RESEARCH

Dental caries status and treatment need among pregnant women attending antenatal clinics in Dar-Es-Salaam region, Tanzania

Farizana R. Msagati[1*], Godbless J. Mandari[1] and Elison N. M. Simon[2]

Abstract

Background Literature shows that pregnant women are more susceptible to dental caries due to several reasons, including changes in salivary flow, reduced pH in the oral cavity, and sugary dietary cravings. The unmet need for care is of special concern, as the failure to obtain treatment can affect the health status of the mother and her unborn child.

Objectives To determine dental caries status and treatment needs among pregnant women attending antenatal clinics in the Dar-es-Salaam region.

Materials and methods A descriptive cross-sectional hospital-based study was conducted among 461 pregnant women aged 14–47 years. Informed consent was obtained from participants during data collection. Dental caries status and treatment need were diagnosed according to the WHO criteria. The Data collected was cleaned and analyzed using SPSS version 23.0 software for generating frequency distribution tables, chi-square tests, and logistic regression analysis. The Confidence Interval was 95% ($p < 0.05$).

Results The overall prevalence of dental caries was 69%, with a mean DMFT score of 2.86 (± 3.39). Untreated dental decay was observed in 60.5% of study participants, which needed more restorative treatment (fillings & RCT) than a tooth extraction. Caries experiences differed significantly among the pregnant women in various gravidity. In logistic regression, dental caries experience was significantly higher among multigravida respondents (*p-values* = 0.04) (OR: 1.840, CI 1.021–3.319).

Conclusion This study demonstrated a high level of dental caries experience and the presence of treatment needs. Multiple pregnancies were a major factor that contributed to high levels of dental caries.

Keywords Dental caries, Pregnant women, Treatment need, Tanzania

*Correspondence:
Farizana R. Msagati
msagatifarizana@gmail.com
[1]School of Dentistry, Department of Restorative Dentistry, Muhimbili University of Health and Allied Sciences (MUHAS), Dar-Es-Salaam, Tanzania
[2]School of Dentistry, Department of Oral and Maxillofacial surgery, Muhimbili University of Health and Allied Sciences (MUHAS), Dar-Es-Salaam, Tanzania

Introduction

Dental caries is a major oral health problem among pregnant women with most of the carious lesions remaining untreated and as a result, these women suffer from varying severity of pain that often lead to distress [1–4]. The behavioural and physiological changes that occur during pregnancy increase their susceptibility to dental caries [5, 6]. Changes that specifically predispose pregnant women to dental caries include increased acidity in the oral cavity, sugary dietary cravings, improper tooth brushing, and inadequate attention to oral health [6, 7]. A high prevalence of dental caries among pregnant women was reported in several studies [2, 8, 9]. In India, the prevalence of dental caries was 63.3% and they were 2.2 times more likely to suffer from dental caries as compared to non-pregnant women. Literature shows that the decayed component was the main contributor to dental caries experience [6]. Other factors that were associated with the high prevalence of dental caries during pregnancy as reported by various literature include; standard of living, behaviour, oral hygiene, eating habits, social status, and socio-demographic characteristics [2, 7, 8]. Also, a study done by Kumar and colleagues revealed that mean caries experience differs significantly among pregnant women in different trimesters [9], which indicate that the trimester of pregnancy could be a significant predictor of caries experiences.

Lack of restorative dental care contributes to further progression of carious lesions which lead to unnecessarily extracted teeth on an emergency basis. Dental pain due to untreated dental caries can also affect pregnant women's ability to eat, sleep, and perform their daily activities. Several studies have reported limited dental services among pregnant women due to various reasons even when there were obvious signs of oral disease [9–12].

The unmet need for care is of special concern, as the failure to obtain treatment can affect the health status of the mother and her unborn child. The literature shows a consistent positive association between the presence of clinically defined need and infrequent dental services utilization whereby those who were most in need of care did not receive it [13, 14]. In India, it was reported that most pregnant women had poor oral hygiene with a large proportion of unmet need whereby 3.3% needed either immediate care or referrals [15]. Only a few studies have testified about restorative and extraction needs among pregnant women. In India, it was conveyed that one surface restoration was the most required treatment, and the need decreased as age advanced [9]. In a similar study, the need for fissure sealant increased with gestational period and the teeth requiring caries arresting care were only observed in individuals in the third trimester of pregnancy. In Brisbane, Australia, Jago and colleagues [16] stated that 70% of pregnant women had teeth that needed restorative care and 10% needed tooth extraction.

