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Review Article

Obesity and Oral Health-Emphasis on Early Childhood Caries (ECC) and Trying to Implement Prevention Strategies Right from Neonatal Age Besides Updating on other Causes of the Same-A Mini Review

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Abstract

With the incidence of obesity increasing worldwide and at a very fast pace with its associated comorbidities like Type 2 diabetes Mellitus (T2DM), Hypertension, dyslipidemia and some cancers, there is a need to find various factors that need control to halt the epidemic. One of the important factor is the correlation of oral health with obesity. In our earlier reviews we have emphasized on the importance of increased sugars in deteriorating oral health specially in children drinking a lot of soft drinks, fruit juices, or even use of energy drinks in harming adults as well. Further we emphasized the role of saliva in proper concentrations, some minerals and in patients in the extremes of age. Here we conducted a systematic review to update on the information further beyond those provided in earlier reviews and we utilized a pubmed engine for obesity and oral health and subsequently on "early childhood caries" (ECC); 'role of dentists", etc. We found around 1000 articles of which we selected 40 articles for this review. Here we highlight regarding how ECC needs to be detected and approach for treatment, importance of uranium in countries involved in war by detecting using salivary 2PY (N1 Methyl-2-pydone-5-carboxamide) as a biomarker, role of involving training in dentistry curriculum regarding learning BP taking, glucose detection, importance of emphasizing on nutrition from early infancy and same in nurseries and further importance of taking care of oral health in psychiatry patients.

Keywords: *Early Childhood Caries (ECC); Obesity; Oral Health; Sugars; Salivary 2PY; Training Dentistry Students*

Introduction

The increasing incidence of obesity globally has forced one to try and find the multiple causes of increasing obesity globally. Obesity and especially abdominal obesity is usually accompanied with metabolic syndrome, including insulin resistance, hypertension and dyslipidemia [1]. Several studies have shown that obesity is associated with oral and dental problems like chronic periodontitis [2,3]. It has been reported that both dental caries and obesity are diseases with multifactorial etiology related to dietary habits that are closely correlated with sociodemographic background of the individuals [1,4]. Further diet has a direct local effect on oral health, on the integrity of teeth and on the pH and composition of saliva and plaques [5]. It has been concluded that particular diets, those containing high content of saturated fatty acids, non milk extrinsic sugars and low in poly saturates, fibers and vitamins represent common risk factors for diseases

such as DM, coronary heart diseases, obesity and dental caries [6]. Earlier we have tried to correlate how oral health and obesity are interrelated emphasizing the association between childhood obesity and adult obesity with oral health and in extremes of life. Here we have paid detailed stress on has to be laid on preventing early childhood caries right from birth and how it is becoming increasingly important to give emphasis on correlation of sugars and poor oral health right from birth with obesity epidemic getting out of hand [7-11]. In this review we further try to update on this information.

Methods

Thus we conducted a systematic review regarding articles associated with obesity and oral health from 2018 - 2019. We used the Pubmed search engine With MeSH terms like ''early childhood caries'' (ECC), relation of psychiatric patients s with obesity and oral health and other factors relating to salivary changes associated with obesity.

Results

We found a total of 1000 articles of which only topics that had not been discussed earlier were selected and we used 40 articles relevant to ECC, Psychiatric problems and obesity with OH and some other articles not earlier discussed in importance of training dentistry students to be aware of correlation of obesity and OH so that they can pick up cases of DM, obesity and hypertension patients visiting them.

Discussion

Kuwait is a small country (4.1million) that lies at the northern end of the Persian Gulf between Iraq and Saudi Arabia. As with many countries in the middle east, discovery of oil has precipitated a rise in lifestyle disorders like obesity, hypertension and type 2 diabetes mellitus (T2DM). At the time of this study (2012 - 2014) the prevalence of adult obesity in Kuwait was 45.4% (male) to 58.6% (female) of the population [12], the prevalence of hypertension was 26.3% [13] and the prevalence of T2DM in adults was 29.3%, the 6th highest of any country in the world [14]. In this study Goodson., *et al.* bring together data, suggesting that uranium consumption might have contributed to the development of obesity in Kuwaiti children. Although uranium does not naturally occur at high levels in Kuwait, an estimated 286 tons of depleted uranium was used in Kuwait [15] as munitions during the Gulf war (1990 - 1991). Compounds associated with obesity -related DM can be identified through the measurement of urine samples in a US population (NHANES1991 - 2010). Using inductively coupled plasma mass spectrometry this work has demonstrated that, uranium uptake is significantly associated with DM [16].

