

## Dental caries and periodontal diseases in Mozambique

Cárie dentária e doenças periodontais em Moçambique

Caries dental y enfermedades periodontales en Mozambique

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### Abstract

**Objective:** To determine the rate of dental caries and periodontal rates in Mozambican population. **Material and Methods:** The sample size was 722, categorized in age groups of 6,12, 15-19 and 35-44 in public schools and markets randomly selected in five provinces of Mozambique (Maputo, Gaza, Manica, Tete and Zambezia), in urban and rural areas. Clinical examinations were performed by calibrated examiners using WHO, DMFT/dmft and CPI indexes. Data analysis was descriptive and analytical, using a Chi-square test and Pearson's correlation ( $P < 0.05$ ). **Results:** The adults aged 35-44 presented higher dental caries (DMFT=1.94) than those aged 6 years (dmft = 1.16), 12 years (DMFT=0.60), and 15-19 years (DMFT=0.87). Dental caries was more prevalent in urban area (1.89) than rural area (1.33) with statistical difference  $p=0.004$ . The dental caries was the highest at Manica Province  $n=68$  (85%) and lowest in Tete Province  $n=70$  (31%). Regarding to periodontal status, the most prevalent disease, was Calculus in adults of 35-44  $n=95$  (59.4%), and the prevalence of individual free of periodontal disease was  $n=182$  (34.3%). **Conclusion:** When assessing this population for dental caries and periodontal status, the 35-44 years old presented the highest rate of both diseases at all age.

**Keywords:** Dental caries; Periodontal diseases; Oral health; Epidemiology; Mozambique.

### Resumo

**Objetivo:** Determinar a taxa de cárie dentária e doença periodontal na população moçambicana. **Material e Métodos:** O tamanho da amostra foi de 722, categorizado em grupos de idade de 6,12, 15-19 e 35-44 em escolas públicas e mercados selecionados aleatoriamente em cinco províncias de Moçambique (Maputo, Gaza, Manica, Tete e Zambézia), em áreas urbanas e rurais. Os exames clínicos foram realizados por examinadores calibrados usando os

índices OMS, CPOD / ceo-d e CPI. A análise dos dados foi descritiva e analítica, utilizando o teste Qui-quadrado e correlação de Pearson ( $P < 0,05$ ). Resultados: Os adultos de 35-44 anos apresentaram maior cárie dentária (CPOD = 1,94) em relação as crianças de 6 anos (ceo-d = 1,16), adolescentes de 12 anos (CPOD = 0,60) e 15-19 anos (CPOD = 0,87). A cárie dentária foi mais prevalente na área urbana (1,89) do que na área rural (1,33) com diferença estatística  $p = 0,004$ . A cárie dentária foi maior na Província de Manica  $n = 68$  (85%) e menor na Província de Tete  $n = 70$  (31%). Em relação ao estado periodontal, a doença mais prevalente foi o cálculo em adultos de 35-44  $n = 95$  (59,4%), e a prevalência de indivíduo livre de doença periodontal foi  $n = 182$  (34,3%). Conclusão: Ao avaliar esta população para cárie dentária e estado periodontal, a faixa etária de 35 a 44 anos apresentou a maior taxa de ambas doenças em todas as idades.

