The Impact of Nutritional Status on the Oral Health in a Group of Egyptian Preschool Children

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Abstract: Objective: To study the influence of nutritional status on the oral health. **Introduction:** Nutrition is one of the modifiable factors that impacts on the host's immune response and integrity of the hard and soft tissues of the oral cavity. Diet and nutrition play key roles in tooth development, gingival and oral tissue integrity, bone strength, and the prevention of dental caries and periodontal diseases. Moreover, the impact of nutrient intake systemically affects the development, maintenance, and repair of the teeth and oral tissues. Nutrition and diet affect the oral cavity, and the reverse is also true. A thorough examination of oral cavity can reveal symptoms of nutritional deficiencies, microbial infections, immune disorders and injuries. Few studies have been conducted in Egypt on the inter-relationship between the nutritional status and the assessment of oral health, so the present study was done to clarify the impact of nutritional status on the oral health in a group of Egyptian preschool children. **Subjects and Methods:** This study is a case control study conducted with a sample of 300 children divided equally. Cases are children aged from 3-5 years attending the pediatric malnutrition outpatient clinic of National Nutrition Institute (NNI), Cairo .Both sexes were included. Malnourished cases with hormonal, metabolic, genetic disorders were excluded .Controls were selected from nurseries and kindergarten department of some schools who were apparently healthy and with normal body weight matching with cases in sexes and age range. The sample was subjected to anthropometric measures (weight and height) Dietary intake data of subjects was collected by a specialist dietitian using 24-hour recall and food frequencies of selected food items. General examination for manifestations of malnutrition was performed for all subjects followed by oral examination of subjects which was taken place under adequate illumination in an ordinary chair. Diagnosis of dental caries was carried out according to dmf index for deciduous teeth Assessment of gingival condition was carried out using Gingival index (GI). Data were collected, checked, revised and entered in the computer. Statistical analysis was performed with PASW Statistics 18.0. **Results:** The study showed the presence of significant association between caries and malnutrition. Oral soft tissue lesions as tongue glossitis and gingivitis are statistically associated with malnutrition. Malnourished cases consume more cariogenic foods (sweets, crunches and fizzy drinks) than controls, however, the difference was not statistically significant. The daily intake of carbohydrates rich foods regarding tubers and sweetened beverages is more among cases compared to controls although no statistical difference. On the other hand the daily intake of fruits is more among controls although no statistical difference. Cases consumed statistically less mean amount of proteins, carbohydrates, fibers, calcium, phosphorous, zinc and vit D contributing to their bad nutritional status. Mean amount of iron showed higher intake among controls although not significant Protein,calcium, phosphorus, vit D, iron and zinc adequacy is statistically low among cases compared to controls.

[Wafaa A. Fahmi, Mohamed H. Mostafa; Magda A. El-malt and Al-Shaimaa Abdel Hafiz Abdel Rahim. **The Impact of Nutritional Status on the Oral Health in a Group of Egyptian Preschool Children**. *N Y Sci J* 2013;6(1):89-95]. (ISSN: 1554-0200). http://www.sciencepub.net/newyork. 14

Keyword: malnutrition dental caries

1. Introduction:

Malnutrition is a common nutritional disorder in developing countries and it remains one of the most common causes of morbidity and mortality among children worldwide **(Stephenson et al, 2000).** The World Health Organization represented malnutrition as the cellular imbalance between supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions **(WHO, 2012).** Chronically malnourished children may have delayed tooth eruption, compromised tooth integrity, and increased dental caries. Likewise, oral infectious diseases, as well as other diseases with oral manifestations, may influence diet and nutritional status **Hornick (2002)** .Food and its nutrients contribute to the health of the mouth as well as to the overall health. Diet plays a key role in oral disease prevention. **Scardina and Messina (2008)** studied the causes and consequences of a poor diet and its inter-relationship with oral health. reported that the first signs of micronutrient deficiencies are often manifested in the oral tissues. Consequently, the dentist has a considerable role in the early diagnosis of malnutrition. Furthermore, optimizing oral health