Uranium is a potent renal toxin, with the element accumulating in calcified tissues, livers and kidneys, as a result of both natural and anthropogenic exposures [17,18]. While uranium toxicity can be radiological, uranium chemical toxicity is more acute and particularly that affects the liver, kidneys and lungs. Chemical toxicity likely involves altered glomerular tubule function or damage, the disruption of cellular ion transport ions and the inhibition of aerobic oxidative phosphorylation. Renal impairment and uranium poisoning can be caused at dosages as low as 50 ppb to 20 ppm [18-20]. Uranium in dust is the largest source of uranium-based radiation exposure in uranium processing facilities [20,21].

N1 Methyl-2-pydone-5-carboxamide (2PY) is found at higher concentrations in serum of patients suffering from renal failure [22]. Levels of 2PY in renal tissues of healthy people are typically 1.37 mg/L (± 0.68) whereas concentrations in patients with uremia average 4.02 mg/L (± 3.28) with measurements as high as 7.80 mg/L (± 3.59) [23]. In rats 2PY is one of number of metabolites whose concentration in urine is associated with prolonged low-dose exposure to uranium [24].

Thus Goodson., *et al*. conducted a longitudinal study of 6158 Kuwaiti children, where they selected 94 for salivary metabolomic analysis who were neither obese (by waist circumference), nor metabolic syndrome (MetS) positive (< 3 diagnostic features). Half (43) remained healthy for 2 years. The other half (51) were selected because they became obese and MetS positive 2year later. In the half becoming obese, metabolomic analysis revealed that the level of salivary N1 Methyl-2-pydone-5-carboxamide (2PY) had the highest positive association with obesity ($p = 0.0003$, AUC = 0.72) of 441 salivary biochemicals detected. 2PY is a recognized uremic toxin. Also 2 PY has been

identified as a biomarker for uranium uptake. Considering that a relatively recent military conflict with documented uranium contamination of the area suggests that the weight gain could be a toxicological effect of a longtime, low-level uranium ingestion. Comparison of salivary 2PY in samples from the USA and Kuwait found that only Kuwait samples were significantly related to obesity. Also, the geographic distribution of both reported soil radioactivity from ^{238}U and measured salivary 2PY was highest in the area where military activity was highest. The prevalence pattern of adult DM in Kuwait suggests that a transient diabetogenic factor has been introduced into the Kuwaiti population. Although the authors did not measure uranium in their study, the presence of a salivary biomarker for uranium consumption suggests potential toxicity related to obesity in children [25].

Patients with psychiatric illness are more prone to develop obesity and dental caries in view of general self negligence associated with psychiatric illness and side effects of various medications used in psychiatry. Ashour., *et al*. tried to carry out a cross sectional study by recruiting psychiatric in patients from a mental hospital. Dental caries detection was performed as per the world health organization (WHO) Criteria and body mass index (BMI) was measured. Relationships were assessed using multivariate logistic regression. Relationship between decayed, missing and filled teeth (DMFT) and obesity was assessed. The sample included 126 males and 97 females with a mean (SD) age of 42.3 (2.2 yrs). The prevalence of Dental caries was 92.6%. The mean (SD) DMFT score was 5.2 (4.2). 27%were schizophrenic, 21.9% had mental retardation and 19.7% had bipolar mood disorder. The mean (SD) BMI was 27.7 (6.3) kg/m^2. 173 (55.2%) of in patients were classified as normal weight, 47 (21.1%) as overweight and 45 (20.2%) as obese. The logistic regression model showed a strong association between caries and obesity/overweight (adjusted odds ratio = 2.7; 95%CI - 1.4 - 4.3, P < 0.01). Thus, concluding that the present study demonstrated a significant association between the frequency of caries and obesity/overweight among resident patients in a psychiatric hospital. But the limitations of the study being cross -sectional, causal relationships couldn't be established due to other unexplored factors [26].