Also, in Tanzania information about dental caries and treatment need is limited, therefore, the determination of this information (dental caries status and treatment need) shall give an overview of the real situation, hence providing appropriate preventive measures.

Methodology

Study design and setting

This was a descriptive cross-sectional hospital-based study conducted in three regional referral hospitals of Dar-es-Salaam located at Temeke, Mwananyamala, and Amana.

Study population

The study population included all consented pregnant women who attended antenatal clinics at Mwananyamala, Amana, and Temeke regional referral hospitals from October 2021 to February 2022. These hospitals were chosen strategically (according to catchment area) as they receive referral patients from different parts of the region, hence providing a closely representative sample.

Sample size and sampling techniques

A sample of 461 participants was calculated using a formular as stated by Mohamad and colleagues [17].

Since the hospitals could be considered to cause "a clustering effect", a Design Effect (DEF) of 1.2 was included to correct for diminished intra-cluster variability [18].

Sampling techniques

A consecutive sampling method was used to recruit participants for the study. Every pregnant woman who consecutively attended the selected health facility at the time of data collection was admitted into the study until the pre-determined sample was obtained. All pregnant women with acceptable details on their pregnancies (according to the nurses/doctors' clinical examination results and through their antenatal cards) were included in the study. The pregnant women who for any compelling health reasons were unable to effectively participate (e.g. frail, mentally disabled, or in labour pain), were excluded from the study.

Data collection

Information on socio-demographic characteristics such as age (coded in years as per the last gestation period (in weeks), gravidity (prime, second, third, more than three), and health insurance coverage (yes, no) were obtained through personal interviews administered by the principal investigator. The questionnaire was purposely developed by the principal researcher after reviewing related

Msagati *et al. BMC Oral Health*   (2024) 24:1038

Page 3 of 8

literature [9, 11, 16], and under the guidance of qualified supervisors GJM & ES.

Dental caries status and treatment need were diagnosed according to the WHO criteria [19] modified for this study. Dental caries was reported as decayed (DT), missing (MT), filled teeth (FT), and DMFT.

Treatment needs were reported as restorative care (filling, root canal treatment, treatment modalities not confirmed) and extraction.

Clinical examination was conducted by one trained and calibrated principal investigator (FM) with the participant seated on a chair in an isolated room. Full mouth dentition status was examined, under standard artificial light, using examination gloves, a mouth mirror, and a probe. The status of the dentition and the treatment need were recorded accordingly in a clinical form by a trained assistant. A tooth was coded as sound if it showed no evidence of treated or untreated clinical caries, as filled (F) when the tooth cavity has been restored with direct restorative material, without a carious lesion or fistula/abscess, as missing (M) when a tooth is missing due to caries. Decayed tooth (D) was defined by the presence of a lesion in a pit/fissure or on a smooth surface with a detectable softened floor/wall and undermined enamel. Stained pits or fissures that caught the probe, but do not have undermined enamel or softened floor walls were coded as sound. Also when in doubt, the tooth was coded as sound. Dental caries was reported using the decayed (DT), missing (MT), filled (FT) teeth, and DMFT index where DMFT score>0 was considered as dental caries experience.

Dental caries treatment need was recorded into restorative care (dental filling, root canal treatment), and extractions. A decayed tooth was considered for; filling when there was an internal or distinct cavity confined in dentine, and root canal treatment when there was a deep cavity involving the pulp with signs and symptoms of irreversible pulpitis (each patient with a deep cavity was asked if he had ever experienced pain, and if so, the duration and nature of the pain was recorded). If in doubt the tooth was coded as modalities of treatment not confirmed hence the need for further investigations.

Extraction was recorded when the tooth was severely damaged by caries such that only a retained root was present or there was irreparable damage to the crown.

All aspects of this study were submitted for approval by the Scientific Research and Ethics Committee of MUHAS after being reviewed and necessary modifications were done.

Validity and reliability

The clinical examiner was trained and calibrated by a benchmark examiner (Dr. G. Mandari) in recording dental caries. Both the questionnaire and the clinical examination forms were pre-tested through a pilot study on 10% of the sample size where necessary modifications were also done. Intra-examiner reproducibility was assessed by examining twice 25 participants among 46 during a pilot study to ensure that the tools were accurate, and precise (i.e. measures only the intended information). Measurements obtained were analysed using kappa statistics. Intra-examiner consistency for decayed teeth was 0.84 while for missing and filled teeth was 1 (Kappa value).

