

# Nutrient intake, oral symptoms, and oral health-related quality of life among antenatal mothers in Sarawak

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## ABSTRACT

**Introduction:** This study aimed to determine the association between nutrient intake, oral symptoms, and oral health-related quality of life (OHRQoL) among antenatal mothers in the Sri Aman district, Sarawak. **Methods:** A total of 124 antenatal mothers in the second and third trimesters, through systematic random sampling, participated in this cross-sectional study. A validated self-administered questionnaire was used to collect their socioeconomic and obstetric profiles, perceived oral health status, and OHRQoL. Three days 24-hour diet recall assessment involving two weekdays and one weekend day was used for nutrient intake assessment. **Results:** Most mothers (75.0%) had at least one oral symptom: cavitated tooth (51.6%), bleeding gum (32.3%), halitosis (27.4%), gum pain (13.7%), toothache (12.1%), and swollen gum (6.5%). Most mothers also had inadequate intakes of energy, vitamin D, iodine, calcium, zinc, fluoride, and iron. The most affected OHRQoL domain was psychological discomfort, followed by functional limitation and physical pain. Nutrient intake was not significantly different between antenatal mothers with and without oral symptoms. Antenatal mothers with at least one oral symptom, presence of toothache, cavitated tooth, bleeding gum, and halitosis had significantly lower OHRQoL. **Conclusion:** Most antenatal mothers had inadequate nutrient intake, particularly vitamin D and calcium. Nutrient intake was not significantly associated with oral symptoms. The oral symptoms of dental caries and periodontal disease were prevalent; and the presence of toothache, cavitated tooth, bleeding gum, and halitosis were associated with poor OHRQoL.

**Keywords:** antenatal mothers, nutrient intake, oral health-related quality of life, oral symptoms

## INTRODUCTION

The physiological hormonal changes during pregnancy are critical for positive pregnancy outcomes. However, it also causes detrimental effects on oral health among antenatal mothers. Recurrent vomiting enhances the acidic environment in the oral cavity (Shahid &

Srivastava, 2019). Impaired oral hygiene due to nausea and vomiting, as well as food cravings for sugary food to offset it, further increases antenatal mother's risk of developing dental caries (Sari, Saddki & Yusoff, 2020). Besides that, oestrogen and progesterone enhance vascular permeability, and vascular proliferation

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could result in the recruitment of more inflammatory cells in the gingival (Costantinides *et al.*, 2020). As a result, the inflammatory response of periodontal tissues to bacteria in dental plaque is exaggerated even to a minimal amount of plaque accumulation (Rathee & Jain, 2022).

Therefore, antenatal mothers are susceptible to dental caries and periodontal disease. The presence of signs and symptoms of dental caries and periodontal disease could negatively affect the self-perception of oral health-related quality of life (OHRQoL) among antenatal mothers (Cordero *et al.*, 2019). This underlines the importance of maintaining good oral health during pregnancy.

A healthy diet is important for the preservation of oral health and positive pregnancy outcomes. However, a scoping review reported that nutrient intake for most antenatal mothers, particularly iron, folate, vitamin D, and calcium were inadequate in urban and suburban areas of Malaysia (Mohamed *et al.*, 2022). It is well established that nutrition and oral health has a bi-directional relationship in the general population (American Dental Association, 2021). However, there are very limited studies to establish the relationship between sufficient nutrient intake and oral symptoms suffered by antenatal mothers.

Thus, this study aimed to determine the nutrient intake, oral symptoms, and OHRQoL among antenatal mothers in Sri Aman district, Sarawak. The association between nutrient intake and oral symptoms, and the association between oral symptoms and OHRQoL were determined. The findings of this study can perhaps be further used to reinforce and strengthen the strategies outlined in the guidelines of "Oral Healthcare for Antenatal Mothers" by the Ministry of Health Malaysia (Oral Health Division, 2004).

## **MATERIALS AND METHODS**

### **Population and sample**

This study was a cross-sectional study of antenatal mothers who received antenatal care from the Maternal and Child Health (MCH) clinic of Sri Aman Health Clinic in Sri Aman district, Sarawak. There is a total of five Health Clinics in the Sri Aman district, Sarawak, and all Health Clinics offer maternal and child health care services at their respective MCH clinic. The MCH clinic at Sri Aman Health Clinic is the main MCH clinic in Sri Aman district, with the highest number of registered antenatal mothers. It is also the referral centre of antenatal care from other Health Clinics in the Sri Aman district.