**Palavras-chave:** Cárie dentária; Doenças periodontais; Saúde oral; Epidemiologia; Moçambique.

### Resumen

Objetivo: determinar la tasa de caries dental y enfermedad periodontal en la población de Mozambique. Material y métodos: El tamaño de la muestra fue de 722, categorizados en grupos de edad de 6,12, 15-19 y 35-44 en escuelas públicas y mercados seleccionados al azar en cinco provincias de Mozambique (Maputo, Gaza, Manica, Tete y Zambézia), en zonas urbanas. y zonas rurales. Los exámenes clínicos fueron realizados por examinadores calibrados utilizando los índices de la OMS, DMFT / dmft y CPI. El análisis de los datos fue descriptivo y analítico, utilizando la prueba de chi-cuadrado y correlación de Pearson ( $P < 0.05$ ). Resultados: Los adultos de 35-44 años tenían mayor caries dental (CPOD = 1,94) en comparación con los niños de 6 años (dmft = 1,16), los adolescentes de 12 años (CPOD = 0,60) y los de 15-19 años (CPOD = 0,87). La caries dental fue más prevalente en el área urbana (1.89) que en el área rural (1.33) con una diferencia estadística  $p = 0.004$ . La caries dental fue mayor en la provincia de Manica  $n = 68$  (85%) y menor en la provincia de Tete  $n = 70$  (31%). En cuanto al estado periodontal, la enfermedad más prevalente fue el cálculo en adultos de 35-44  $n = 95$  (59,4%), y la prevalencia de individuos libres de enfermedad periodontal fue  $n = 182$  (34,3%). Conclusión: Al evaluar esta población por caries dental y estado periodontal, el grupo de edad de 35 a 44 años presentó la tasa más alta de ambas enfermedades en todas las edades.

**Palabras clave:** Caries dental; Enfermedades periodontales; Salud bucal; Epidemiología; Mozambique.

## 1. Introduction

Data on oral health in Mozambique are scarce. The data obtained in this research are very significant for Mozambique, due to the need of information for decision making and management of financial resources. In addition, the last national epidemiological survey in Mozambique occurred in 1978. This is a study of prevalence of dental caries and periodontal disease according to the standard ages defined by the WHO, 6, 12, 15-19 and 35-44 years of age. This study has clinical relevance because it offers an estimate of the stages of dental caries and periodontal disease throughout the life cycle. With the data acquired from this study, strategies for controlling these diseases can be implemented, particularly in children and adolescents.

According to Frencken et al, in the last five decades, the world is trying to reduce dental caries and periodontitis (Frencken et al., 2017). Nevertheless, a large part of the world's population still suffers from these two oral diseases, which are the main causes of tooth loss (Marcenes & Bernabé, 2021). Dental caries is still the most widespread chronic and prevalent oral disease worldwide, interfering with quality of life (Frencken et al., 2017; Pitts et al., 2017; Tinanoff et al., 2019). It is a multifactorial disease with a complex interaction of cultural, social, behavioural, nutritional and biological risk factors associated with its initiation and progression. Other factors include poor oral hygiene (Gupta, Bray, Kumar, & Johnson, 2017; Sampson, 2020) and low maternal education (Haque et al., 2016; Vollmer, Bommer, Krishna, Harttgen, & Subramanian, 2017).

Africa has enormous ethnic groupings, with differences among them regarding to capital, living conditions, religion, health care accessibility, and educational attainments (Abid et al., 2015). The prevalence of dental caries has increased in many

African countries as a result of high sugars consumption and inadequate exposure to fluorides (Organization, 2007). Globally, the highest prevalence of dental caries in primary teeth is found in children in Africa (Mothupi, Nqobco, & Yengopal, 2016). The DMFT levels vary considerably, from less than 1.0 in Ghana and Guinea-Bissau to over 4.0 in Gabon and Mauritius. Additionally, local studies show a rapid increase in the incidence of the disease in both urban and rural populations. Most cases of tooth decay remain untreated (Organization, 2016).

In 2010, untreated caries in permanent teeth was the most prevalent condition worldwide, affecting 2.4 billion people, and untreated caries in deciduous teeth was the 10<sup>th</sup> most prevalent condition, affecting 621 million children worldwide. The global age-standardized prevalence and incidence of untreated caries remained static between 1990 and 2010. Evidence shows that the burden of untreated caries is shifting from children to adults, with 3 peaks in prevalence at ages 6, 25, and 70 years old (Kassebaum et al., 2015). According to Msyamboza *et al.*, estimated the prevalence of dental caries in Malawi, was 20.3 % in children and 49.1 % in adults and low number of people with filled teeth which was present in only 10 % of adults aged 35 or more, due to inadequate availability or lack of restorative or preventive dental care and treatment (Msyamboza et al., 2016).

Periodontitis, is the second most prevalent oral disease and cause of tooth loss in the world. Severe periodontitis was the sixth most prevalent condition affecting 10.8%, 743 million people aged 15–99 worldwide. The most common and simple form of periodontal disease is gingivitis, which its risk factors includes poor oral hygiene, tobacco use, excessive alcohol consumption, stress, poor general health, diabetes mellitus, and HIV (Frencken et al., 2017).