Data management and analysis

Data were fed into a computer, cleaned, and analysed using the software Statistical Package for Social Sciences (SPSS, version 23.0). Mean, standard deviations and frequency distribution tables were used to describe the collected data. Bivariate analysis using the chi-square test was used to compare proportions and logistic regression was used to find factors associated with dental caries experiences. The confidence interval was 95% ($p<0.05$).

Results

Socio-demographic distribution of study participants (SDC)

A total of 461 pregnant women participated in this study. Their age ranged from 14 to 47 years with a mean of 28.8 (±5.8) years where 65.6% were thirty years old or less. About half (52.1%) of the participants had a primary level of education or less. The mean gestational period was 29.5 (±7.4) weeks and 72.7% were in the third trimester. Multigravida were 77.2% of the study participants, and only 8.9% had medical insurance coverage (Table 1).

Table 1 Distribution of study participants by Socio-demographic characteristics, ($n=461$)

Socio-demographic characteristics	*n*	%
Age (in yrs.)		
≤ 30	293	65.6
> 30	168	36.4
Level of Education		
≤ Primary level	240	52.1
≥ Secondary	221	47.9
Gestational period		
Trimester 1 & 2	126	27.3
Trimester 3	335	72.7
Gravidity		
Prime-gravida	105	22.8
multiple-gravid	356	77.2
Medical insurance		
Yes	41	8.9
No	420	91.1

Msagati *et al. BMC Oral Health*   (2024) 24:1038

Page 4 of 8

Dental caries status among pregnant women

Dental caries status among pregnant women is presented in Tables 2 and 3. The prevalence of dental caries among pregnant women was 69% with a mean DMFT of 2.86 (±3.39). The decayed component was the dominant expression of DMFT by 60.5%, with an average of 1.67 (±2.16), followed by missing teeth (54.4%) with an average of 1.16 (±1.83). Filled teeth (FT) account for only 1.5% of the total study participants (Table 2).

Dental caries experience among pregnant women by socio-demographic characteristics

In this study, it was observed that dental caries experience increased with age, whereby those aged above thirty years had higher caries experience 187 (78%) with a mean DMFT of 3.99 (±4.11) compared to those aged

Table 2 Distribution of dental caries status among pregnant women

Variables		Frequency *n* (%)	
		Yes	No
1.	Dental caries (decayed)	279 (60.5)	182 (39.5)
2.	Missing teeth	251 (54.4)	210 (45.6)
3.	Filled teeth	7 (1.5)	454 (98.5)
4.	DMFT Index	318 (69)	143 (31)

thirty years and below 131 (63.8%) with a mean DMFT of 2.20 (±2.69). Moreover, multigravida had a higher dental caries experience 260 (73%), with a mean DMFT of 3.20 (±3.58) compared to the prime-gravida. These differences were highly statistically significant in the bivariate model with *p-value*=0.02, and *p-value*=0.01 respectively. However, no statistical significant differences were

Table 3 Dental caries experiences among pregnant women by SDC (*n*=461)

SDCs	Dental caries experiences, *n* (%)			*P*-value
	No experience	With experience	Total	
Age group				
≤ 30	106 (36.2)	187 (63.8)	293	0.02*
>30	37 (22)	131 (78)	168	
Gestation period				
Trimester1&2	39 (31)	87 (69)	126	0.99
Trimester 3	104 (31)	231 (69)	335	
Gravidity				
Prime gravida	47 (44.8)	58 (55.2)	105	0.01*
Multigravida	96 (27)	260 (73)	356	
Level of Education				
≤ Primary	70 (29.2)	170 (70.8)	240	0.37
≥Secondary	73 (33)	148 (67)	221	
Health insurance				
Yes	10 (24.4)	31 (75.6)	41	0.381
No	133 (31.7)	287 (68.3)	420	