is important in maximizing functional capacity to consume a healthful and varied diet .Eating habits have a direct effect on dental caries. The ability of various carbohydrate-containing foods to contribute to dental caries depends on how well it adheres to the tooth surface and how frequently it is consumed. Since carbohydrates should provide for more than half of the total energy requirements for children and adults, it is both unrealistic and undesirable to eliminate sugars and starches. However, the types of carbohydrates and the frequency at which they are consumed can be adjusted to reduce the risk of dental caries (Hornick, 2002).A study to test the association between anthropometric measurements and dental caries in Turkish school children by Koksal et al. (2011) showed that children with low body weight have a higher risk of developing dental caries. Healthy gum tissue normally prevents penetration of bacteria that can lead to gingivitis. Deficiencies of vitamin C, folic acid, or zinc may increase the permeability of gingival tissue, making these patients more susceptible to bacterial plaque that causes periodontal disease. Studies examining vitamin C and calcium intake found that individuals with low intakes of vitamin C and calcium are at risk for periodontal disease (Nishida et al., 2000a&b).Few studies have been conducted in Egypt on the inter-relationship between the nutritional status and the assessment of oral health, so the present study was done to clarify the impact of nutritional status on the oral health in a group of Egyptian preschool children.

2. Subjects and methods:

This study is a case control study conducted with a sample of 300 children divided equaly.Cases are children aged from 3-5 years attending the pediatric malnutrition outpatient clinic (Less than 2 standard deviation (SD) regarding weight /age Z-score WHO 1995) National Nutrition Institute (NNI), Cairo .Both sexes were included. Malnourished cases with hormonal, metabolic, genetic disorders were excluded .Controls were selected from nurseries and kindergarten department of some schools who were apparently healthy and with normal body weight matching with cases in sexes and age range. The sample was subjected to anthropometric measures (weight and height) Height was measured using the Raven Minimeters, with direct reading of height according to WHO (1995).The weight was recorded using platform scale according to WHO, (1995).A portable plate scale used for the control group was subjected to regular calibrations according to NNI. The World Health Organization (WHO) anthropometric software was used to convert anthropometric measurements of the included subjects into indicators for weight / age Z-score values that were used in the analysis (WHO Anthro, 2005). Dietary intake data of subjects was collected by a specialist dietitian using 24-hour recall and food frequencies of selected food items. The dietary recall was taken in detail. Food items and drinks consumed during 3 days in the recent past including the day off. .Energy and main nutrients were computed and analyzed using the food composition tables developed by NNI (2006), the computed amounts of energy were compared to the recommended intake and classified based on FAO/WHO/UNU (2004), computed amounts of proteins were compared to the recommended intake and classified based on FAO/WHO/UNU (2007), and computed amounts of minerals and vitamin were compared to the recommended intake and classified according to FAO/WHO (1998). Less than 50% of recommended daily allowance (RDA) consider unsafe amount, 50% - <75% need improvement, 75% - <100 accepted, 100% - < 120% normal and >120% consider unaccepted. Food frequency questionnaire was used to assess the energy and nutrient intake by determining the amount and how frequently a person consumed numbers of foods that are major sources of nutrients. Respondents indicate how many times a day, week, month, or year that they usually consume the foods and describe the size of his or her usual serving as small, medium, or large relative to a standard serving. Then this data was recorded, coded, entered for analysis (Lee H.et al., 1989) & Block, 1992). General examination for manifestations of malnutrition was performed for all subjects followed by oral examination of subjects which was taken place under adequate illumination in an ordinary chair. Prior to examination, children were asked to wash their mouth with water then the teeth were cleaned and dried using cotton pellet swabs. Diagnosis of dental caries was carried out according to the WHO (1987) specifications. The prevalence of dental caries was calculated using the dmf index for deciduous teeth (Haugejordan, 1978). Assessment of gingival condition was carried out using Gingival index (GI) according to Loe and Silness (1963).

Data Handling and Statistical Analysis:

Data were collected, checked, revised and entered in the computer. Statistical analysis was performed with PASW Statistics 18.0 ® (Predictive Analytics Software) for Windows. Quantitative data were presented as means and standard deviation (SD) values. Student's t-test was used for comparisons between means of two groups. Due to the non-parametric distribution GI, dmf index, Mann-Whitney U test was used for comparisons between the two groups. Qualitative data were presented as frequencies and percentages. Chi-square (x^2) test was

used for comparisons between the two groups.The significance level was set at $P \leq 0.05$.

