severe early childhood caries and general health in a group of Sudanese preschool children

Rabab Helmy Mahmoud Ahmed, Prof. Dr. Nancy Ahmed Fakhry Khattab, Prof. Dr. Mohammed Abou El-Yazeed Ahmed, Dr. Tamer Gad Rashed, Dr. Ghada Abd El-Wahab Ahmed.

Abstract

Back ground: Dental health problems as a sequence of ECC especially its severe form (S-ECC) rang from local pain, infections, difficulty in chewing leads to general health problemsas malnutrition, gastrointestinal disorders and poor child growth or development**.** debilitating condition can not only affect the children but also their families and the communities in which they live.

Methods:the study sample consisted of1000 Sudanese children aged 3-6 years, including 100 children having complete blood count records. anthropometric measurements were taken for every child following WHO methodology and criteria. Hb level was recorded for children who already had CBC analysis for medical reasons.

Results: There was a significant difference between caries free and S-ECC regarding all BMI categories except normal weight children. Although, there was insignificant difference between both caries groups considering Hb level.

Conclusions:although there was insignificant correlation between caries and Hb level, a weak negative correlationwas found between caries and BMI.Consequently, proper management of S- ECC is critical for child general health and development.

Key-words: Severe Early childhood caries, Growth, BMI, Anemia, Hb level.

Introduction:

According to **AAPD, 2020**, Early childhood caries (ECC) is defined as the presence of 1 or more decayed, missing (due to caries) or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (S-ECC). From ages 3 through 5, 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5) surfaces constitute a S-ECC.

Over the last 20 years, there was an increase of dental caries prevalence in primary teeth among Sudanese school children which may be attributed to the lack of dental awareness and school dental health services in addition to the increase in availability and easy accessibility to cariogenic food stuff**(Ahmed T. and Abuaffan A., 2015).**Also, Changes in lifestyles, like increased consumption of more energy-dense, nutrient-poor foods with high levels of sugar combined with reduced physical activity were akey cause to both nutritional and dental caries diseases **(Bagherianand Sadeghi, 2013).**

S-ECC may impact a child's growth which is an indicator that the World Health Organization (WHO) identifies as the best single measure for defining the overall health and nutritional well-being of children **(EdalatA. *et al.*, 2014)**. Past studies have suggested different relationships between S-ECC and BMI (body mass index). Some authors have reported a positive relationship between caries and obesity **(Davidson K. *et al.*, 2016).** Conversely, other studies have reported that S-ECC can have a negative impact on a child's ability to eat and grow, leading to a lower BMI **(EdalatA. *et al.*, 2014)** Moreover, some studies have reported no significant association between BMIand caries at all **(Hayden C. *et al.*, 2013).**

It was also assumed that S-ECC could be a possible risk factor for iron deficiency-related anemia due to symptoms that might be caused by

difficult eating because of tooth painor a high sucrose diet that can compromise the intake of other nutrients. In addition, cytokines and other inflammatory factors that are released from damaged tissues during pulpitis and chronic dental abscess are known to suppress erythropoiesis and the synthesis of hemoglobin (Hgb) **(Sheiham A., 2006)**.

For that, the aim of this study was to assess the relationship between S-ECC, growth (represented by BMI) and anemia (represented by Hb level) in a group of Sudanese preschool children.

Participants and Methods

1000 Sudanese preschool children wereselected from Sudanese educational centers based on calculated sample size and predetermined criteria. 500 children were selected as cases with S-ECC; including 50 children having complete blood count records. The other 500 children were selected as caries-free children; including 50 children having complete blood count records.

Complete blood count (CBC) records were obtained from children; recommended by the pediatricians to undergo minor surgeries or for any other reason.

In this study, included children were Sudanese aged 3-6 years, with complete primary dentition. Children with chronic medical problems that can affect normal growth, mental or physical disabilities, and those who were born prematurely were excluded.

ethical approval was obtained from Ethics Committee of Medical Research, at the National Research Centrenumber (18166) before starting this study. Also, Informed consent was taken from every child's parent, to agree for their participation in this study.