The aim of the present study was to determine the dental caries and periodontal status in Mozambican populations, in urban and rural area of five provinces of Mozambique in the year 2015.

## 2. Methodology

This cross-sectional study followed the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) guidelines.

### *Ethical aspects*

The protocol was approved by the National Committee of Bioethics of Mozambique Health, protocol Ref. n<sup>o</sup> 214/CNBS/13, (annex). Informed consent forms were signed by the guardian before the oral examination. The examination was performed in 2015, and the children with dental problems were referred to the public dental service.

### *Study Location*

The study was conducted in Mozambique, a country located in the south-eastern strip of the African Continent. With a surface area of 799,380 km<sup>2</sup>, it is political-administrative divided into 11 provinces (Estatística & Saúde, 2013). Five provinces, namely, Maputo, Gaza, Manica, Tete e Zambezia, were cluster randomly selected.

### *Sampling*

Mozambique had a population of 26,423,623 million people, approximately 70% of whom live in rural areas. More than half of the population (52%) is in the 0 to 18 year age group and 20% in the 6 to 12year age group (Estatística & Saúde, 2013). The sample size was 722, categorized in age groups of 6, 12, 15-19 and 35-44 years in public schools and markets

randomly selected in those five provinces. Schools and markets were sampled by conglomerates, three rural and three urban schools per province. Therefore, the sample was selected using the probabilistic method, called conventional. The choice of this method was due to the fact that the name infers, for convenience reasons, ease of obtaining, limited budget, availability of time, as well as being the most recommended for experimental research. The formula used to determine sample size was proportional estimation.

$$n = \frac{(N \cdot Z_{\frac{\alpha}{2}}^2 \cdot p \cdot q)}{(N-1) \varepsilon^2 + Z_{\frac{\alpha}{2}}^2 \cdot p \cdot q}$$

Where:

n → Sample Size

$\varepsilon$  → Margin of error

$Z_{\frac{\alpha}{2}}$  → Critical value.

p → represents the proportion of individuals suffering from oral disease;

q → represents the proportion of individuals not suffering from oral disease.

N → size of population suffering from oral diseases.

The 95% confidence interval was applied, with a 2% margin of error, 50% success rate (p) and 50% failure rate. All volunteers were included in these age groups, of which, who signed informed consent, and without any pathology that interferes. All volunteers outside the above age groups with or without oral pathologies were excluded.

### ***Calibration***

Eleven examiners, dentist from each province, performed theoretical and practical activities including discussions on diagnosis criteria of dental caries oriented by two professors from University of Western Cape, South Africa. Approximately 10% of the sample was re-examined in order to verify the intra-examiner reproducibility. The Kappa score for intra-examiner agreement expressed was 0.90 (93.75%). This value indicated reliability within acceptable limits.

### ***Examination methodology***

Clinical examinations were performed by calibrated examiners using World Health Organization, DMFT and dmft indexes. From eleven calibrated examiners, only five performed clinical examination, under natural light, using CPI probes ('ball point') and #5 mirrors. Based in WHO Basic methods, Dental caries was recorded using the DMFT/dmft (total of decayed, missing, and filled teeth) and CPI (Community Periodontal Index), according to the WHO diagnostic criteria (Organization, 2013).

### ***Data analyses***

The descriptive and analytical approaches were used for data analysis in a personal computer, using SPSS 20. Descriptive results were analyzed as relative frequencies. The bivariate analysis was to test association between urban and

rural areas, according to dental caries and periodontal status. The data were analyzed using the bivariate test and Pearson Correlation at 5% significance level.

