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RESEARCH ARTICLE

PREVALENCE OF DENTAL CARIES AND ITS CORRELATES AMONG PRIMARY SCHOOL PUPILS IN LUFWANYAMA DISTRICT, ZAMBIA

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Abstract

Introduction: Dental caries is the most common preventable oral disease affecting all ages and socioeconomic groups worldwide, and the effects on life in general are well observed. In order to formulate proper adequate preventive measures, policy makers need to have an idea of the magnitude of the problem. This is why it is very important to undertake and publish prevalence studies timely and regularly. There have never been a published study done among the population of our study. In this study, we aimed at establishing the prevalence of dental caries and its correlates among primary school going children in Lufwanyama district of Zambia.

Methods: This was a cross-sectional descriptive study in which a total number of 1228 primary school pupils from different schools of Lufwanyama district were asked questions from a structured questionnaire and responses recorded for each pupil. Dental examinations were also done on all participants by a qualified and legally registered dentist. Data were analyzed using Stata/MP 16 to generate frequencies, tables and tabulate associations like odds ratios.

Results: A total of 1228 out of 1800 pupils participated in the survey, giving a response rate of 68 percent. Overall, 559 (45.5 percent) pupils were male. The overall prevalence of caries was 38.2 percent.

Female pupils were 22 percent (AOR=1.22, 95% CI [1.06, 1.41]) more likely to have caries than male pupils. Pupils whose diet at home was predominantly sweet things and carbohydrates were 47 percent (AOR=1.47, 95% CI [1.25, 1.72]) more likely to have caries than pupils who had fruits, meat and vegetables at home. Meanwhile, pupils who had sweet things and carbohydrates at school were 76 percent (AOR=1.76, 95% CI [1.44, 2.15]) more likely to have caries than pupils who had fruits, meat and vegetables at school. Compared to pupils who brushed their teeth two times or more, those who brushed their teeth less than two times were 3.49 (95% CI [3.02, 4.05]) times more likely to have caries.

Conclusion: The prevalence of dental caries among primary school going children is comparatively high in Lufwanyama district and many factors influence it. Dietary factors and dental/oral hygiene are the main influencers; all of which are modifiable factors. Dental caries greatly affects oral health; oral health have a huge effect on people's quality of life, which in itself affects their general health status. For the caries prevalence to be lowered in this district, there will be need to invest in community programs that will keep on sensitizing people on good oral hygiene, oral health supportive-diets and the importance of regular dental checkups. Primordial and primary preventive measures to take center stage as they both cheaper and effective.

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Introduction:-

Background

Dental caries are the most common preventable oral diseases affecting all ages and socioeconomic groups worldwide. Global oral health data shows a decrease in dental caries in developed countries, and an increase in developing countries, especially where community preventive programs have not been properly established yet¹

By definition in simpler term, dental caries (also called tooth decay) is damage to a tooth that can happen when decay causing bacteria normally found in your mouth make acids, by feeding on fermentable carbohydrates. These acids attack the tooth surface (enamel), which can eventually lead to cavities forming in a tooth. If this decay is not treated in good time, it can cause severe pain, local and generalized infection, tooth loss and even death.

Dental caries are perhaps the most prevalent and one of the oldest chronic disease worldwide. The disease is the result of a complex interaction between acid producing tooth-adherent bacteria (normally found in the mouth) and fermentable carbohydrates (from the food we eat). Risk factors for caries includes factors such as high numbers of cariogenic bacteria, high frequency sugar consumption, inadequate salivary flow, insufficient fluoride exposure, poor oral hygiene, and poverty. Dental caries are commonly known for causing severe toothache when left untreated to in early stages. Complications of dental caries follows a continuum from simple cavity formation to face-disfiguring and life threatening orofacial swellings as infection spreads^{2,3}