Natarajan., *et al*. evaluated the relationship between missing posterior teeth and BMI with regard to age and socioeconomic state in a sample of the suburban south Indian population. 500 individuals that included both male and female subjects aged > = 40yrs with missing posterior teeth and not rehabilitated by any prosthesis underwent clinical history, intraoral examination and anthropometric measurement to get information as per age, sex, socioeconomic status, missing posterior teeth and BMI (underweight < 18.5 kg/m^2, normal weight 18. 5 - 23 kg/m^2, overweight 23 - 25 kg/m^2, obese without surgery 25 - 32.5 kg/m^2, obese with surgery < 32. 5kg/m^2). Multivariate logistic regression was used to adjust data according to age, sex, number of missing posterior teeth and socioeconomic status. People with a higher number of tooth were more obese. Females with high tooth loss were found to be more obese than male. Low socioeconomic group obese female had significantly higher tooth loss. Thus, concluding that BMI and tooth loss are interrelated. Management of obesity and tooth loss can help to maintain the overall health status [27].

Natto and Hameedaidan 2019 tried to identify all the published systematic reviews (SRs) and meta-analysis (MAs) that studied the relationship between periodontal and systemic diseases and to assess their quality using 2 scales (the Overview Quality Assessment Questionnaire [OQAQ]and A Measurement Tool to Assess systematic reviews [AMSTAR] checklist). For SR's and MA's to be included, they should have investigated one of the following systemic diseases: pulmonary conditions, cardiac conditions, anxiety, depression, mood disorders and several other diseases. 2 investigators screened medline via Pubmed, Embase, Scopus, Web of Science and the Cochrane Database of systematic reviews. The tools used to evaluate quality were the AMSTAR scale and OQAQ. The protocol was prospectively registered in PROSPERO. Their search strategies found 691 unique articles, 42 of which met the eligibility criteria and were included in this review. DM (diabetes mellitus) was the most investigated disease (14/42), followed by obesity (11 studies) and Cardiovascular (CVS) studies (5 studies). A total of 40 reviews reported and the characteristics of included studies and as per the AMSTAR Scale, 39 reviews had a priori design. The number of reviews that fulfilled the status of publication criterion was the lowest (7reviews only) followed by the numbers used in the assessment of publication bias (11 reviews). The number of high -quality reviews was higher with the OQAQ than

with AMSTAR checklist (33 vs 25 studies), but the AMSTAR showed a higher number of medium quality reviews than the OQAQ (14 vs 6 studies). Both showed the same number of low quality reviews. Thus, concluding high quality SRs and MAs are crucial to understanding the relationship between systemic and periodontal diseases. Medical practitioners must be able to inform patients about oral health and specific periodontal health concerns [28].

Early childhood caries

Balanced nutrition is very important during childhood, which is a period of increased activity, body growth and development of cognitive ability. In the last few years dietary sugar has been considered a central risk factor in the development of some important diseases, together with alcohol and tobacco.

Sugars added to foods during processing, preparation or at the table, sweeten food and beverage taste, improve their palatability and are used to preserve foods and to confer property such as viscosity, texture and color. They provide sensory enhancement of foods and enjoyment but, although they may be required in some clinical solutions, they are not a necessary component of the diet in healthy children. In addition to its role in caries, for which moderate evidence is present regarding a direct correlation, increasing attention has been paid to how dietary sugars affect obesity, T2DM and cardiometabolic and kidney diseases [29].

The dental caries process can be described as a loss of minerals (demineralisation) of the teeth when the pH of the plaque drops below the critical value of 5.5; reapposition of minerals (mineralization) occurs when the pH increases. Whether a lesion will develop, depends on outcome of balance between demineralization and remineralization, in which the latter process is significantly slower than the former.

Diet and nutrition might interfere with the above mentioned mechanism. Sugars and other fermentable carbohydrate, after being hydrolysed by salivary amylase, provide substrate for the action of oral acidogenic and aciduric bacteria (Streptococci mutants and Lactobacilli especially), that reduce salivary and plaque pH. Otherwise, a diet lower in sugars and fermentable carbohydrate and high in calcium-rich cheese may favour remineralization.

