Prevalence And Demographic Predictors Of Adult Dental Caries Among At Public Oral Health Facilities In Two Districts In Kwazulu-Natal, South Africa: A Cross Sectional Study

Research Article

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Abstract

Introduction: Dental caries is the most common oral condition and remains a major problem in the adult population of both developing and industrialized countries.

Aim: The aim of this study was to determine the prevalence and demographic determinants associated with adult dental caries at selected public health facilities in eThekwini and uMgungundlovu districts in the KwaZulu-Natal (KZN) South Africa.

Materials And Methods: An observational cross sectional study was conducted at thirteen (seven dental clinics from eThekwini and six from uMgungundlovu districts) over a 5-month period of November 2018 to end of March 2019. All adult patients that attended the outpatient dental and maxillofacial department (between 7am-4pm) in the two districts were included in the study. The clinician (a qualified dentist and/or dental therapist) consulting the patients completed a standardized questionnaire following an oral health assessment. Associations were measured using bivariate analysis and multivariate logistical regression analysis.

Results: Sixty nine percent (3273/4716) of the adult patients (> 18 years of age) presented with dental caries. Dental caries was slightly higher among the younger adult population of 18-32 age group (70%; 1670);males (1832; 72.8%) and participants that achieved higher than secondary education (2486; 68.6 %). Females participants (OR 1.4 (95% CI 1.2-1.6)), patients consuming an unhealthy diet (OR1.2 (95% CI 1.2-1.6)) were more likely to develop dental caries, whilst patients achieving more than secondary level education ((OR 0.8 (95% CI 0.7-0.9)) were less likely to develop dental caries.

Conclusions: Social determinants have an influence on the development of adult caries and require intervention during early childhood.

Keywords: Adult Dental Caries; Socio-Demographic Predictors; South Africa; Public Health Facilities.

Introduction

Globally, oral health disease affects an estimated 48% of the population. In 2015, untreated caries in permanent teeth was the most prevalent condition affecting 2.5 billion people worldwide (95% UI: 2.4 to 2.7 billion), with the number of incident cases of caries in permanent and in deciduous teeth, estimated at 616 million worldwide in 2015[1]. The prevalence of untreated caries in the permanent dentition showed a slight decline of less than 1% from 2010 to 34•1% in 2015. The peak prevalence of untreated dental caries in the permanent dentition was in the 15–19 years age group of in 2015 compared the peak at 25 years age group and

70 years in 2010[2]. The Institute of Metric data indicated that in 2017 the estimated prevalence of untreated dental caries globally was 30129 cases per 100 000[3].

The prevalence of untreated dental cores varies between the various regions of the world. The highest prevalence in 2017 were estimated for the Eastern Mediterranean region (>50 per 100 000cases), followed by Eastern Europe, Russia and portions of South America (41-50 per 100 000 cases). Sub-Saharan Africa showed similar prevalence to the United States of America and South East Asia (20-30 per 100 000 cases)[3].

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3341

South Africa is an upper middle-income county with a dual economy and the highest inequality index (gini co-efficient) in the world[4]. The majority (84%) of the population is dependent on the public healthcare system for health services. Although, access to primary healthcare services has improved over the past two decades, oral health services remain variable, with better access in urban areas. There is very little data on oral health services in generaland on dental caries in particular. Previous data from the South African Oral Health Survey in 2001 showed that almost 60% of 6-year-old children had dental caries with 80% of all dental caries in children in South Africa went untreated[5]. Results from on the oral health component of the Cape Town Bellville South Vascular and Metabolic Health (VMH) Study implemented during the cross-sectional community-based survey conducted between 2014 and 2016, indicated that dental caries 93.7% of the sample of 1,885 individuals that underwent clinical oral examination[6]. A recent cross-sectional analytical study by the current author's within the two districts at selected public health facilities indicated that dental caries was the most prevalent oral condition at 66.4%[7].