Clinical examination was done by single operator while children were seated in a supine position in an ordinary chair under day light and examined visually using disposable mirror and prob according to the methodology and criteria of **WHO, 2013.**

Children with S-ECC were diagnosed according to the diagnostic criteria established by the American Academy of Pediatric Dentistry **(AAPD, 2020**). All children with dental problems were guided for treatment through parents or sending an examination chart about the case of their child as adocumentfo further referal.

For every child, two anthropometric measurements (weight and height) were taken using the standardized methodology recommended by **WHO (2008).**Measurements were compared to the **WHO** growth curves **(WHO, 2007).**

BMI for age was calculated for every child using WHO Anthro (for children < 5 years) and WHO Anthro plus calculator software (for children > 5 years)(Version 1.0.4) **(WHO, 2009)**thenpercentiles were categorized according to the BMI percentiles obtained from **WHO (2007)** reference data as follow: Underweight group: BMI - for age- less than 5th percentile. Normal weight group: BMI- for age greater than or equal to 5th percentile but less than 85 percentiles. Overweight group: BMI- for age-greater than or equal to 85 percentiles but less than 95 percentiles. Obese group: BMI-for age- greater than or equal to 95 percentiles.

Hemoglobin level was only recorded for the children who already had CBC analysis for medical reason. Children with hemoglobin values less than 11 g per dL were diagnosed as being anemic according to **WHO, 2007.**

All data was recorded in a specially designed examination chart using dmft index (decayed, missed, filled primary tooth), anthropometric data and Hb level.

Statistical analysis was performed with SPSS 20®[1], Graph Pad Prism®[1], and Microsoft Excel 2016[3] and presented in tables & figures.

• All qualitative data were presented as frequency & percentages; all comparisons were performed by using Chi square test.

• All Correlations were performed by using Pearson`s correlations.

Results

Descriptive data

483 (48.3%) boys and 517 (51.7%) girls Sudanese preschool children were included in this study table (1), their age ranged from 2.5: 6.9 years.while mean ± standard deviation was (4.79 ± 1.18) as presented in table (2).

Table (1): Frequency & percentages of gender:

Gender	N	%	P value
Male	483	48.30%	0.12
Female	517	51.70%	

N: count %: Percentage
**significant difference as P < 0.05.*

Table (2): Count, minimum, maximum, mean and standard deviation of age:

	N	Min.	Max.	M.	SD
Age	1000	2.5	6.9	4.7999	1.18

N: count Min: minimum Max: maximum
M: mean SD: standard deviation

Comparison between different BMI categories revealed a significant difference (P < 0.05) as normal children (68.5%) were significantly the highest while obese children (4.5%) were significantly the lowest, as presented in figure (1).

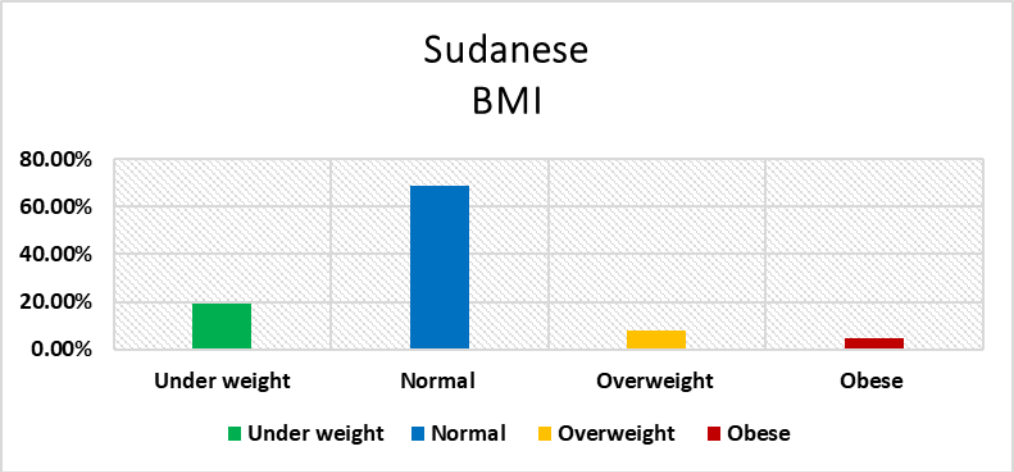

Figure (1): Bar chart representing percentages of BMI categories.