Significance *P<0.05, was assessed using a chi-square test n=frequency
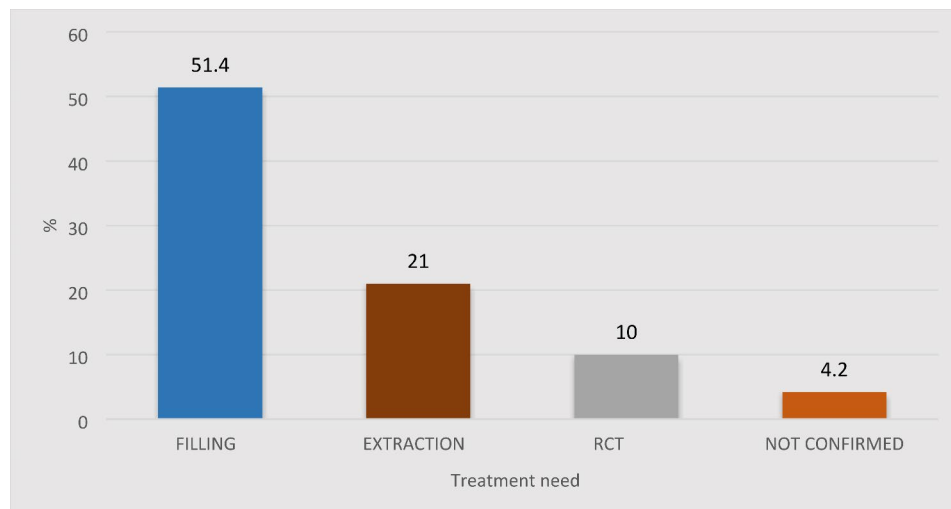

Fig. 1 Distribution of study participants according to dental treatment needs. (*n*=461)

Msagati *et al. BMC Oral Health*   (2024) 24:1038

Page 5 of 8

Table 4 Dental treatment needs among pregnant women by SDC, *n* = 461

Socio-demographic characteristics	Need for restorative care *n* (%)		*p*-value	Need for extraction *n* (%)		*p*-value
	No	Yes		No	Yes	
Age (in Yrs.)						
≤ 30	139 (47.4)	154 (52.6)	0.067	244 (83.3)	49 (16.7)	0.00**
>30	65 (38.7)	103 (61.3)		120 (71.4)	48 (28.6)	
Gestational period						
Trimester1&2	51 (40.5)	75 (59.5)	0.317	106 (84.1)	20 (15.9)	0.095
Trimester 3	153 (45.7)	182 (54.3)		258 (77)	77 (23)	
Gravidity						
Prime-gravida	57 (54.3)	48 (45.7)	0.02*	89 (84.8)	16 (15.2)	0.097
Multigravida	147 (41.3)	209 (58.7)		275 (77.2)	81 (22.8)	
Education level						
≤primary	108 (45)	132 (55)	0.736	187 (77.9)	22.1 (53)	0.567
≥secondary	96 (43.4)	125 (56.6)		177 (80.1)	44 (19.9)	
Medical insurance						
Yes	19 (46.3)	22 (53.7)	0.778	30 (73.2)	11 (26.8)	0.314
No	185 (44.)	235 (56)		334 (79.5)	86 (20.5)	

observed in dental caries experiences between gestational period, level of education, and health insurance cover, (*p-value>0.05*) (Table 3).

A total of 279 (60.5%) pregnant women had carious lesions of varying severity, whereas most of them (178, 63.8%) had more than one carious tooth that needed treatment. More than half (51.4%) of the study participants had at least one tooth that needed conventional filling. The need for root canal treatments accounted for 10% of the study participants while in about 4% of the participants, the modalities of treatment were not confirmed and therefore needed further investigations. 21% (21%) of the study participants had at least one grossly carious tooth or root remnant that required extraction (Fig. 1).

Results of this study showed that the need for restorative care was higher among multigravida women (58.7%) than among prime-gravida women (42.9%). Also, the need for extractions was higher (28.6%) among pregnant women aged above thirty years compared to those aged thirty years and below (16.7%). The differences between the two observations were highly statistically significant (*p-value*=0.02 and *p-value*=0.00, respectively). The need for restorative care was observed to be slightly higher among the third-trimester women (59.5%), higher among women aged>30 years (61.3%), higher among women in secondary education (56.6%), and higher among the "no health insurance" women (56%) compared to the respective counterparts; however, these differences were not statistically significant. Though the need for extractions between the trimesters, levels of education, and having medical insurance were moderate, the differences were also not statistically significant (*p-value>0.05*) (Table 3).