Global literature indicates the existence of a social gradient with respect to oral health diseases. Specifically for dental caries, lower socio-economic status, lower educational status and childhood poverty were associated with adult dental caries[3]. In a large-scale epidemiological survey among the Southern Chinese,socioeconomic factors had a considerable effect on dental caries status. Individuals who were unemployed, or had no income, had higher dental caries scores compared to the those employed and with a higher income[8].

Inequality and differential access to dental services further exacerbate the impact of dental caries. Oral health services in private sector in South Africa is technology driven, curative focus the introduction of aesthetic treatments, to enhance profit motives and consumerism. In contrast, oral health services at public health facilities in South Africa and Kwa-Zulu Natal in particular constantly experience challenges such as under-funding, limited resource allocation, overcrowding and often patients presenting late to seek help with advanced disease.There is limited preventive oral health services addressing the underlying risks for oral helath diseases and dental caries in particular.

The present study aimed to determine the risk factors/predictors associated with dental caries among adults attending dental clinics at public health facilities in eThekwini and uMgungundlovu districts in in Kwa-Zulu Natal, with a view to stimulating a change in the approach to oral health services.

Materials And Methods

Study Design And Setting

An observational cross sectional study was conducted over a 5-month period from November 2018 to the end of March 2019 atseven dental public health clinics in eThekwini and six in uMgungundlovu districts. These two districts combined serve more than 40% of the entire population of the province. These two districts also represented both urban and semi-urban parts of the province.

Study Population, Sample Size And Sampling

The study population included all adults patients (>18 years and above) that attended the selected facilities for oral health services during the study period. The estimated combined population size for the two districts was approximately 4 million. The aim was to recruit at least 10% (4000 participants) for this study, noting that almost 90% of the population use public dental facilities for their oral health needs. Adult patients of 18 years and older who attended the out-patient dental and maxillofacial department (between 7am-4pm) in the two districts as well as those who attend the inpatient dental and maxillofacial department in the facilities after hours, were included in the study. For the purposes of the study, all patients attending the facilities, providing verbal informed consent, and responding to the questions were included in the study. There was no sampling of patients.

Data Collection

All patients received a clinical examination from the dentist/dental therapist.. The clinician, a qualified dentist or dental therapist consulting the patients, completed a standardized questionnaire following an oral health assessment. The structured questionnaire contained sociodemographic characteristics, health-related behaviours and key sociodemographic variables such as education, employment, access to water, diet status, alcohol consumption and tobacco use. Dental caries was diagnosed based on a clinical assessment using a dental mirror and a probe.

Data Management and Analysis

At the end of the data collection period, the data was retrieved from the facilities. Initially, the data was eye balled for missing data. Blinded double entry of the data into an investigator generated Microsoft Excel database was pefomed by two data capturers. The data was crosschecked for discrepancies. Data with primary diagnosis and more than four variables omitted were discarded from the database. The data was imported to Statcorp Software for Statistics and Data Science (STATA) version 13. Measures of central tendency were calculated for numerical data and proportions were determined for categorical data. Univariate statistics (Chi-squared) were used to assess for any significant differences between the participants' characteristics.

For bivariate analysis, dental caries was the independent variable. Dependent variables included socio-demographic factors such as age, gender, education level, employment status and the location of the facility, access to fluoridated water supply; smoking habits, alcohol use and dietary status (healthy or unhealthy). Unadjusted and adjusted Odds Ratios (AORs) using a 95% confidence level and p-value of less than 0.05 as statistically significant were calculated.

Ethics approval and consent to participate

Ethical approval was obtained from the Biomedical Research and Ethics Committee of the University of KwaZulu-Natal (UKZN), reference number (BREC 386/18). Written permission, consent and access to the health facilities to conduct the study was obtained from the KwaZulu Natal Department of Health. Verbal informed consent was obtained from all patients prior to clinical examination and administering the standardised questionnaire.

Results

Study Population

At the end of the 5 months study, 4716 adult patients attending oral health services within the public health sector consented to and participated in the study. The mean age of the participants was 37.1 years (SD: 14.3), which was skewed to the right (median: 33 years: IAR: 26-46 years). The male to female ratio was 1.14 to 1 indicating a majority of males (53%). There was no statistical difference in the mean age of males and females. The majority of participants n=3625 (76.9%) had achieved higher than secondary level of education andn=3063 (65%) were unemployed (Table 1). Ninety five percent (4472) had access to clean 3301 (70%) of the participants self-reported consuming a healthy diet, 3483 (73.8%) did not consume alcohol and 3697 (78%) did not smoke.