Biochemical measurements Hb (level), comparison between anemic and anemic free children revealed that anemic children (57%) were significantly higher than anemic free children (43%) ($P < 0.05$), as presented in figure (2).

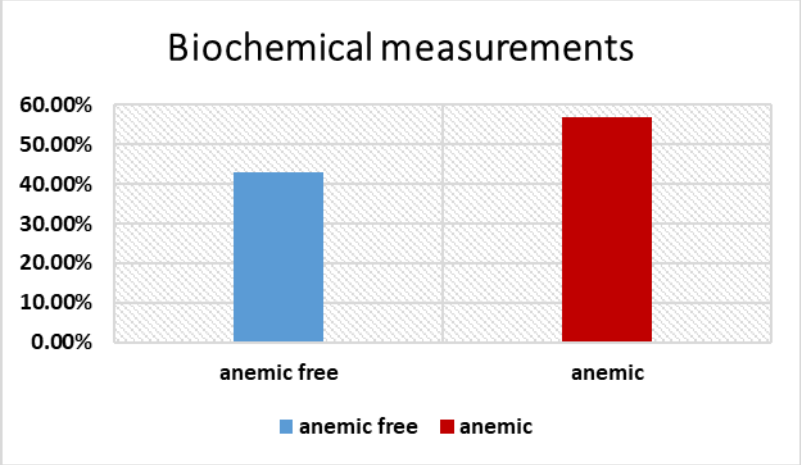

Figure (2): Bar chart representing percentages of biochemical measurements (Hb level).

Correlation between caries status, BMI and Hb level:

Distribution of caries groups among different BMI categories and comparison between different BMI categories of caries free and S-ECC groups revealed a significant difference ($P < 0.05$) between all categories in both groups as normal children were significantly the highest and

obese children were significantly the lowest in both groups. while, comparison between both caries groups concerning BMI categories revealed a significant difference (P < 0.05) regarding all BMI categories except normal children.Moreover, correlation between BMI and caries distribution revealed a weak (r<0.5), negative (-) & significant (P<0.05) correlation as presented in table (3).

Table (3): Frequency & percentages of BMI categories among caries free & S-ECC groups:

BMI	Cries free		SECC		P value	r(P)
	N	%	N	%		
Under weight	67	13.40%	125	25.00%	0.001*	-0.2 (0.04*)
Normal	344	68.80%	341	68.20%	0.831	
Overweight	56	11.20%	23	4.60%	0.002*	
Obese	33	6.60%	11	2.20%	0.0007*	
P value	0.0001*		0.0001*			

N: count *%: Percentage*
**significant difference as P < 0.05.* *r: Pearson`s correlation coefficient*

Comparing biomechanical measurements in both caries free & S-ECC groups, it was found that anemic children in caries free group wereinsignificantly higher than anemic free children, while in S-ECC groupanemic children were significantly higher than anemic free children.While**,** Comparison between both caries groups concerning anemia status revealed in significant difference between both caries groups.Moreover, correlation between Hb level and caries revealed a weak (r<0.5), negative (-), insignificant (P > 0.05)correlation as presented table (4).

Table (4): Frequency & percentages of biochemical measurements among caries free & S-ECC:

Hb	Cries free		S-ECC		P value	r (P)
	N	%	N	%		
Anemic free	22	44.0%	21	42.00%	0.14	-0.12 (0.11)
Anemic	28	56.0%	29	58.00%	0.14	
P value	0.23		0.001*			

N: count *%: Percentage*
**significant difference as P < 0.05.* *r: Pearson`s correlation coefficient*

Discussion

S-ECCand its resulting manifestations as pain, abscesses and chewing difficulty can affect the child's feeding and sleep leading to malnutrition and consequently the child's general health, growth and development are affected**.**Malnutrition is a complex disorder not solely caused by lack of food. Feeding practices and other risk factors leading to malnutrition and/or anemia may be associated with greater risk for ECC (**Folayan M. *et al*., 2020)**.This study aimed to assess the relation between S-ECC, growth represented by BMI and nutritional anemia represented by Hb level in a group of Sudanese preschool children.

