. J. Rugg-Gunn, H. Whelton, G. M. Whitford, Fluoride and oral health, *Community dental health* 33 (2) (2016) 69–99.
- [16] W. Mulu, T. Demilie, M. Yimer, K. Meshesha, B. Abera, Dental caries and associated factors among primary school children in Bahir Dar city: a cross-sectional study, *BMC Research Notes* 7 (1) (2014) 949–949. doi:10.1186/1756-0500-7-949.

- URL <https://dx.doi.org/10.1186/1756-0500-7-949>
- [17] A. Shahravan, A.-A. Haghdoost, H. Hessari, M. Baneshi, M. Rad, The impact of mother's literacy on child dental caries: Individual data or aggregate data analysis? (2017). doi:10.4103/jehp.jehp_2_15. URL https://dx.doi.org/10.4103/jehp.jehp_2_15
- [18] F. Schwendicke, W. M. Thomson, J. M. Broadbent, M. Stolpe, Effects of Taxing Sugar-Sweetened Beverages on Caries and Treatment Costs, *Journal of Dental Research* 95 (12) (2016) 1327–1332. doi:10.1177/0022034516660278. URL <https://dx.doi.org/10.1177/0022034516660278>
- [19] W. Sohn, B. A. Burt, M. R. Sowers, Carbonated Soft Drinks and Dental Caries in the Primary Dentition, *Journal of Dental Research* 85 (3) (2006) 262–266. doi:10.1177/154405910608500311. URL <https://dx.doi.org/10.1177/154405910608500311>
- [20] S. Thornley, R. Marshall, G. Reynolds, P. Koopu, G. Sundborn, G. Schofield, Low sugar nutrition policies and dental caries: A study of primary schools in South Auckland, *Journal of Paediatrics and Child Health* 53 (5) (2017) 494–499. doi:10.1111/jpc.13449. URL <https://dx.doi.org/10.1111/jpc.13449>
- [21] R. A. Togoo, Z. Meer, R. Kandlaya, S. M. Yaseen, T. D. Al-Shehri, H. G. Al-Ghamdi, Availability of Cariogenic Foods in Primary School Canteens of Abha City, Saudi Arabia: A Cross-Sectional Study, *World Journal of Dentistry* 3 (3) (2012) 239–242. doi:10.5005/jp-journals-10015-1163. URL <https://dx.doi.org/10.5005/jp-journals-10015-1163>
- [22] R. Touger-Decker, C. van Loveren, Sugars and dental caries, *The American Journal of Clinical Nutrition* 78 (4) (2003) 881S–892S. doi:10.1093/ajcn/78.4.881s. URL <https://dx.doi.org/10.1093/ajcn/78.4.881s>
- [23] A. Valverde, J. Montero, G. Camañas, B. Peralta, R. G. D. Diego, Oral Health Habits in Primary and Secondary School Children, *Journal of oral health and dental management* 13 (4) (2014).
- [24] S. Verma, P. Mallaiah, U. G. Kadalur, R. Sharma, Indian Dietary Habits in Relation to Dental Caries among 12-15-year-old School Children in Bangalore City, *Int J Oral Health Med Res* 3 (1) (2016) 44–47.