Caries incidence increased dramatically in post-industrial societies with increasing affluence, and in particular with the availability of processed sugar. In more recent times, improved oral hygiene practices coupled with fluoridation of the public water supply along with the presence of fluoride in dentifrices, mouth rinses and processed foods, have greatly reduced the prevalence of dental caries in the population. The mentioned prevent measures have proved to be more effective if applied from the time teeth start appearing in the mouth. Nevertheless, caries remains a significant problem in some sections of society, especially those with low socioeconomic status and with limited access to healthcare services³

According to a report published by the World Health Organization (WHO) in 2010 on oral health, dental caries was cited to be the major oral health problem affecting 2.43 billion people (35.3 percent of the population) worldwide. Regionally, dental caries was mentioned to be one of the most prevalent diseases, and approximately 30 percent of the population was estimated to be suffering from decay of their permanent teeth in the WHO African Region in 2017 (WHO 2017). A report by the Ministry of Health of Zambia government in 2017 reviewed that approximately 31.5 percent reported oral pain and discomfort due to tooth decay.

On factors, a recent study done in the United Kingdom reviewed that female adolescents had experienced more carious lesions compared to males of the same age group⁴. In their study⁶, reported that prevalence of caries was 62 percent lower in children who brushed their teeth several times a day as compared to those who never brush their teeth. Their conclusion was that tooth brushing is related to oral health, with a major clinical impact. The positive effect of tooth brushing was superior to that of a correct diet in preventing dental caries. On the other hand, we couldn't find any literature that talked about associations between sugary foods at home or at school with dental caries.

Statement of the Problem and research question

Dental caries have continued to appear among the top 10 causes of morbidity among the Zambian population, and as such, contributes heavily to disease burden for health services. The burden on health services is even more when complications arise, which is also common for dental caries. As an infectious disease, dental caries are preventable with known measures. These include good oral hygiene, reduction in fermentable carbohydrates and regular dental check-ups. It has been observed that starting these interventions from the time the first tooth appears in the mouth have greater impact in dental caries prevention.

In most dental clinics in the country, more than half of the budgets goes to materials and instruments needed to manage dental caries. This clearly implies that a high prevalence in dental caries adds to health costs for the government also. Even with the above stated facts, in government institutions, dental departments and oral health programs remains one of the areas with the least funding from government, and also from other health services stakeholders like Non-Governmental Organizations (NGOs).

One way to help inform policy is to regularly publish prevalence of dental caries, and the related complications. Even with this obvious need for up to date information on dental caries, there have been no recently published studies to ascertain the prevalence of this common condition and its correlates on any age group in Zambia, and Lufwanyama as a district, hence this study. Hence the research question; WHAT IS THE PREVALENCE OF DENTAL CARIES IN LUFWANYAMA DISTRICT AND WHAT FACTORS INFLUENCE.

Significance of the Study

To effectively plan a health services delivery program, policy makers need to appreciate the magnitude of the problem at any given time. Studying and reporting on dental caries prevalence will afford the policy makers with timely information which helps with budget and human resource allocations.

One effective way of monitoring the effectiveness of interventions applied to alleviate or get rid of a preventable or curable condition is to establish and compare prevalence before and after intervention.

Prevalence is very much connected to incidence of disease. Increased or reduced incidence could lead to undertaking more specific studies that might seek to explain the increase or decrease.

Hence, the results of this study can and will be used to plan better for healthcare delivery system, to evaluate existing interventions, and to do other studies that will seek to understand the current and past prevalence.

Study Objectives

Main Objective

The general objective of this study was to establish the prevalence of dental caries and its correlates among primary school pupils in Lufwanyama district of Zambia.

Specific Objectives

1. To determine the association between sex and dental caries in primary school pupils.
2. To determine the association between the numbers of times one brushes teeth and dental caries.
3. To determine the association between intake of sugary foods at home and dental caries.
4. To determine the association between intake of sugary foods at school and dental caries.

Methodology:

Study population

This study was conducted in Lufwanyama District among Primary school going Children.

Study design

This was a cross sectional descriptive study.

Sample size and Sampling

Sample size was calculated to be 2016 using the formula, $n = Z^2P(1-P)/d^2$, (Where n = sample size; Z = statistic for the level of confidence; P = expected prevalence; d = precision).