Direct correlation between intake of dietary sugars and caries has been verified by studies throughout life. The food types (solids or beverages), exposure time and frequency of eating also play an important role in the development of dental caries. Since the 1st studies, besides diet, other factors involved in dental caries etiopathogenesis include salivary flow (quality and quantity), the immune system, age, socioeconomic status, level of education, lifestyle behaviors, oral hygiene and use of fluorides [30].

Over the past decade, the American Academic of Paediatrics Dentistry introduced the definition of early childhood caries (ECC) consisting of the presence of one or more cavities, missing or filling in the primary tooth in a child under 6 years of age (Figure 1 and 2).

Figure 1: *Courtesy ref no- 35. Type 2 (moderate to severe) ECC in a 4-years-old girl, frontal and occlusal view: cervical and interproximal areas of yellowish decalcification in maxillary incisors with molars involvement.*

Figure 2: *Courtesy ref no.35 Type 2 (moderate to severe) ECC in a 4-years-old boy, frontal and occlusal view: compared to the previous case, carious lesions affect almost all teeth, with crown destruction and consequent permanence of brown black root stumps. Note the presence of fistulas.*

The disease has widespread spread and it has been shown that children developing ECC have a diet characterized by high free sugars intake, especially as beverages like fruit juices, soft drinks etc. Further the role of candies and pacifier dipped in sugar or honey is not negligible. Greater incidence of ECC has been well documented in Europe [31], Italy [32]. The OMS Collaboration Centre for Epidemiology and Community Dentistry (Milan, Italy), conducted a research in 2004 - 2005 showing 21.6% decay prevalence in Italian 4year old children [33].

Generally, children with ECC consume free sugars daily. In particular, sucrose is needed as substratum in the production of extracellular polysaccharides, that in turn facilitate bacterial adhesion to the dental surface and increase the porosity of plaque in close contact with the tooth, with a subsequent production of acid on the enamel surface. This condition represents an aggravating factor in dental caries development in primary teeth, due to the thinner and uniform enamel and of the shorter dentin in primary teeth, than in permanent ones, due to dentin tubules having a non-homogenous distribution.

Greater the frequency of amount of free sugar consumption, more frequently pH falls below 5.5 the threshold value with subsequent problem in buffering the general acidity.

Consequences of ECC on a child's health and life quality are numerous and severe; i.e. greater risk of malocclusion and development of new decays, in mixed and permanent dentition, increased instances of pain and dental emergencies, greater chances of pain and dental emergencies, risk of bacteremia; possible alteration of child's growth and development, problems in learning associated with reduced scholastic performance. Hence it is essential to use preventive measures as early as possible, in children, also considering that bacteria might get transmitted from the mother to child, directly from the saliva.

Role of breast feeding

As per WHO breast feeding is the best way of getting nutrition delivered to young infants with nutrients, regarding healthy growth and development. Problem arises when breastfeeding is used exclusively instead of adding complementary foods following 6 months of age upto 2 years of age or even beyond that. Various studies showed prolonged and unrestricted breast feeding as a potential risk factor for ECC development. On-demand breast feeding, especially at night, would seem to cause ECC as milk remains in the baby's mouth for longer periods of time. Still evidence is limited as far as human milk being cariogenic and other factors like oral hygiene, might influence development of caries more rather than on demand breast feeding. Further the biomechanics of breast feeding is separate from bottle feeding and milk is expressed into the soft palate and swallowed without remaining on teeth. We have to remember that the main factors influencing development of caries in infants is the presence of bacteria, Streptococci mutants, which thrive in the combination of sugars, small amount of saliva and a low pH [34]. Future studies that use more detailed methods regarding assessment are required for finding the cariogenic nature of breast feeding. Till that time breast feeding does need to be strongly encouraged. Dental professionals need to teach the parents to start taking proper care of oral hygiene with the children as early as the 1st tooth erupts and to limit the consumption of sugary beverages to the minimum [35].