3. Results:

Table (1) shows age groups and gender characteristics of the sample. It is noticed that 48%of cases lies in the age group 3<4 versus 32.2% among controls. This clarifying too early affection with malnutrition, although no statistical differences regarding age groups and gender. Cases show statistically less anthropometric measures including weight, height and weight /height % table (2). As regard to oral hygiene practiced by tooth brushing and frequent oral water rinse ,cases practiced tooth brushing statistically less than controls (22.7% versus 67.3%) p=0.000. Repeated oral rinse is less practiced among cases (92.0% versus 96/0%) but showed no statistical difference table(3). This result denotes the importance of tooth brushing as a hygienic practice among well nourished subjects. All malnutrition manifestations are statistically higher among cases including (pityaris alba, pallor, angular stomatitis, hair falling, brittle nails and dry lips and dry skin) table(4). A significantly higher mean dmf index among cases (p=0.035) is noticed. Dmf index assess dental caries for deciduous teeth .This denotes that cases are more susceptible to dental caries and malnutrition is associated with high dmf and dental caries. Cases show a higher gingival Index (GI) assessing gingival condition although not significant table (5). The prevalence of tongue glossitis among cases accounts to 6.7%versus 0.7% among controls. The prevalence of gingivitis among cases accounts to 94.7% versus 86.6% among controls. Statistically there are significantly more affection with tongue glossitis and gingivitis (p=0.001and p=0.029 respectively). Glossitis and gingivitis are common finding among malnourished case table (6). 64% of cases preferred cariogenic foods sweets, crunches and fizzy drinks) compared to56.7%among controls, thus higher percentage of malnourished cases preferred cariogenic foods. This difference is not statistically significant table (7). The daily intake of carbohydrates rich foods regarding tubers and sweetened beverages account to 8.0% and 11.3% respectively among cases while the percentages decreased to reach 4.0% and 9.3% among controls. The daily intake of carbohydrates rich foods regarding tubers and sweetened beverages is more among cases compared to controls although no statistical difference. On the other hand the daily consumption of fruits accounts to 6.0% for cases and rises to reach 12.7% among controls. The daily intake of fruits as carbohydrates and fibers rich food is more among cases compared to controls although no statistical difference table (8)

Comparing the mean intake of certain food elements, cases consumed less mean amount than controls of proteins, carbohydrates, fibers, calcium, phosphorous, zinc and vit D. The difference is statistically significant. Mean amount of iron showed higher intake among controls 7.8mg ±1.8 versus 7.4mg± 2.5 among cases although not significant .Regarding the mean intake of vit C it showed no statistical difference between cases and controls table (9). Regarding adequacy, protein intake among 1.3% of cases is unsafe while among non of controls . Protein intake among 3.3% of cases need improvement while only 0.7% among controls. Protein adequacy is statistically low among cases compared to controls. Calcium intake among 8.7% of cases is unsafe while only among 0.7% of controls. Calcium intake among 40.7% of cases need improvement while only 8.7% among controls. Calcium adequacy is statistically low among cases compared to controls. Phosphorus intake among 17.3% of cases is unsafe while only among 0.4% of controls. Phosphorus intake among 22% of cases is acceptable while among 52.7% of controls. Phosphorus adequacy is statistically low among cases compared to controls. VitD intake among 22.7% of cases is unsafe while only among 15.3% of controls. Vit D intake among 10% of cases is acceptable while only 5.3% among controls. vit D adequacy is statistically low among cases compared to controls. Zinc intake among 2% of cases is unsafe while non of controls. Zinc intake among 19% of cases need improvement while only 5% among controls. Zinc adequacy is statistically low among cases compared to controls table (10)

3. Discussion:

In the present study, a significant association between caries in the primary teeth experienced by dmf index and nutritional status was found. The higher mean dmf index(higher caries percentage) was found among malnourished cases versus controls (p value = 0.035). This may be due to bad dietary habits and oral hygiene. This goes in accordance with Moynihan, (2005) he stated that malnutrition adversely affects various aspects of human oral health including tooth development, tooth eruption, dental caries, and periodontium. Also Poster et al. (2005) reported that caries of the primary dentition had been associated with early childhood malnutrition as well as the evidence that enamel hypoplasia, salivary gland hypofunction and saliva compositional changes may be underlying changes explanatory mechanisms for the effect of malnutrition on dental caries.