The sample size for this study was determined based on research objectives, whereby the highest number of sample size was chosen. The final sample size selected was determined using the power and sample size calculations (PS) software version 3.1.6, based on comparison of mean nutrient (calcium) intake between subjects with oral symptoms and without oral symptoms, where the power of study was 80%, with 95% confidence. Standard deviation (*SD*) was determined at 240 mg (Adikari *et al.*, 2016). If the true mean difference between groups with and without oral symptoms was 120 mg, 64 subjects with oral symptoms and 64 control subjects were needed. The calculated sample size was 128. To accommodate for 10% non-response rate, a sample size of 141 was decided.

The inclusion criteria of this study were antenatal mothers in the second and third trimesters, aged 18 years and above, and able to read and write in the Malay language. Antenatal mothers who were non-citizen, and with mental disorders (which will affect memory) diagnosed by physicians were excluded by checking their antenatal health

record books. Potential participants were selected using a systematic random sampling method with sampling interval of three from patient registration books. Antenatal mothers who fulfilled the inclusion and exclusion criteria were invited to participate in this study. Written informed consent was obtained from antenatal mothers prior to data collection. Due to time constraint in this study, data collection was ceased when sample size achieved 130.

This study obtained ethical approval from the Human Research Ethics Committee of Universiti Sains Malaysia (Ref: USM/JEPeM/22010075) and Medical Research & Ethics Committee, Ministry of Health Malaysia (Ref: 22-00439-OKS (2)).

### Variables

Variables collected in this study were sociodemographic profile (age, ethnic group, highest education level, employment status, and monthly household income), obstetric profile (gestational age, gravida status, and parity status), perceived oral health status (perceived oral health status, oral symptoms, satisfaction with oral health status), nutrient intake (energy, carbohydrate, fat, protein, vitamin A, iron, folate, vitamin C, vitamin D, calcium, iodine, zinc, fluoride), and OHRQoL.

To assess the association between nutrient intake and oral symptoms, the independent variable was nutrient intake, while the dependent variable was oral symptoms. Nutrient intake was assumed to cause a change in oral symptoms. To assess the association between oral symptoms and OHRQoL, the independent variable was oral symptoms, while the dependent variable was OHRQoL. Oral symptoms were assumed to cause a change in OHRQoL.

### Research tools

A structured self-administered questionnaire adapted from Sari *et al.* (2020), with original authors' permission, was used to obtain information on socio-demographic profile (including age, ethnic group, educational level, employment status, and monthly household income), obstetric profile (including gestational period, gravida status, and parity status), and perceived oral health status (including perceived oral health status, oral health problems, satisfaction with oral health status). The list of oral health problems was developed by a panel of clinical dental specialists (Sari *et al.*, 2020). Additionally, there was an open question through an "other" answer option with text entry on it for participants to specify other oral health problems they may have.

The Malay version of the short Oral Health Impact Profile questionnaire, designated as S-OHIP (M), validated by Saub, Locker & Allison (2005), was adopted to measure the OHRQoL of antenatal mothers. More specifically, the S-OHIP(M) measured perceptions of oral impacts on life experiences. Permission to use the questionnaire was obtained from original authors. There were two questions in each of the following seven domains in the questionnaire: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. The frequency of oral impacts throughout the past 1 year was evaluated using a five-point Likert scale that were coded as '0' for 'never', '1' for 'hardly ever', '2' for 'occasionally', '3' for 'fairly often', and '4' for 'very often'. To measure the overall severity of the impacts, the total score of all 14 items (with a range of 0 to 56) was calculated. A higher S-OHIP(M) score implied a greater oral impact, and a worse OHRQoL. In

addition, the prevalence of impact for each item, which was the percentage of subjects who reported 'fairly often' or 'very often' was determined.

A 24-hour diet recall form by the Non-Communicable Disease (NCD) Section, Disease Prevention Division, Ministry of Health (MOH) Malaysia was used to measure the mothers' nutrient intakes. Information recorded in the standardised 24-hour diet recall form included the following: i) the recall day to indicate working day or weekend, ii) time of foods and beverages taken, iii) type and description of foods and beverages taken, and iv) household measurement of each serving.

### **Data collection**

Before the study, the principal investigator was trained and calibrated by a qualified nutritionist on how to administer the 24-hour diet recall assessment. Problems encountered were discussed and improved before the study. An interview guideline on administering the 24-hour diet recall assessment was produced and endorsed by the nutritionist to be used in this study.

The antenatal mothers were approached while they were waiting to be seen by the medical officer in the waiting area. The inclusion and exclusion criteria were determined by interviewing the mothers and checking their antenatal health record books. Eligible mothers who were identified as potential participants using the systematic random sampling method were invited to participate in the study. Information regarding study rationale, objectives, procedures, risk, volunteering clause, and confidentiality were given; written informed consent was obtained from mothers who agreed to participate in this study.

The self-administered questionnaire was distributed to the participants.