Socio-Demographic Profile Of Patients With Dental Caries

The assessing physician diagnosed sixty nine percent (3273) of the patients as having dental caries(Figure 1), whilst the other 31% (1443) presented with other oral conditions such as peri-odontal disease, trauma and tooth loss. The mean age of patients with dental caries was 37.4 years (SD: 14.4) which was skewed to the right with the median age being 33 years (IQR: 26-46).The mean age of males and females with dental caries were almost equal at 37.4 years. Of the total study population; males(1832; 72.8%) when compared to females (1441; 65.5%); participants who achieved higher than secondary education (2486; 68.6 %) compared to those with less than secondary level of education (787; 72.2%); unemployed participant's (2158; 70.5%) compared to employed participants (1114; 67.5%)and non-smokers (2595; 70.0%) compared to smoker (678; 66.5%) had a statistically significantly higher dental caries rates(Table 1).

Figure I: Combined prevalence of dental caries in the eThekwini and uMgungundlovu districts of KwaZulu-Natal,South Africa
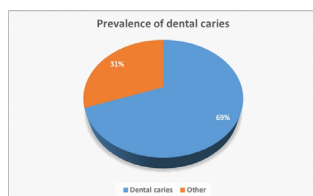

Table I: Frequency table of the socio-demographic profile of study population by dental caries status

Variables	Dental Caries		
	Yes (N;%)	No (N:%)	Study Population (N;%)
Age			
Mean Age	37.4(14.4)	36.6 (SD:13.9)	37.15(14.3)
Median Age	33(IQR: 26-46)	32 (IQR: 26-45)	33(IQR: 26-46)
Age Category			
18-32	1670 (70.0)	714 (30.0)	2384 (50.5)
>33	1603 (69.0)	729 (31.0)	2332 (49.5)
Gender			
Male	1832 (72.8)**	684 (27.2)	2516 (53)
Female	1441 (65.5)	759 (34.5)	2200 (47)
Education			
> Secondary	2486 (68.6)*	1139 (31.4)	3625 (76.9)
< Secondary	787(72.2)	303(27.8)	1090 (23.1)
Employment status			
Employed	1114 (67.5)	437 (32.5)	1651(35)
Unemployed	2158 (70.5)*	905 (29.5)	3063(65)
Access to water			
Has access	3092 (69.1)	1380 (30.9)	4472 (95)
Do not have access	181 (74.2)	63 (25.8)	244(5)
Diet			
Healthy	2258 (68.4)	1043 (31.6)	3301 (70)
Unhealthy	1012 (71.7)	399 (28.3)	1411(30)
Alcohol consumption			
Yes	842 (68.3)	391 (31.7)	1233(26.2)
No	2431 (70.0)	1052 (30.0)	3482 (73.8)
Smoker			
Yes	678 (66.5)	341 (33.4)	1019(22)
No	2595 (70.0)*	1102 (30.0)	3697 (78)

** p <0.001 and * p <0.05

Jimmy Mthethwa, Ozayr Mahomed. Prevalence And Demographic Predictors Of Adult Dental Caries Among At Public Oral Health Facilities In Two Districts In Kwazulu-Natal, South Africa: A Cross Sectional Study. *Int J Dentistry Oral Sci.* 2021;8(7):3341-3346.

Although participants that had access to water (3092; 69.1%), those that did not consume alcohol (2431; 70.0%) and those that consumed healthy diet (2258; 68.4%) rates of dental caries, this was not statistically different (Table 1).