Tab (1) General Characteristics of The Sample Variables

Variables		Cases		Controls	
		no.	%	no.	%
Age group	3<4 y	72	48.0	49	32.6
	4<5y	51	34.0	58	38.6
	5y	27	18.0	43	28.6
	P=0.77				
Gender	Boy	57	38.0	67	44.7
	Girl	93	62.0	83	55.3
	P=0.24				

Tab. (2) Mean ± SD of Anthropometric Measures in the Studied Groups

Variables	Cases	Controls	*P*-value
	Mean ± SD	Mean ± SD	
Weight	12.7 ± 1.6	18.3 ± 6.8	<0.001
Height	94.5 ± 6.9	105.4 ± 7.1	<0.001
Weight/Height%	13.4 ± 1.2	17.3 ± 6.6	<0.001

Tab. (3) Percent Distribution of Hygienic Practices among the Studied Groups

Variable		Cases		Controls		*P*-value
		no.	%	no.	%	
Repeated oral water rinse	Yes	138	92.0	144	96.0	0.145
	No	12	8.0	6	4.0	
Tooth brushing	Yes	34	22.7	101	67.3	0.001
	No	116	77.3	49	32.7	

Tab. (4) Percent Distribution of Malnutrition Manifestations in the Studied Groups

Manifestations of malnutrition	Cases		Controls		*P*-value
	no.	%	no.	%	
Pityarsis alba	49	32.7	0	0.0	0.001
Pallor	135	90.0	2	1.4	0.001
Angular stomatitis	8	5.3	0	0.0	0.004
Hair falling	54	36.0	1	0.7	0.001
Brittle nails	8	5.3	0	0.0	0.004
Dry lip	62	41.3	9	6.0	0.001
Dry skin	24	16.0	1	0.7	0.001

Tab. (5) Mean ± SD of the dmf Index and Gingivitis Index of the Studied Groups

Variables	Cases	Controls	*P*-value
	Mean ± SD	Mean ± SD	
Dmf	3.10 ± 3.80	2.18 ± 3.08	0.035
GI	1.42 ± 0.58	1.31 ± 0.70	0.230

Tab. (6) Percent Distribution of the Studied Groups by Oral Soft Tissue Findings

Soft tissue findings	Cases		Controls		*P*-value
	no.	%	no.	%	
Tongue glossitis	10	6.7	1	0.7	0.001
Gingivitis	142	94.7	130	86.6	0.029
Oral mucosal lesions	2	1.3	1	0.7	0.562

Tab. (7) Percent Distribution of Snack Preferred Food in the Studied Groups

Preferred food	Cases		Controls		*P*-value
	no.	%	no.	%	
Cariogenic	96	64.0	85	56.7	0.194
Non-cariogenic	54	36.0	65	43.3	

Tab. (8) Percent Distribution of the Frequency of Consumption of Carbohydrates Containing Food in the Studied Groups

Time	Food type	Cases		Controls		*P*-value
		no.	%	no.	%	
Daily	Grains	42	28.0	43	28.7	0.207
	Tubers	12	8.0	6	4.0	
	Sweets	70	46.7	68	45.3	
	Sweetened Beverages	17	11.3	14	9.3	
	Fruits	9	6.0	19	12.7	
Weekly	Grains	22	14.7	23	15.3	0.990
	Tubers	23	15.3	20	13.3	
	Sweets	51	34.0	51	34.0	
	Sweetened Beverages	27	18.0	29	19.3	
	Fruits	27	18.0	27	18.0	
Monthly	Grains	6	4.0	3	2.0	0.451
	Tubers	48	32.0	49	32.7	
	Sweets	44	29.3	50	33.3	
	Sweetened Beverages	44	29.3	45	30.0	
	Fruits	8	5.3	3	2.0	