### 3. Results

#### Dental caries

The sample consisted of 722, distributed in 376 (52.0%) female 346 (47.9%) males. The dental caries prevalence at 6 years was (dmft = 1.16); at age 12 (DMFT=0.60), at age of 15-19 was (DMFT = 0.87) and at 35-44 was (DMFT =1.94) (Table 1). The prevalence of dental caries was quite similar in both gender, female n=183 (48.7) and male n=171 (49.4%). However, the dmft/DMFT was quite higher in urban n=236 (55.3%) than rural n=118 (40%), being statistically significant ( $p < 0.050$ ). However, caries experience expresses that the largest proportion is the decayed component (41.0%), followed by the missing component (20.5%) and at last filled (1.4%). Such results denote deficiency in the assistance services of oral health, mainly, by the analysis of the filled component (Table 1). The rate of dental caries was the highest at Manica Province n=68 (85%), followed by Zambezia n=83(68.8%) and lowest in Tete Province n=70 (31.0%), (Table 2).

*Table 1. Prevalence of dental caries by component*

Age	Decayed			Missing			Filled			dmft/DMFT		
	Mean	n	%	Mean	N	%	Mean	N	%	Mean	n	%
<b>6</b>	1.16±2.03 <sup>A</sup>	68	35.4	0.18±0.66 <sup>A</sup>	18	9.4	0.01±0.14 <sup>A</sup>	1	0.5	1.35±2.21 <sup>A</sup>	76	39.6
<b>12</b>	0.60±1.16 <sup>B</sup>	58	28.3	0.17±0.81 <sup>A</sup>	12	5.8	0.01±0.14 <sup>A</sup>	1	0.5	0.78±1.47 <sup>A</sup>	67	32.7
<b>15-19</b>	0.87±1.67 <sup>AB</sup>	57	34.5	0.23±0.59 <sup>A</sup>	26	15.8	0.01±0.16 <sup>A</sup>	1	0.6	1.11±1.84 <sup>A</sup>	69	41.8
<b>35-44</b>	1.94±2.43 <sup>C</sup>	113	70.6	1.72±2.15 <sup>B</sup>	92	57.5	0.06±0.33 <sup>B</sup>	7	4.4	3.72±3.51 <sup>B</sup>	142	88.8
<b>Total</b>	<b>1.11±1.91</b>	<b>296</b>	<b>41.0</b>	<b>0.53±1.34</b>	<b>148</b>	<b>20.5</b>	<b>0.02±0.20</b>	<b>10</b>	<b>1.4</b>	<b>1.66±2.58</b>	<b>354</b>	<b>49.0</b>

Different upper-case letters indicate statistical significance between the ages (row) ( $p < 0.05$ ). Source: Authors.

*Table 2. Mean of dmft/DMFT by province*

dmft/DMFT	Province										Total	x <sup>2</sup>	p	
	Maputo		Tete		Gaza		Zambézia		Manica					
	N	%	n	%	N	%	n	%	n	%	n	%		
<b>=0</b>	40	65.6	156	69.0	122	52.1	38	31.4	12	15.0	368	51.0		
<b>&gt;0</b>	21	34.4	70	31.0	112	47.9	83	68.6	68	85.0	354	49.0		
<b>Total</b>	<b>61</b>	<b>100.0</b>	<b>226</b>	<b>100.0</b>	<b>234</b>	<b>100.0</b>	<b>121</b>	<b>100.0</b>	<b>80</b>	<b>100.0</b>	<b>722</b>	<b>100.0</b>		

Source: Authors.

#### Periodontal Status

The percentage of individual with healthy periodontal was n=182 (34.3%) and this was more prevalent at age 12 years old, n=91 (44.4%) (Table 3), in urban area n=115 (35.8%) and in Maputo city n=24 (77.4%). The periodontal condition most prevalent in all age groups examined was calculus n=266 (50.2%), and it was more prevalent in rural area n=112 (53.6%) than

urban area n=154 (48.0%), and higher in adults aged 35-44 years old, n=95 (59.4%) than other ages. Manica province showed more calculus n=41 (68.3%) than other provinces (Table 4).

**Table 3. Prevalence of periodontal status by age.**

CPI	Age						Total	
	12		15-19		35-44		n	%
	N	%	N	%	N	%		
<b>Healthy</b>	91	44.4	60	36.4	31	19.4	182	34.3
<b>Bleeding</b>	15	7.3	12	7.3	4	2.5	31	5.8
<b>Calculus</b>	89	43.4	82	49.7	95	59.4	266	50.2
<b>Pocket 4-5mm</b>	8	3.9	10	6.1	19	11.9	37	7.0
<b>Pocket 6mmou +</b>	2	1.0	1	0.6	11	6.9	14	2.6
<b>Total</b>	205	100.0	165	100.0	160	100.0	530	100.0

Source: Authors.