Socio-Demographic Factors Associated With Dental Caries

Bivariate analysis indicated that being a female OR 1.41(95% CI 1.24-1.61 and those consuming an unhealthy diet OR 1.2 (95%CI 1.0- 1.3) were significantly more likely to have dental caries than males andthose consuming a healthy diet. Participants who had achieved more than secondary level of education OR 0.84 (95% CI 0.7-0.99) and being unemployed OR 0.87 (95% CI 0.7-0.98) were significantly less to have dental caries compared to the participants with less than secondary school education and being employed. Although not significant, participants with access to water showed an increased odd of developing dental caries OR 1.28 (95%CI 0.95-1.75) on bivariate analysis (Table 2).

After controlling for confounding and interactions, being a female OR 1.41(95% CI 1.2-1.6) and those consuming an unhealthy diet OR 1.2 (95%CI 1.02- 1.38) were significantly more likely to have dental caries than males and those consuming a healthy diet. Participants who had achieved more than secondary level of education OR 0.83 (95% CI 0.7-0.98) were significantly less to have dental caries compared to the participants with less than secondary school education. Participants with access to water showed an increased but non-significant odd of developing dental caries OR 1.25 (95%CI 0.95-1.68) on multivariate analysis (Table 2).

Discussion

After adjusting for three demographic factors (an unhealthy diet, female gender and achieving less than secondary education) emerged as significant predictors of dental caries amongst adult obtaining oral health services in the public sector in KwaZulu Natal. These findings are supported by a myriad of studies from both developed and developing countries, which showed a varying association between diet, alcohol use, gender and access to clean water and dental caries among adults.

Diet And Dental Caries

The current study showed that adults who consumed an unhealthy diet OR 1.2 (95% CI 1.2-1.6) were more likely to have dental caries than those who consumed a healthy diet. The relationship between dietary practices and dental caries haveemerged since the 1950's[9]. Unhealthy diets increases a person's risk for being obese. An Australian study showed that there was a positive association between dental caries and being overweight or obese compared with having normal weight or being underweight. However, when controlling for confounders for confounders, sugar consumption was a key determinant and the statistical significance between dental caries and unhealthy diet disappeared[10]. Over the last ten years, evidence has emerged that dietary practices that include free sugars that are present in food and carbonated beverages including fruit juices and fruit juice concentrates constitute a necessary cause for dental caries[11]. In addition, other studies

Table 2: Bivariate and multivariate analysis of the predictors of dental caries among the adult population of eThekwini and uMgungundlovu districts

	Unadjusted odds ratio	Confidence interval	Adjusted odds ratio	Confidence interval
Age category				
Age 33 years and above versus 18-32 years	1.06	0.94-1.21	1.06	0.94-1.21
Gender				
Female versus males	1.41**	1.24-1.61	1.4**	1.2-1.6
Education				
> Secondary versus < secondary	0.84*	0.7-0.99	0.83*	0.7-0.98
Employment				
Unemployment versus employment	0.87*	0.7-0.98	0.92	0.81-1.05
Water access				
Access to fluoridated water versus no access	1.28	0.95-1.75	1.25	0.95-1.68
Diet				
Unhealthy diet versus healthy diet	1.17*	1.02-1.35	1.2*	1.02-1.38
Alcohol consumption				
Alcohol consumption versus no alcohol	0.93	0.81-1.07	1.07	0.91-1.25
Smoking				
Smoking versus non smoking	0.84*	0.73-0.98	0.98	0.83-1.17

** p <0.001 and * p <0.05

suggest a linear relationship between the sugar consumption and dental caries in adults, with the amount being more important than the frequency of intake[12]. Although, our study did not sugary intake but assessed dietary behaviour, most South Africans consume high-energy but nutrient poor foods[13]. South Africans consume between 12 and 24 teaspoons of sugar per day - four to eight teaspoons are from sugary sweetened beverages[14].

A 5-year follow-up of a cohort of 2010 urban and rural men and women aged 30-70 years of age from the North West Province in South Africa, indicated that added sugar intake, particularly in rural areas, has increased rapidly. In rural areas, the proportion of adults who consumed sucrose-sweetened beverages approximately doubled (for men, from 25% to 56%; for women, from 33% to 63%)[15].