In the present study the most prevalent body weight category was the normal weight group (68.5%) followed by the underweight group (19.1%), overweight group (7.9%) and the obese group (4.5%), which were consistent in distribution order with a previous study done by **Ahmed T. and Abuaffan A., 2015** on Sudanese children of older age group with minimum differences due to differences in the sample size, ages of the examined group as well as the time interval between the two studies.

In S-ECC group, underweight children were significantly higher than in caries free group which was consistent with **Cameron *et al*., 2006** in UK and **Floyd B., 2009** in india and **Ahmed T. and Abuaffan A., 2015** in

Sudan. This can be explained by more intake of proteins and fatty meals by overweight and obese children which are the least type of cariogenic diets and Children with established dental decay may be less able to chew and this can affect their food choice.

On contrary, this result was not consistent with **Willershausen*et al.*, 2004** from Scotland, **Gerdin*et al.*, 2008** from Sweden and **Davidson K. *et al.*, 2016** from Canada who reported that either overweight or obese children in the S-ECC group were significantly higher compared to their caries-free peers.The differences in body weight categories among different populations may be due to variations in socioeconomic status, dietary habits, in addition to the public awareness (**Ahmed T. and Abuaffan A., 2015).** As Sudanese children might have chronic nutritional stress due to poor economic status and lack of awareness regarding oral and general health.

Correlation between caries distribution and BMI was weak negative significant this was in agreement with **Ambarkova V. and Bakracevska G., 2015**in Ohrid city **and Krishna H.*et al.*, 2017** on Indian children**.** This might be because high percentage of decayed component (untreated caries) cause toothache, thus reducing food intake leading to low weight gain. Also, the involvement of dental and periodontal tissues can have a negative effect on a child's chewing abilities and psychophysical wellness, thus determining a change in what and how he/she eats, and in sleeping habits as well, with substantial negative consequences on weight and height **(Liang H. *et al.*, 2008)**.

Another explanation of how untreated severe caries with pulpitis can affect growth is that chronic inflammation from pulpitis and chronic dental abscesses affects metabolic pathways.Also, Impacts of S-ECC including pain, irritability and disturbed sleeping habits and in turn Disturbed sleep may affect glucosteroid production and growth**(Low W. et al., 1999).**

One of the most commonly used screening methods for the presence of anemia in a population is the measurement of hemoglobin. This

measurement is relatively simple, cheap and can be carried out under field conditions in agreement with **WHO, 2007.**Inthis study, insignificant correlation was found between caries status and Hb level. This result was in contrast to **ShaoulR. *et al*., 2012 and Folayan M. *et al*., 2020.**The inconsistent findings of the previous studies may be due to differences in the methods used for nutritional assessments, age range cut-offs, and confounders of dental caries, including differences in definition and severity of ECC **(Seow W. *et al*., 2009).**

The clinical importance of this study is that S-ECC has been identified as a risk marker for underlying condition (nutritional deficiency and /or anemia). Therefore, physicians and dentists treating young children should take that into consideration. For physicians, nutritional deficiencies should alert them to the possibility that S-ECC is present and is a possible explanation for the deficiencies to their patients. For dentists, children presenting with S-ECC should be considered at risk for nutritional deficiencies that may affect long-term health and well-being.

Conclusions:

S-ECC can negatively impact preschool children growth, physical development, general health. S- ECC can be an early alarm for underlying chronic conditions before longstanding negative effects are able to take root.

limitations:

Covid 19 was one of the most difficult challenges that restricted entrance to many hospitals and preschools. It took many efforts and long time to have access to children to collect data.

Sometimes low level of literacy hindered answering some questions like child birth date so they were excluded.

References

Ahmed T. and Abuaffan A., 2015. Correlation between body mass index and dental caries among a sample of sudanese children.
Braz Dent Sci, Jul/Set;18(3).

Ambarkova V andBakracevska G., **2015**. Relating Dental Caries Experience with Body Mass Index among Primary School Children from Ohrid City – A Pilot Study. Aperito J Oral Health Dent;1:1-3.