Significance **p-value<0.05* was assessed using the Pearson chi-square test. n=frequency.

Discussion

The participants in this study were mainly urban pregnant women from different suburbs of the city of Dar es Salaam who attended antenatal clinics in the three regional referral hospitals during the study period.

A few pregnant women did not consent to participate in the study possibly due to existing barriers in our society that hinder pregnant women from attending dental services [20–22]. Nevertheless, the number of participants matched the calculated sample size. This study demonstrated a high level of dental caries experience and treatment needs in this group of women. The majority had dental carious lesions that needed restorative care rather than tooth extraction.

There was rather a wide range of age at presentation to the clinic but the majority were below 30 years of age and in the third trimester of the gestation period (Table 1). This age profile was in agreement with a study done in the Democratic Republic of Congo where the majority of pregnant women attending the clinic in a single centre were aged below 30 years [23]. This can also be explained by the fact that the recommended childbearing age is between 20 and 35 years. Slightly above half (53%) had a maximum of primary school education only. Very few (8.9%) of the pregnant women had medical insurance which might be attributed to the fact that the three centres where the study was conducted were public institutions and therefore by policy antenatal and maternal services were provided at a subsidized cost by the government. As such patients without insurance coverage opted for these centres while those with medical insurance had

Msagati *et al. BMC Oral Health*   (2024) 24:1038

Page 6 of 8

the opportunity of taking the alternative of attending private intuitions. The fact that the majority were in the third trimester might have been influenced by the policies of the referral system in the country which encourages pregnant women to attend nearby clinics where, in case of any anticipated or encountered problems, they can be referred to higher centres. Other reports from developing countries like Palestine and India had also shown that most of the women who attended antenatal clinics were in the third trimester [2, 9].

The prevalence of dental caries among these pregnant women was 69%, with a mean caries experience of 2.86 per person. This finding was slightly lower than that of the general population of Tanzania where the prevalence of dental caries was 76.6%, Tanzania oral health survey (2020) is yet to be published. This is probably because the national oral health survey was conducted for people aged thirty years and above only while the majority of our study participants were below thirty years of age. Also, this study was conducted in an urban area. Literature from within the country and various other countries, has shown that caries experience in urban areas tends to be low compared to rural areas [4, 11, 24]. High levels of prevalence of dental caries among pregnant women ranging from 62.7 to 100% were also reported in India, Palestine, and Brazil [2, 9, 10, 15, 25]. Similar to findings in India and Palestine, in this study the decayed component was the dominant expression of DMFT [2, 15]. In Brazil, however, it was different, with the missing component found to have the highest value of the DMFT index [25]. Within the high dental caries experience, the filled component represented a dismal 0.7%, while in Palestine it was 22% of the DMFT score [2]. This may indicate that many of the pregnant women either opted to stay with the untreated decayed teeth or only visited the dentist at a late stage when they were in pain. As such, often the decayed teeth have undergone severe destruction beyond restorative care hence ending up being extracted. This can also be evidenced by the relatively high proportion (40.7%) of missing teeth observed in this study, indicating that extraction is the most commonly offered treatment of carious teeth. Multigravida women and those above thirty years old had significantly higher caries experience than their counterparts (i.e. primigravida and younger age) (Table 3). This could be explained by a cumulative effect of dental caries with advancing age, together with hormonal changes during pregnancy, as was also reported by various studies from other countries [8, 26, 27]. Similar to this study, in Sri Lanka and South Africa, the caries experience was higher among older-aged pregnant women compared to the younger ones [4, 11]. Also, in Palestine, the trend was the same as our findings where the DMTF was higher in multigravida and older women [27]. There was no significant difference observed

between dental caries experience and gestation period similar to the finding reported in South Africa [11].

Apparently, 60.5% of the study participants had at least one or more carious teeth of varying severity that require treatment (Table 3), in contrast to the findings from Australia and India where the need for dental treatment among pregnant women ranged from 70−95% which was much higher than our findings [15, 16]. More than half (53.8%) of the participants needed restorative care varying from simple fillings to root canal therapy (Fig. 1). It was found out, however, that about 21% of the pregnant women, needed tooth extraction which is rather high compared to reports from Sri Lanka and Australia where about 10% of pregnant women needed tooth extraction [15, 16]. Also, in the present study, the need for restorative care was significantly associated with gravidity while the need for tooth extraction was significantly associated with age (Table 4). Tooth extraction and root canal treatment often demand a long time, and special preparations, and may be stressful to the pregnant woman. Had these women attended dental treatment early they would have been saved from these stressful treatment procedures.