Gender And Dental Caries

There is a plethora of evidence in the literature on the association between gender and dental caries. There seems to be consensus that females are more likely to develop dental caries than males. The present study found that females were more likely OR 1.4 (95% CI 1.25-1.62) to have dental caries compared to males. A hospital-based cross-sectional study conducted on 368 patients who visited the University of Gondar Comprehensive Hospital Dental Clinic, showed a significant difference between females (30.56%) and males (17.02%). Being female (AOR=2.15 (95% CI: 1.31, 3.52), was significantly associated with dental caries[16]. The explanation provided in the study was that the biochemical composition of saliva and overall saliva flow rate are modified by hormonal fluctuations during events such as puberty menstruation, and pregnancy, making the oral environment significantly more cariogenic for women than for men[17].

Education Level And Dental Caries

There seems to be consensus in the literature on the association between education levels and dental caries. This study found that those who achieved higher than secondary education level at school were less likely to have dental caries OR 0.8 (95% CI 0.7-0.9) compared to those who had achieved less than secondary level of education. Similarly the study in Ethiopia showed low educational level (AOR=1.81 (95% CI: 1.05, 3.1) to be significantly associated with dental caries[16].

A systematic review of all epidemiological studies (cross-sectional, case-control, cohort and clinical trials) involving adult populations aged 19 to 60 years that reported etiological factors and/or the prevalence of dental caries or risk factors for dental caries found that lower schooling was statistically associated with greater severity of dental caries in six out of nine multivariate analyses34. One study found that lower schooling was associated with lower severity of dental caries, two did not find significant association and one did not find association between schooling of the father and dental caries. There may be various hypothesis to explaining the difference in education levels and dental caries. Our study did not explore these further however, one can assume that participants with higher levels of education are more likely to be aware and exercise a choice and affordability of the type of diet they consume thus decreasing the chances of consuming high calories diet exposing them to developing dental caries. The other possible theory is that a higher level of education enables access to general awareness and preventive measures against dental caries thus less likely to develop dental caries compared to the less educated. Our study finding is therefore consistent with the literature, however further studies are needed to explore the differences in educational levels and dental caries.

Access To Water And Dental Caries

The evidence on the access to fluoridated water and its prevention of dental caries is not clear. The current study indicates that patients with access to piped water from a municipal source that has been fluoridated showed a slightly increased but not significant risk of dental caries ((OR 1.25(95% CI 0.93-1.67)). These findings are in contrast to others that have shown the beneficial effect of fluoridation on adult dental caries. A population-based cohort study in Brazil showed that longer residential lifetime access to fluoridated water was associated with less dental caries even in a context of multiple exposures to fluoride[18]. The results in our study may have been confounded by the interaction with lower educational level, lower socio-economic status and unemployment.

Study Limitations

Although meticulousness and diligence were maintained to ensure the integrity and veracity of the study, the study has several limitations. The most critical of these is information bias. The questionnaire did not quantify any unit of measure in the alcohol consumption as a result, bias could have an impact in our results as most papers have reported alcohol consumed in some unit of measure rather than a generalized question irrespective of alcohol consumption. In addition, we did not conduct a detailed analysis of the participants' dietary history, detailed dietary type, as such our results were based on self-reported perception of diet as healthy or unhealthy. Both these limitations could mean underreporting or over reporting by the participants on their responses. Finally having access to municipal water supply was considered safe, clean drinking water that was fluoridated.

Conclusions And Recommendations

This study showed that female sex, consumption of an unhealthy diet and lower than a secondary level of education were the predictors of dental caries. It is therefore imperative to address the proximal determinants of health as part of a comprehensive government strategy to achieving the sustainable development goals. In addition it is important that oral health services adopts a more comprehensive approach that includes health promotion, primary prevention, secondary prevention and tertiary prevention at appropriate levels of the health system. Oral health education and dental outreach should be incorporated within the integrated school health program.

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Jimmy Mthethwa, Ozayr Mahomed. Prevalence And Demographic Predictors Of Adult Dental Caries Among At Public Oral Health Facilities In Two Districts In Kwazulu-Natal, South Africa: A Cross Sectional Study. *Int J Dentistry Oral Sci.* 2021;8(7):3341-3346.

3345

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3346