Tab. (9) Mean ± SD of Essential Nutrients Intake in the Studied Groups

Variable	Cases	Controls	P-Value
	Mean ± SD	Mean ± SD	
Proteins(gm)	47.29 ± 21.55	64.87 ± 27.55	0.001
Carbohydrates(gm)	167.89 ± 42.03	196.81 ± 40.76	0.001
Calcium(mg)	398.37 ± 118.3	511.07 ± 121.6	0.001
Iron(mg)	7.43 ± 2.5	7.84 ± 1.8	0.109
Phosphorus(mg)	543.98 ± 158.5	673.31 ± 157.1	0.001
Zinc(mg)	5.02 ± 1.6	6.22 ± 1.5	0.001
Vit D(mcg)	13.10 ± 8.8	16.01 ± 9.3	0.006
Vit C(mg)	57.40 ± 52.3	52.38 ± 42.6	0.380
Fibers(gm)	4.32 ± 1.4	4.63 ± 1.3	0.05

Tab (10) Percent distribution of adequacy of some food elements among the studied sample

Nutrient element	Unsafe		Need improvement		Acceptable		Normal		Unacceptable	
	%Cases	%Control	%Cases	%Control	%Cases	%Control	%Cases	%Control	%Cases	%Control
Protein	1.3	0.0	3.3	0.7	11.3	2.0	12.0	8.7	72.0	88.7
P value	0.001									
Calcium	8.7	0.7	40.7	8.7	29.3	40.0	18.7	33.3	2.7	17.3
P value	0.001									
Phosph	17.3	4.0	54.0	25.3	22.0	52.7	5.3	16.0	1.3	2.0
P value	0.001									
Iron	0.7	0.0	7.3	0	23.3	13.3	25.3	28.7	43.3	58
P value	0.001									
Vit D	22.7	15.3	9.3	6.7	10	5.3	10.7	7.3	47.3	65.3
P value	0.038									
Vit C	16.0	20.7	12.7	21.3	12.0	10.7	8.0	6.0	51.3	41.3
P value	0.173									
Zinc	2.0	0.0	19.0	5.0	47.0	11.0	35.0	40.0	47.0	94.0
P value	0.001									

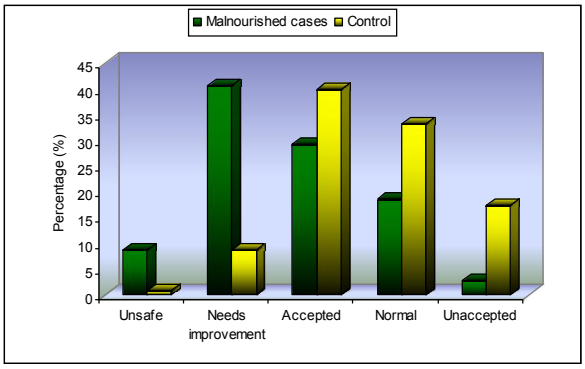

Fig. (1): Bar chart representing the mean amounts of calcium intake among the studied samples

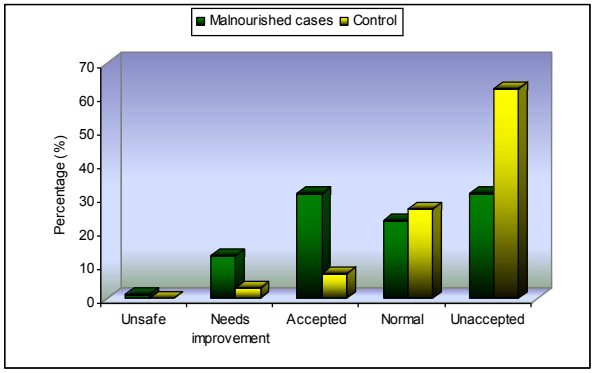

Fig. (2): Bar chart representing the mean amounts of zinc intake among the studied samples

In addition Poster et al. (2008) concluded that childhood chronic malnutrition beginning in the early childhood and extending into adolescence is correlated with decreased stimulated salivary flow, so the decreasing of salivary flow, increase the risk of dental caries. Furthermore, in the study of Linjewile-Marealle (2006) to compare oral health status of well and malnourished children under five years old, it was found that the prevalence of dental caries was higher in malnourished group compared to the well nourished group .On the contrary gingival index GI presented no significant difference. This indicated that gingivitis is moderate type gingivitis.