**Table 4: Prevalence of periodontal status by province.**

CPI	Province										Total	
	Maputo C		Tete		Gaza		Zambezia		Manica		n	%
	n	%	N	%	N	%	n	%	n	%		
<b>Healthy</b>	24	77.4	64	37.2	45	25.9	36	38.7	13	21.7	182	34.3
<b>Bleeding</b>	0	0.0	23	13.4	0	0.0	4	4.3	4	6.7	31	5.8
<b>Calculus</b>	7	22.6	83	48.3	108	62.1	27	29.0	41	68.3	266	50.2
<b>Pocket 4-5mm</b>	0	0.0	2	1.2	11	6.3	22	23.7	2	3.3	37	7.0
<b>Pocket 6mmou +</b>	0	0.0	0	0.0	10	5.7	4	4.3	0	0.0	14	2.6
<b>Total</b>	31	100.0	172	100.0	174	100.0	93	100.0	60	100.0	530	100.0

Source: Authors.

#### 4. Discussion

Recent studies in developing countries showed that the prevalence and severity of dental caries have increased with industrialization and exposure to western diets. Data from 20 countries of the Eastern Mediterranean Region (EMRO) showed that the average number of decayed, missing, and/or filled teeth (DMFT) among 12-y-olds ranges from 0.4 to 4.4. Abid found a higher prevalence and severity of dental caries in the primary than in the permanent dentition among 6-y-olds (Abid et al., 2015). These findings match with those reported in the present study. According to Fonseca caries in primary teeth are associated with early protein-energy malnutrition (da Fonseca, 2017).

Furthermore, the highest caries experience has been reported in Gabon, West Africa, and in Lebanon and Kuwait, Middle East. Very low DMFT figured (0.3–0.5) were found in some Eastern and Western African countries. The mean DMFT of 12 years old of low-income countries was 1.9 compared with 3.3 DMFT for middle-income countries and 2.1 DMFT for high-income countries (WHO, 2013). World Dental Federation and World Health Organization revealed that most of the DMFT consists of teeth with untreated caries lesions (Bernabé & Marcenes, 2020). In most countries, more than 90% of caries remain untreated (Dye, 2017). These findings were also in agreement with the outcomes found in this study.

A survey from 1980 of Mozambique conducted in four provinces, Niassa, Tete, Zambezia and Maputo, in 823 children of 6 years old and 980 adolescents of 12 years old, revealed that the dmft/DMFT index was, 2.6, 0.8, respectively (Hobdell & Cabral, 1980). Another research carried out in Mozambique in 1989, comprised 575 children at 11-13 years old and 239 adults at 25-34 years old and 45-54 years old from urban and rural areas of Maputo Province, showed that, the experience of caries in children was less in rural area, 23%, than in urban area, 65%. In adults was also less at rural area at age 25-34 years old, 69% DMFT 3,7 and 94% DMFT 7.9 at 45-54 years old, and more in the urban group aged 25-34 years, with caries prevalence at 93% and DMFT 8.1 (Olsson, Segura-Bernal, & Tanda, 1989).

A study including Mozambique, Uganda and Tanzania in 1997 compared the dmft of 910 children aged 5 to 7 years. Mozambique presented the lowest dmft of the three countries. Both children in suburban and rural Mozambique had lower rates than in the other two countries. Only children from the urban area presented dmft of 4.2, higher than Tanzania 3.8 and lower than Uganda 5.5 (Lalloo, Hobdell, Mosha, Mboli, & Tanda, 1999).

Another Mozambican study published in 2010, assessed the prevalence of dental caries in 12-year-olds in urban and suburban Maputo-City in 601 schoolchildren, where the DMFT was 0.99. Those who were caries-free constituted 60.07% of the sample, and 39.93% had caries experience. The decayed component (D) predominated, with an average of 0.82; then the missing component (M), with an average of 0.12; and the filled component (F), with an average of 0.06. Children in urban schools had fewer caries 0.84 than children in suburban schools 1.14 (M. A. A. Mapengo et al., 2010). These results denote poor access to oral health care services, especially when analysing the filled component. However, the WHO target in the primary dentition, the dmft index was 1.56, at six years of age; 66.51% of children had caries experience, didn't reach the WHO target of 50.0% for the year 2000. But for the age of 12, it was achieved, setting the average DMFT of 1 for 2010.