American Academy of Pediatric Dentistry (AAPD), 2020. Policy on early childhood caries (ECC): Classifications, consequences, and preventive strategies.
Pediatr Dent Ref Man. Chicago, Ill. 79-81.

Bagherian A., Sadeghi M., 2013. Association between dental caries and age-specific body mass index in preschool children of an Iranian population.
Indian Journal of Dental Research, 24(1).

Cameron F., Weaver L., Wright C. andWelbury R.,2006. Dietary and social characteristics of children with severe tooth decay.
Scott Med J. Aug;51(3):26.

Davidson K., Schroth R., Levi J. andMittermuller B, 2016. Higher body mass index associated with severe early childhood caries.
BMC Pediatr.16(1):137-144.

Edalat A., Abbaszadeh M., Eesvandi M. andHeidari A, 2014. The Relationship of Severe Early Childhood Caries and Body Mass Index in a Group of 3- to 6-year-old Children in Shiraz.
J Dent Shiraz Univ Med Sci. 15(2): 68-73.
Floyd B., 2009. Associations between height, body mass, and frequency of decayed, extracted, and filled deciduous teeth among two cohorts of Taiwanese first graders.
Am J PhysAnthropol. 140(1):113-9.

Folayan M., Tantawi M., Schroth R., Vukovic A., Kemoli A., Gaffar B. and Obiyan M. Early Childhood Caries Advocacy Group, 2020.

Associations between early childhood caries, malnutrition and anemia: a global perspective. BMC Nutrition, 6:16.

Gerdin E., Angbratt M., Aronsson K. and Eriksson E., 2008. Dental caries and body mass index by socioeconomic status in Swedish children. Community Dent Oral Epidemiol, 36:459-65.

Hayden C., Bowler J. and Chambers S., 2013. Obesity and dental cariesin children: a systematic review and meta-analysis.
Community Dent Oral Epidemiol, 41(4):289-308.

Krishna H., Manaswini E., Kumar V., Bellamkonda P., Bhargava A. andJaidupally R., 2017. Association between nutritional status and early childhood caries in Indian children. J Int Soc Prevent Communit Dent., 7:131-5.

Liang H., Arif A., Cunniff M., Overman P. and Moncy M., 2008. Obesity and dental caries in children aged 2-6 years in the United States. National health and nutrition examination survey 1999-2002.
J Public Health Dent, 68: 227-33.

Low W., Tan S. and Schwartz S., 1999. The effect of severe caries on the quality of life in young children. Pediatr Dent, 21: 325-326.

Seow WK, Clifford H, Battistutta D, Morawska A, Holcombe T., 2009. Case-control study of early childhood caries in Australia. Caries Res., 43(1):25–35.

Shaoul R., Gaitini L, Kharouba J., Darawshi G., Maor I., Somri M., 2012. The association of childhood iron deficiency anaemia with severe dental caries. Foundation Acta Pædiatrica, 101, e76–e79.

Sheiham A., 2006. Dental caries affects body weight, growth and quality of life in pre-school children.
Br Dent J.;201: 625e6.

Willershausen B., Haas G., Krummenauer F and Hohenfellner **K., 2004.** Relationship between high weight and caries frequency in German elementary school children.
Eur J Med Res., 9:400-4.

WHO Multicentre Growth Reference Study Group., 2007. WHO Child Growth Standards: length/height-for-age, weight-for-age, weight-for-length, weight for-height and body mass index-for-age: methods and development. Geneva.

World Health Organization, 2007. Assessing the iron status of populations: report of a joint World Health Organization/ Centers for Disease Control and Prevention technical consultation on the assessment of iron status at the population level, 2nd ed., Geneva. Available at **http://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/9789241596107**.

World Health Organization, 2008. Global Strategy on Diet, Physical Activity and Health, Childhood Oveaweight and Obesity, Geneva.

World Health Organization, 2009.WHO Anthroplus for personal computers manual: software for assessing growth of the world's children and adolescents. Geneva: **http://www.who.int/childgrowth/software/anthro_pc_manual.pdf**

World Health Organization, 2013. Oral health survey, Basic Methods.