Cluster sampling was employed in this study. Different primary schools within the Lufwanyama district served as clusters. A school was randomly selected from each of the 8 Zones of the district (Zones as demarcated by the Ministry of Education). Data was collected on all consenting pupils whose parents assented from the selected clusters (from grade 1 to grade 7).

Procedure and instruments

Data was collected using a questionnaire. A questionnaire was administered by interviewing the participants one by one within school premises and responses recorded on a different paper for each respondent on the same day. A total of 1228 responses were recorded. The questions focused on participants' age, sex, oral hygiene, regular diet at home and school, and individual perceptions on dental caries. A hired qualified registered dentist conducted intra-oral examinations to check for dental caries in all consenting participants. These examinations took place in a secluded room within school premises. In this study, all teeth with acquired holes/cavities other than by trauma, filled teeth due to dental caries, and those missing due to dental caries were recorded as dental caries (Decayed, Missing, and Filled Tooth -DMFT). Participants found with serious dental problems were referred to the nearest Clinic/ hospital. Data collection took place between 15th February and 24th February, 2022. To determine the perceived seriousness of dental caries by participant, a direct question was asked from the questionnaire (Question 2: do you think dental caries is a serious condition?). For regular diet at school and home, the most predominant one was picked.

Data analysis and presentation

Data was stored using both hard copy and soft copy platforms. Data was organised cluster by cluster and was analysed using Stata/MP 16.0, using the same tool to generate descriptive statistics, frequencies and associations between the dependant variable (dental caries) and the independent variables. Counts and percentages were used for descriptive statistics. Chi-square test was used to determine associations between the various exposure variables (age, sex, predominant diet at home, predominant diet at school, number of times one brushes teeth in a day, what one uses to clean teeth and ones perceived seriousness of dental caries) and the outcome of interest at the 5 percent significance level. Significant factors associated with the outcome in bivariate analyses was considered in a multivariate logistic regression to obtain independent factors associated with the outcome.

Odds ratios and their 95 percent confidence intervals are reported. Results are presented using percentages and tables. These study results were subjected to peer reviews.

Results:

Sample description

A total of 1228 pupils participated in the survey, giving a response rate of 68 percent (32 percent non-response bias). Overall, 559 (45.5 percent) pupils were male. The participants were grouped in two age groups; below 12, and 12 and above.

For males, 374 (66.9 percent) were aged below 12 years; 298 (53.3 percent) had fruits, meat and vegetables as regular diet at home; 140 (25 percent) had fruits, meat and vegetables as regular diet at school; 329 (58.9 percent) brushed their teeth twice or more in a day; 482 (86.2 percent) used a toothbrush and toothpaste to clean their teeth; 520 (93.0 percent) perceived dental caries to be a serious condition; 188 (33.6 percent) had dental caries.

For the females, 405 (60.5 percent) were aged below 12 years; 377 (56.4 percent) had fruits, meat and vegetables as regular diet at home; 159 (23.8 percent) had fruits, meat and vegetables as regular diet at school; 362 (54.1 percent) brushed their teeth twice or more in a day; 590 (88.2 percent) used a toothbrush and toothpaste when cleaning their teeth; 622 (93.0 percent) perceived dental caries to be a serious condition; 281 (42.0 percent) had dental caries.

The overall prevalence of caries was 38.2% ($469/1228 \times 100$); the percentage of males with dental caries out of the whole population was 15.3 ($188/1228 \times 100$), and that of females was 22.9 ($281/1228 \times 100$). Table 2 below shows a description of the sample by sex with other variables.