Caries prevalence is directly correlated with sugar consumption and a lack of community based oral disease prevention and health promotion programs (Van Wyk & Van Wyk, 2010), Studies of Mozambique, 1980, found more carious at urban area, and attributed to sugar consumption, 80% in urban and 20% in rural area (Hobdell, 1981) as well as the present study found more experience of caries at urban area, at age of 6. In 1989, Mozambican research also found more prevalent in urban area, 65%, than rural area, 23%, associated to exposure to markets, and cariogenic factors that occurred in urban areas. In controversy, Mapengo *et al*, found that children in urban school had less dental caries than children in sub-urban schools and both presented poor oral hygiene. Malnutrition was more in sub-urban schools than in urban schools, and the frequency of sugar consumption was higher among urban children compared to suburban schools (Hobdell & Cabral, 1980).

Evaluating by provinces, Manica had higher prevalence at age 6 years, and Zambezia at age 12 years. Tete was the province with the lowest prevalence in both ages. This may be justified by the presence of high fluoride content in water in previous years (M. Mapengo et al., 2009).

The three surveys conducted in Mozambique at age 12-year, in 1980,(Hobdell & Cabral, 1980) 1989,(Olsson et al., 1989), 2009 (M. A. A. Mapengo et al., 2010) and present study, presented DMFT mean, 0.8, 2.09, 0.99 and 0.60 respectively, showing stability from the last research, as well as, for age of 6-year old, in 1980, 1998, 1999 and present study, were also stable, 2.6, 3.2, 1.6 and 1.16, respectively.

Calculus was most common periodontal disease, and more prevalent in rural area than urban area, it believes is due to limited access to conventional oral hygiene instruments. The current study found low gingivitis or bleeding (5.8%) in comparison with studies carried out in Mozambique in 1980 (Hobdell & Cabral, 1980) where children at 6 and 12 years old

presented 97 and 96% prevalence of gingivitis, respectively. This prevalence was high in Niassa (99%), Tete (100%), Zambezia (98%) and low in Maputo (88%). Calculus was found in 42% at age 6, and 64% at age 12 years old, quite same as in this study, (50.2%). The prevalence of gingival inflammation is very high in several African countries and affects all age groups (Chikte et al., 2019; Tefera & Bekele, 2020). Regarding pocket depth, Chikte et al., evaluated 951 individuals in south Africa, where, over 50% of the subjects had shallow pockets (4–5 mm), and almost 6% had deep pockets (Chikte et al., 2019).

The WHO target at age 5 years for year 2000, was 90% free of caries, such has not been achieved, prevalence was 39.6% of individuals with dental caries experience. At age 12, the global age for monitoring dental caries, the WHO goal was an average DMFT <1 which was achieved, with a mean of DMFT=0.60. The goal for teenagers is 0% of teeth lost at 18, was not achieved, with prevalence of 15.8% of missing teeth. Among adults, 57.5% of edentulous people were identified, which goes against the WHO recommendation, which provides for a maximum of 2% of edentulous people aged 35-44 years. Access to restorative services is almost non-existent, which results in an adult population with decayed, not filled and consequently missing teeth.

The limitations in this study were related with small sample. Further studies should be followed up the groups to relate the cause-effect. On the other hand, the strengths of our research include the fact that there is lack of recent studies covering other provinces of Mozambique.

## 5. Conclusion

In conclusion, the mean of oral diseases was low. DMFT/dmft mean were 1,66 in almost half of people. Adults of 35-44 years old presented the highest prevalence dental caries than age of 6, 12 and 15-19 in all provinces, as well as, for periodontal disease. Manica province presented highest prevalence of dental and periodontal diseases than other provinces. The decayed component is the most prevalent in all age groups, 6, 12, 15-19 and 35-44 years old and followed by missing.

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