The participants took about 5-10 minutes to complete the questionnaire, which was collected back immediately after completion. Antenatal mothers were then informed of the 24-hour diet recall assessment that would be conducted over three non-consecutive days involving two weekdays and one weekend day. To increase the accuracy of diet assessment, a copy of samples of household measuring instruments was provided to them. An interviewer administered the 24-hour diet recall assessment. The first interview was conducted face-to-face right after they returned the self-administered questionnaire. The second and third 24-hour dietary recall assessments were conducted using phone interviews. Each diet recall assessment took about 15-20 minutes.

The three days 24-hour diet recall assessment data were analysed using the Nutritionist Pro™ Diet Analysis Software (Axxya System, Washington, USA) to obtain nutrient intake information. Malaysian Food Composition database was used to analyse diet data. The results of nutrient analyses were compared to the recommended nutrient intake (RNI) for Malaysian antenatal mothers (NCCFN, 2017). Nutrient intake of antenatal mothers was categorised as inadequate or adequate based on the given RNI values.

### **Statistical analysis**

Data entry and analysis were performed using IBM SPSS Statistics for Windows version 26.0 (IBM Corp., Armonk, NY, USA). Data were first checked and cleaned. Descriptive analysis was first conducted. Categorical data were reported in frequency and percentage, and continuous data were reported as mean and *SD* or median and interquartile range (*IQR*), depending on the distribution of normality. Mean and *SD* were reported if the skewness was

within an acceptable range of -2 to +2, and kurtosis was within an acceptable range of -7 to +7 (Soh & Idris, 2017). In addition, the Kolmogorov-Smirnov test was also done, whereby significant findings indicated non-normal distribution.

To study the association between nutrient intake and oral symptoms, an independent *t*-test was used to compare the mean nutrient intake values between antenatal mothers with and without oral symptoms. The Mann-Whitney U Test was used if the observations were not normally distributed. An independent *t*-test was also used to study the association between oral symptoms and OHRQoL by comparing the mean S-OHIP (M) scores between antenatal mothers with and without oral symptoms. Similarly, the Mann-Whitney U Test was used if the observations were not normally distributed. Statistical significant level was set at  $p=0.05$ .

## RESULTS

### Sociodemographic and obstetric profiles of antenatal mothers

A total of 130 antenatal mothers participated in this study. However, only 124 of them completed the self-administered questionnaire and the three days 24-hour diet recall assessment, giving a response rate of 95.4%. Table 1 shows the sociodemographic and obstetric profiles of antenatal mothers. The age of mothers ranged from 18 to 42 years, with mean age of 29.1 (*SD* 5.55) years. Most of them were unemployed (61.3%) and the mean monthly household income was RM 2,284 (*SD* 1,846). Most antenatal mothers (71.0%) were in their second trimester. More than half of the antenatal mothers (66.1%) were pregnant for at least a second time.

### Nutrient intake of antenatal mothers

Table 2 shows the nutrient intake

of antenatal mothers. A total of 13 nutrients were extracted from the antenatal mothers' diet intakes. Most antenatal mothers in their second trimester (76.1%) and third trimester (88.9%) had inadequate energy intake. Nearly half (41.1%) had inadequate carbohydrate intake based on total energy intake (TEI). While most of the antenatal mothers had adequate folate (83.9%) and vitamin C (79.8%) intakes, the intakes for vitamin A, iron, vitamin D, calcium, iodine, fluoride, and zinc were mostly below the RNI values. All antenatal mothers had inadequate vitamin D and fluoride intakes, and almost all antenatal mothers (95.9%) had inadequate calcium intake.

### Perceived oral health status and oral symptoms of antenatal mothers

Overall, half of the antenatal mothers (52.8%) were satisfied with their oral health status. Less than half of them perceived their oral health status as good (39.5%) and very good (7.5%), respectively. A quarter (25.0%) of antenatal mothers in this study reported not experiencing any oral symptoms, while most (75.0%) had at least one oral symptom. The most common oral symptom reported was cavitated tooth (51.6%), followed by bleeding gum (32.3%), halitosis (27.4%), gum pain (13.7%), toothache (12.1%), swollen gum (6.5%), and others (1.6%). Other oral symptoms included discomfort from wisdom tooth (0.8%) and yellowish teeth (0.8%).