This study provides information on dental caries status and treatment need among pregnant women. The collected data are important for the effective planning and design of dental services, as well as for choosing interventions appropriate to special groups like pregnant women. Also, the information so gained is valuable to oral health professionals, planners, and policymakers on preventive, curative, and rehabilitative initiatives, thus improving oral health care services among pregnant women.

Unanswered questions:

Further studies are encouraged on the safety of dental services during pregnancy. Also, studies to determine the barriers that hinder pregnant women from utilizing dental services and whether these are common across different societies, are recommended.

Conclusion and recommendations

This study demonstrated a high level of dental caries experience and the presence of treatment needs. The majority of pregnant women had dental carious lesions which needed more restorative care than tooth extraction. Therefore, appropriate intervention is necessary to prevent the ultimate loss of most of these teeth.

Abbreviations
D   Decay
M   Missing
F   Filled
DMFT   Decay, Filled and Missing Teeth
WHO   World Health Organization
SPSS   Statistical Package for Social Sciences
MUHAS   Muhimbili University of Health and Allied Sciences

Data availability
The generated and analyzed data are available from the authors (corresponding author), upon reasonable request and with permission of the MUHAS and the ministry of health Tanzania.

Declarations

Ethical considerations
An ethical clearance letter was obtained from the MUHAS Higher Degrees Research and Publications Committee vide letter Ref. No. DA.282/298/01.C/843 of 3rd September 2021 before commencing the study. Before filling out the consent, each participant received a detailed oral explanation of the nature and purpose of the study. The participants were assured of confidentiality and anonymity. Also they had the right to withdraw without any conditions. Informed consent was obtained from the participants, their parents, and legally authorized representatives before participating in this study.

Study limitation and mitigation
There was a limited number of participants in the referral hospitals hence data collection was extended beyond the originally expected time to attain the calculated sample size. Some of the participants were also worried and hesitant to participate fully in the study as they were afraid of dental treatment while pregnant; therefore all participants were reassured that there were no invasive procedures and their safety was guaranteed.

Ethics approval and consent to participate
Ethical approval was obtained from the MUHAS Higher Degrees Research and Publications Committee vied letter Ref. No. DA.282/298/01.C/843 of 3rd sept 2021. Data collection was conducted under the ethical standards outlined in the 1964 Declaration of Helsinki and its later amendments [28, 29]. Informed consent was obtained from the participants, their parents, and legally authorized representatives in this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