No significant associations were observed between regular diets at home, regular diet at school, teeth brushing frequency, what was used to brush teeth and the participants' perceived seriousness of dental caries on one hand and sex on the other. Overall, 553 (45 percent) of the pupils reported having regular carbohydrate diets at home, 929 (75. percent) had regular carbohydrate diets at school, 537 (43.7 percent) brushed teeth less than 2 times in a day, 156 (12.7 percent) did not use a toothbrush and tooth paste for brushing teeth and 86 (7 percent) did not perceive dental caries to be serious. Meanwhile, dental caries were associated with sex; females (42.0 percent) tended to have a higher proportion of caries than male (33.6 percent) pupils ($p=0.003$).

Factors associated with caries in bivariate analyses are shown in Table 3. All the factors except age ($p=0.201$) were significantly associated with caries.

Independent factors associated with caries are shown in Table 4. Female pupils were 22 percent (AOR=1.22, 95% CI [1.06, 1.41]) more likely to have caries than male pupils. Pupils whose diet at home was predominantly carbohydrates were 47 percent (AOR=1.47, 95% CI [1.25, 1.72]) more likely to have caries than pupils who had fruits, meat and vegetables at home. Meanwhile, pupils who had carbohydrates at school were 76 percent (AOR=1.76, 95% CI [1.44, 2.15]) more likely to have caries than pupils who had fruits, meat and vegetables at school. Compared to pupils who brushed their teeth two times or more, those who brushed their teeth less than two times were 3.49 (95% CI [3.02, 4.05]) times more likely to have caries.

Discussion:

Dental caries has, from way back, been known to affect a good percentage of people in all social classes and age groups. Dental caries have been repeatedly connected to diet and oral hygiene, and time duration between eating and brushing teeth. In our study, understanding the time factor in causation of dental caries, we aimed at establishing the prevalence at early stages of life in a semi-rural setting. The results of our study indicates that the prevalence of 38.2 percent was high compared to WHO recommendations (below 10 percent), but not higher than most studies done elsewhere around the globe; 45 percent⁸, 73 percent⁹ and 43 percent¹⁰. Considering that we had a relatively low response rate of 68 percent, it is likely that our results underestimated the prevalence rate of dental caries due to non-response bias of 32 percent. A very recent study conducted in Ethiopia on school children by Shitie^{11,12} established the prevalence of dental caries that was slightly higher than ours at 46.9 percent.

As mentioned in their research, talked of the hypothesis that the higher prevalence of dental caries among females can be explained the following 3 factors: 1) earlier eruption of teeth in girls, hence longer exposure of their teeth to cariogenic environments, 2) easier access to food supplies by women and frequent snacking during food preparation, 3) pregnancy induced changes that alters physiological systems and forces diet change. In agreement to other studies cited, our research found that caries prevalence was higher in females than males, with an addition that girls generally liked sweet foods more than boys.

Time is the fourth factor in dental caries etiology (others are carbohydrates, susceptible tooth surface and bacteria). It is a very important actor in that cariogenic bacteria needs time to act on carbohydrates and produce the acid that attacks the tooth surface. This means that when we brush immediately after eating, we are not allowing that process to take place, hence preventing dental caries.

Our results indicate that reduced (frequency) intake of sugary foods had a preventive effect, even when someone does not brush two or more times in a day, but brushing teeth twice more in a day did not have a preventive effect in

individuals who predominantly consumed sugary foods. This means that to effectively prevent dental caries, a big deal of attention should be paid to diet modifications.

Eating sweet things and carbohydrates at school has been found to be more cariogenic¹¹ because: 1) most foods sold near school or those packed for school are the sticky ones that do not easily wash off, hence have more time to aid in acid production, 2) it is unusual that pupils carry toothbrushes at school, and usually does not find the time and space to brush the teeth. Our study also shows that predominantly consuming sugary foods in school had a higher dental caries causative effect than sugary foods taken at home. The reason for this could be that individuals usually brush their teeth at some point after eating at home, but this is not usually the case after eating at school. Some pupils who were asked if they brush teeth after eating at school responded that 'it is not possible because we do not carry our toothbrushes at school'. This calls for inclusion, in the 'package' of oral health educational programs, a component that emphasizes on how easy it is to carry a toothbrush and toothpaste at school or work (just the same way people carry 'face make-up kits' and electronic gadgets).