Caries prevalence and severity in primary teeth of children are high. Untreated tooth decay in the primary dentition is a common and global phenomenon. The costly restorative treatment and the insufficient supply or skewed distribution of dental health workforce make it impracticable to control dental caries in children, especially in underprivileged communities. A simple program for promoting oral self-care via tooth brushing with fluoride dentifrice has been well documented with promising results. However, this program alone is probably not able to deal with severe cases involving multiple carious lesions. Evidence exists that fluoride varnish is considered a safe and effective agent for caries prevention in young children. For treating established dentine lesions, clinical trials of ART (Atraumatic Restorative Treatment) treatment with highly viscous glass ionomer cement (GIC) provide some evidence with good success rates in primary dentition. In light of its clinical success, silver diamine fluoride (SDF) can be an option for controlling tooth decay, especially at the cavitation level in preschool children. SDF may revolutionize paediatric and community dentistry and may be a breakthrough dental agent this century due to its safety, efficiency, feasibility and effectiveness in preventing and arresting dentine caries. Although black staining is a known side effect of SDF, the health benefits of having no toothache and dental infection can far outweigh this, particularly where access to dental care is challenging. Regardless of various atraumatic approaches, good plaque control remains paramount for the success of caries control in young children [36].

Dental caries in primary teeth is prevalent, affecting millions of children around the world. Functionalized tricalcium phosphate (fTCP) has been incorporated into sodium fluoride (NaF) varnish to enhance the remineralization process. NaF varnish with the adjunctive application of silver nitrate ($AgNO_3$) solution is effective in arresting dentine caries. So far, there is no published randomized clinical trial investigating the effectiveness of the adoption of $AgNO_3$ solution and NaF varnish containing fTCP in arresting dentine caries in preschool children. The objective of the study of Chen., *et al*. was to compare the effectiveness of a 25% $AgNO_3$ solution plus a 5% NaF varnish containing fTCP and a 25% $AgNO_3$ solution plus a 5% NaF varnish in arresting coronal dentine caries among preschool children when applied semi-annually over a 30-month period. Thus, a randomized double-blind controlled trial, was conducted. The null hypothesis tested is that no difference exists between the effectiveness of a 25% $AgNO_3$ solution plus a 5% NaF varnish with fTCP and a 25% $AgNO_3$ solution plus a 5% NaF varnish in arresting dentine caries in preschool children when applied semi-annually. According to the sample size calculation, approximately 2000 3 to 4-year-old kindergarten children will be screened and at least 408 children with coronal dentine caries will be recruited. The children will be randomly allocated to two treatment groups via stratified randomization: group A - biannual application of a 25% $AgNO_3$ solution followed by a 5% NaF varnish and group B-biannual application of a 25% $AgNO_3$ solution followed by a 5% NaF varnish with fTCP. Clinical examinations will be conducted every 6 months to assess whether the carious lesions have become arrested (primary outcome). Confounding factors, such as demographic background and oral hygiene behaviors, will be collected through a parental questionnaire.

The effectiveness of the topical application of a 25% $AgNO_3$ solution followed by a 5% NaF varnish with fTCP in arresting coronal dentine caries among preschool children remains unknown. Because the proposed caries-arresting methods are simple, noninvasive and low cost, these can be widely recommended for caries control in young children [37].

The nationwide cross-sectional survey investigated the association between periodontal disease and reported self reported systemic health in periodontal patients who regularly visited private dental clinics in Japan. Data from 999 patients of 444dental clinics were analyzed, the patients were aged 40 yrs or older, regularly visited dentists and had diagnosed periodontal disease (identified as 2 or more teeth with a clinical attachment level > = 6 mm). Medical history was collected with a self reported questionnaire, number of teeth with a probing pocket depth (PPD) > = 5 mm was used to define periodontal status and the highest quartile was used as the dependent variable. A Poisson regression model showed that histories of DM and hypertension were associated with a large number of teeth with a PPD > = 5 mm (diabetes prevalence rate ratio [PRR] 1.36, 95% CI 1,00 - 1.85; Hypertension: PRR 1.27, 95% CI 1.02 - 1.58 after adjusting the potential periodontal risk factors. These findings suggest that DM and hypertension are associated with worse periodontal disease. Dentists should confirm the DM and hypertension status of patients who receive maintenance care, since these conditions could affect periodontal management of patients [38].