References
1. Cho GJ, Kim S, youn, Lee HC, Kim HY, Lee KM, Han SW et al. Association between dental caries and adverse pregnancy outcomes. Sci Rep. 2020;10(1).
2. Kateeb E, Momany E. Dental caries experience and associated risk indicators among Palestinian pregnant women in the Jerusalem area: a cross-sectional study. BMC Oral Health. 2018;18(1):1–8.
3. Malhotra SKS. Safety of analgesics in pregnancy. Int J Obs Gynaecol Res. 2016;3(1):208–12.
4. Karunachandra NN, Perera IR, Fernando G. Oral health status during pregnancy: rural-urban comparisons of oral disease burden among antenatal women in Sri Lanka. Rural Remote Health. 2012;12(3):1–11.
5. Deshpande RR, et al. Screening of antimicrobial activity of active compound of embeliabasal, chlorhexidine and S-floagainst salivary microflora. Int J Pharm Pharm Sci. 2012;2:70–2.
6. Mousa O, Hamed A, Omar N, Al. The association of knowledge on oral health and utilization of dental services among pregnant women. J Nurs Educ Pract. 2019;9(6):1–6.
7. De Castilho ARF, Mialhe FL, De Souza Barbosa T, Puppin-Rontani RM. Influence of family environment on children's oral health: a systematic review. J Pediatr (Rio J). 2013;89(2):116–23.
8. Silva de Araujo Figueiredo C, Gonçalves Carvalho Rosalem C, Costa, Cantanhede, et al. Systemic alterations and their oral manifestations in pregnant women. J Obstet Gynaecol Res. 2017;43(1):16–22.
9. Kumar S, Tadakamadla J, Tibdewal H, Duraiswamy P, Kulkarni S. Factors influencing caries status and treatment needs among pregnant women attending a maternity hospital in Udaipur city, India. J Clin Exp Dent. 2013;5(2):72–6.
10. Patil S, Ranka R, Chaudhary M, Hande A, Sharma P. Prevalence of dental caries and gingivitis among pregnant and nonpregnant women. J Datta Meghe Inst Med Sci Univ. 2018;13(1):44–7.
11. Africa CWJ, Turton M. Oral health status and treatment needs of pregnant women attending Antenatal Clinics in KwaZulu-Natal. South Afr. 2019;2019:1–7.
12. Bolsson GB, Knorst JK, Santos BZ. Factors influencing the dental caries in pregnant women: a cross-sectional study Fatores que influenciam a cárie dentária em gestantes : um estudo transversal Factores que influyen en la caries dental en mujeres embarazadas : un estudio transversal. 2021;2020(1):1–11.
13. Muirhead VE, Quiñonez C, Figueiredo R, Locker D. Predictors of dental care utilization among working poor canadians. Community Dent Oral Epidemiol. 2009;37(3):199–208.
14. Arcury TA, Savoca MR, Anderson AM, Chen H, Gilbert GH, Bell RA, et al. Dental care utilization among North Carolina rural older adults. J Public Health Dent. 2012;72(3):190–7.
15. Gupta R, Acharya AK. Oral Health Status and Treatment needs among pregnant women of Raichur District, India. Scientifica (Cairo). 2016;1:1–8.
16. McEniery JDJPJCJFATM. Dental caries status of pregnant women attending a brisbane martenity hospital. Community Dent Oral Epidemiol. 1984;12(6):398–401.
17. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. Gastroenterol Hepatol Bed Bench. 2013;6(1):14–7.
18. Cordell HJ. Sample size requirements to control for stochastic variation in magnitude and location of allele-sharing linkage statistics in affected sibling pairs. Ann Hum Genet. 2001;65(5):491–502.
19. World Health Organization. WHO. 2013. pp. 1–125 Oral Health Surveys - Basic Methods 5th edition.
20. Saddki N, Yusoff A, Hwang YL. Factors associated with dental visit and barriers to utilisation of oral health care services in a sample of antenatal mothers in Hospital Universiti Sains Malaysia. BMC Public Health. 2010;10(1):1–11.
21. Lee RSY, Milgrom P, Huebner CE. Conrad D a. dentists' perceptions of barriers to providing dental care to pregnant women. Women's Heal Issues. 2010;20(5):359–65.
22. Widita I, Hastono SP. Factors Associated with Dental Care utilization among pregnant women at Klapanunggal Health Centre, Bogor, Indonesia. J Heal Promot Behav. 2019;4(2):145–52.
23. Tibasaga L, Rogelyne. Factors Influencing Utilization of dental Services Among Pregnant women in Referral Hospital of Bunia, in Democratic Republic of Congo. (Doctoral dissertation, International Health Sciences University). International Health Sciences University.; 2015.
24. Mosha HJ, Senkoro AR, Masalu JRP, Kahabuka FML. and KB. Oral helth statu and treatment needs among Tanzanias of different age groups. 2005. p. 18–27.
25. A, LBB a. LNB Da SC a JMRV a MABR. Oral health conditions among pregnant women attended to at a health care center in manaus, Amazon, Brazil. Rev Odonto Cienc. 2011;26(4):291–6.
26. Karnik A, Pagare S, Krishnamurthy V, Vahanwala S, Waghmare M. Determination of salivary flow rate, pH, and dental caries during pregnancy: a study. J Indian Acad Oral Med Radiol. 2015;27(3):372–6.

Msagati *et al. BMC Oral Health*   (2024) 24:1038

Page 8 of 8

27. Naseem M, Khurshid Z, Ali H, Niazi F, Zohaib S, Sohail M. Oral health challenges in pregnant women: recommendations for dental care professionals. Saudi J Dent Res. 2016;7(2):138–46.
28. Shrestha B, Dunn L. The declaration of Helsinki on Medical Research involving human subjects: a review of Seventh Revision. J Nepal Health Res Counc. 2020;17(4):548–52.
29. Puri KS, Suresh KR, Gogtay NJ, Thatte UM, Declaration of Helsinki. 2008: Implications for stakeholders in research. J Postgrad Med. 2009;55(2):131–4.

Publisher's note