Our results indicate that 'perceiving' dental caries as a serious condition did not do much to compel the pupils to improve on teeth brushing frequency and diet adjustment. This is probably because of the misconception on 'how serious' dental caries are. This calls for consistent practical community teachings on the very serious complications of dental caries; the use of photos, videos and real-time experiences can be more effective. Normally, people that psychologically perceive a disease to be a serious problem are more likely to practice preventive measure that makes them not have that condition.

What is used to brush the teeth is another factor that makes a difference in dental caries prevalence. A conventional toothbrush is made in such a way that it scrapes off food particles everywhere including hidden areas like in between teeth. Using any other tool cannot be as effective.

A standard toothpaste contains fluoride, which makes the tooth more resistant to acid attacks, hence preventing dental caries. Regarding what was used to brush teeth, our study found a connection between not having a toothbrush and the frequency of brushing teeth; all pupils that indicated they didn't have a toothbrush brushed their teeth less than 2 times a day (some even days without brushing). This, therefore, means that providing toothbrushes for those that cannot afford could be another step to prevent dental caries and reduce the prevalence rate.

For best results, it would be appropriate to take an approach that takes into account all the contributing factors; oral hygiene, dietary modifications, fluoridation of water and some food stuffs, consistent and sustained community oral health educational programs, and economic empowerment for the needy. Dental caries develops over time, so a dental caries prevalence of 38.2 percent in individuals who have lived for less than 20 years means we are likely to have a much higher prevalence in older individuals^{14, 15}. So this calls for another prevalence research on the older populations.

Limitations

The total sample size was lower than we intended due to the difficult terrains in far places of the district in rain season which made us fail to reach 2 of the intended schools. Also, financial challenges delayed our data collection. Another limitation was that information gotten for 5 of the 8 variables was subjective, with potential for exaggerations and misinformation (predominant diet at home, predominant diet at school, what is used to clean teeth, how times one brushed teeth and whether participant perceived dental caries a serious condition or not). These challenges were mitigated by mentioning beforehand to the pupils that the answers to these questions must be accurate for the exercise to be fruitful and help both the participant and researcher, and the community at large. Also we used body language and facial expression to see if someone telling the truth; when we suspect untruth, we would re-emphasise the need for the truth and ask the questions again. Lastly, we would check the current condition in the mouth (this can tell if someone brushed, and with a proper tool)

Conclusion:

The prevalence of dental caries among primary school pupils in Lufwanyama District is higher than the recommendations by the World Health Organization WHO (below 10 percent), but still lower than what has been found in some other studies done around the globe. Even when it is generally agreed that dental caries is a multifactorial disease, dietary modifications alone is more preventive than other factors alone.

Having such a high prevalence in primary pupils who were all below 16 years means that we are likely to have a much higher prevalence in the older population^{16, 17}. This therefore calls for another similar study, but on adult participants.

This study met its objectives; the prevalence of dental caries was established, the association between sex and dental caries in primary school pupils was determined, the association between the numbers of times one brushes teeth and

dental caries was determined, the association between intake of sugary foods at home and dental caries was determined, and the association between intake of sugary foods at school and dental caries.

Recommendations

For sustained lower dental caries prevalence and reduced expenditure on curative measures, we recommend that more attention and finances be directed to preventive measures of dental caries, targeting the younger population in our societies. The Government of Zambia through the Ministry of Health and its cooperating partners would save a lot of money and lives by allocating adequate attention oral health and the need to prevent dental caries and related conditions. Oral health departments at every level of healthcare service delivery must be equipped and supported to enable them run the needed preventive programs which include: 1) Community Oral Health education programs, 2) train and employ adequate oral health workers, 3) enhance fluoride supplementation, 4) provide dental material used to treat dental caries. This will prove to be both cheaper and more effective.

Disclosure Statements

Conflict of Interest

The authors have no conflicts of interest to declare.

Funding Sources

None.

Ethical Approval

Obtained from UNZABREC and NHRA.

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