There is a lack of information about knowledge, attitude and behavior regarding oral hygiene and dietary habits of adult patients attending dental clinic settings. Hypertension, DM, obesity and caries are increasing among different populations, resulting in the deterioration of the quality of life related to oral and general health. Thus Farghaly., *et al.* aimed to involve 2nd year students in assessing oral health knowledge, attitude, behavior, dietary habits and general health of dental patients and screening for Blood pressure (BP), blood glucose level and obesity. A convenient sample of 652 adult subjects participated in the study. They were screened, involved in an interviewer-led Questionnaire, led by the students over the period of 2 successive academic years (2013 - 2014 and 2014 - 2015). Subjects with high BP and/or blood glucose levels were more likely to disagree regarding the presence of a relation between general health and dental health [(correlation coefficient® = -0. 159, probability value P < 0.001) respectively]. Subjects with high BMI were less aware of the importance of using the tooth brush in prevention of gingival inflammation. The overall students satisfaction score was 71.5%. The practical part of the research had the highest satisfactory score (83.7%). There is scarcity of data regarding dental health care knowledge and attitudes in dental clinical settings. Additional clinical training for dental students would increase their willingness to play a preventive and educational role in the oral care of patients [39].

The nutrition and physical activity self-assessment for childcare (NAP SACC) intervention has demonstrated effectiveness in the USA. A feasibility randomized controlled trial was conducted in England to adapt the intervention to the UK context. A n embedded process evaluation focused on three key questions. i) Was it feasible and acceptable to implement the intervention as planned? ii) How did the intervention affect staff and parent mediators? iii) Were the trial design and methods acceptable? 12 Nurseries in south-west England were recruited and randomized to intervention or control. The intervention comprised: NAP SACC UK Partner (Health Visitor) support nurseries to review practices and policies against best practice and then set goals to improve physical activity, nutrition and oral health; two staff training workshops; and a web based parent support element. The process elevation comprised: observation of partner training (n = 1, Partner/manager meetings (n = 5) and staff workshops (n = 10), semi-structured interviews with Partners (n = 4). managers (n = 4) and parents (n = 20), analysis of self assessment forms, goal setting forms and Partner logbooks; and assessment of staff and parent knowledge, motivation and self efficacy mediators. Overall, NAP SACC UK was feasible to implement and acceptable to nursery staff, managers, Partners and parents. The intervention was implemented as planned in 5 of the 6 intervention nurseries. Partners and managers appreciated the opportunity to review and improve nursery practices and valued the relationship logged between them. Staff rated the training workshops highly, despite attending outside of the working hours. Most goals set up nurseries were achieved. However, Partners raised concerns about Health Visitors capacity to deliver the intervention in any subsequent roll out. Mediator scores improved in all but 2 areas in intervention staff and parents., with decreases or minimal changes in the control group. The web based parent element was not

well used and should be removed from any subsequent trial. The trial methods were acceptable to managers, staff, Partners and parents. Thus, concluding that implementing and evaluating a physical activity and nutrition intervention in nursery settings is feasible and acceptable. A full RCT of NAP SACC UK (with appropriate modifications) is required [40].

Conclusion

Thus, in this review we have highlighted how geographical areas like Kuwait or any others involved in war might have effects of uranium in the area for long which might have contributed to obesity as revealed by salivary 2PY levels. Further how psychiatry patients might be getting obese with poor oral health correlating with obesity. Further the importance of "Early childhood caries" (ECC) has been emphasized and its correlation with increased sugars as earlier emphasized for older children. Hence need for taking oral health precautions right from infancy is important. Association with obesity has been traced right from time of ECC. How treatment is to be done has been given. Similarly in earlier reviews we had highlighted how it was important for dentists to learn how to diagnose at their level DM, Hypertension and now need is arising that dentistry students be taught right in training days regarding same with the obesity epidemic growing by leaps and bound. Further importance in nursery settings regarding importance of nutrition has been further emphasized.

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