The oral soft tissue finding as tongue glossitis is statistically higher among cases versus controls. Tongue glossitis was presented as localized absence of tongue papillae. The absence of tongue papillae is a common finding of deficiency of folic acid ,vit B2 and iron. This finding goes in accordance with Linjewile-Marealle (2006) who reported that malnourished children were more likely to present with oral mucosal lesions than well nourished group .Also, Oh et al. (2002) mentioned that the most commonly found pediatric oral lesions are primary herpetic gingivo-stomatitis, recurrent herpes simplex infection, recurrent aphthous ulcers, diffuse intraoral candidiasis, angular cheilitis and geographical tongue. The oral soft tissue finding as gingivitis showed statistically significant higher prevalence among cases. In accordance with Linjewile-Marealle (2006) who found that the prevalence of gingivitis in malnourished children is 37% which is much higher than in well nourished children (1.8%). This could be due to poor oral hygiene rather than nutritional status as all studied children with gingivitis were found to have plaque accumulation in the gingival area. There have been contradictory results with regard to the relationship between malnutrition and the occurrence of gingivitis. Some authors report a strong relationship with higher prevalence of gingivitis in malnourished children (Sawyer and Nwoku, 1985), while others reported no significant difference between the two groups (Abrams and Romberg, 1999).

As regard to the snack preferred food in the studied sample, it was found that a higher percentage of cases preferred cariogenic foods (sweets, crunches and fizzy drinks), however, the difference between the studied groups was not statistically significant. Snacks for toddlers become an important part of their dietary regimen. However, they need regular meal and snack times with access to higher nutrient dense foods. Sweetened beverages like juices, colas, and fruit drinks throughout the day can displace other important nutrient rich foods and increase risk for early childhood caries (Mobley, 2003.

The daily intake of carbohydrates rich foods regarding tubers and sweetened beverages is more among cases compared to controls although no statistical difference. On the other hand the daily intake of fruits as carbohydrates and fibers rich food is more among cases compared to controls although no statistical difference that there was no significant association between dental caries and intake of energy, macronutrient intake, and calcium/phosphorus ratio (Ca/P ratio), respectively. But, the author reported that vegetable intake was significantly associated with lower dental caries score. Mobley (2003) explained that cariogenic foods are those readily metabolized by oral bacteria and referred to as "fermentable carbohydrates" this can include the simple sugars (i.e., glucose, fructose, sucrose), other carbohydrates (i.e. starches, maltodextrins, hydrolyzed starches, high fructose syrups), and the multitude of highly processed foods that list these sugars and starches as major ingredients. Natural foods that have been minimally processed e.g., (fresh fruits and vegetables, grain based foods, meats, eggs, low fat dairy) are considered less carinogenic than those that have been highly processed (e.g., cookies, crackers, sweetened cereals and Juices, colas, candy). Harris et al. (2004)

mentioned that most dietary factors found to be significantly related to children caries are related to either the amount, frequency, or timing of sugar consumption.

Comparing the mean intake of certain food elements , cases consumed less mean amount than controls of proteins, carbohydrates, fibers ,calcium, phosphorous, zinc and vit D. The difference is statistically significant. Mean amount of iron showed higher intake among controls 7.8mg ±1.8 versus 7.4mg± 2.5 among cases although not significant .Regarding the mean intake of vit C it showed no statistical difference between cases and controls .This goes in accordance with dietary guidelines recommended consumption of a variety of food groups to achieve adequate nutrients and appropriate energy intake (Mobley, 2003)(Marshall, 2003), as under nutrition is characterized by inadequate intake of protein, carbohydrates, and micronutrients that resulted in frequent infections and disorders (WHO, 2000).

Protein,calcium,phosphorus,vit D,iron and zinc adequacy is statistically low among cases compared to controls.

Food and nutrient intake data are critical for investigating the relationship between diet and oral health to identify groups at risk for nutrient deficiency or excess, and formulating food and nutrition policies for disease reduction and health promotion (Buzzard, 1994).

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10/22/2012