### Oral health-related quality of life (OHRQoL)

Table 3 shows the prevalence and severity of oral impact among antenatal mothers. The results were obtained using S-OHIP(M) instrument. The most affected oral health domain was psychological discomfort, with a mean score of 1.95 (*SD* 1.89). Meanwhile, the

**Table 1.** Sociodemographic and obstetric profiles of antenatal mothers (N=124)

Characteristics	Mean±SD	n (%)
Age (years)	29.1±5.6	
Age group (years)		
18 – 19		3 (2.4)
20 – 29		66 (53.2)
30 – 39		49 (39.5)
≥ 40		6 (4.8)
Ethnic group		
Malay		36 (29.0)
Chinese		13 (10.5)
Indian		-
Iban		63 (50.8)
Melanau		1 (0.8)
Bidayuh		7 (5.6)
Others		4 (3.2)
Highest education level		
No formal education		-
Primary school		8 (6.5)
Secondary school		67 (54.0)
Post-secondary or diploma		34 (27.4)
Tertiary		15 (12.1)
Employment status		
Employed		48 (38.7)
Unemployed		76 (61.3)
Mean household income (MYR)	2,284±1,847	
Household income (MYR)		
Below 999		16 (12.9)
1,000-2,999		70 (56.5)
3,000-4,999		20 (16.1)
5,000 and above		18 (14.5)
Trimester		
Second trimester		88 (71.0)
Third trimester		36 (29.0)
Gravida status		
Primigravida		42 (33.9)
Multigravida		82 (66.1)
Parity status		
Nulliparous		47 (37.9)
Primiparous		40 (32.3)
Multiparous		37 (29.8)

item of discomfort due to food getting stuck between teeth or dentures had the highest mean score of 1.15 (*SD* 1.07) among all 14 items, followed by feeling shy (mean 0.81, *SD* 1.09), and problems causing bad breath (*mean* 0.79, *SD*

0.95). The highest prevalence of impact experienced was discomfort due to food getting stuck between teeth or dentures (11.3%), followed by feeling shy (10.5%), problems causing bad breath (5.6%), and avoiding smiling (5.6%).

**Table 2.** Nutrient intake of antenatal mothers (N=124)

Nutrients	RNI	Mean±SD	Frequency (%)	
			Inadequate	Adequate
Energy (kcal)	1,890 <sup>b</sup>	1,598±354	67 (76.1)	21 (23.9)
	2,080 <sup>c</sup>	1,674±351	32 (88.9)	4 (11.1)
Carbohydrate (%)	50-65 <sup>†a</sup>	51.3±6.2	51 (41.1)	73 (58.9)
Fat (%)	25-30 <sup>†a</sup>	29.3±4.8	16 (12.9)	108 (87.1)
Protein (%)	10-20 <sup>†a</sup>	19.4±3.5	-	124 (60.5)
Vitamin A (µg)	800 <sup>a</sup>	749.9±382.4	72 (58.1)	52 (41.9)
Iron (mg)	100 <sup>a</sup>	78.3±39.7	88 (71.0)	36 (29.0)
Folate (µg)	600 <sup>a</sup>	2,124±1,966	20 (16.1)	104 (83.9)
Vitamin C (mg)	80 <sup>a</sup>	176.4±144.7	25 (20.2)	99 (79.8)
Vitamin D (µg)	15 <sup>a</sup>	2.7±2.2	124 (100.0)	-
Calcium (mg)	1,300 <sup>§</sup>	465.5 (379.3, 981.4) <sup>‡</sup>	3 (100.0)	-
	1,000 <sup>¶</sup>	562.5±229.4	116 (95.9)	5 (4.1)
Iodine (µg)	200 <sup>a</sup>	74.2±46.7	122 (98.4)	2 (1.6)
Zinc (mg)	7 <sup>b</sup>	10.5±8.0	44 (50.0)	44 (50.0)
	10 <sup>c</sup>	8.8±6.7	28 (77.8)	8 (22.2)
Fluoride (mg)	3 <sup>a</sup>	0.0 (0.0, 0.0) <sup>‡</sup>	124 (100.0)	-

<sup>†</sup>% based on total energy intake (TEI)

<sup>‡</sup>Median (25th, 75th), Kolmogorov-Smirnov <0.05

<sup>§</sup>RNI calcium for age group 18-19 years

<sup>¶</sup>RNI calcium for age group 20 years and above

<sup>a</sup>Similar RNI for all trimesters; <sup>b</sup>RNI for second trimester; <sup>c</sup>RNI for third trimester

### Association between nutrient intake and oral symptoms

Table 4 shows the differences in mean nutrient intake between antenatal mothers with at least one oral symptom and without oral symptoms. It was found that all 13 selected nutrients intake were not significantly different among antenatal mothers with and without oral symptoms.

### Association between oral symptoms and OHRQoL

Table 5 shows the differences in mean S-OHIP(M) score by oral symptoms. It was found that the median S-OHIP(M) score among antenatal mothers with at least one oral symptom was significantly higher compared to those without oral symptoms. Antenatal mothers with at least one oral symptom had lower

OHRQoL compared to those without oral symptoms. Antenatal mothers in this study with toothache, cavitated tooth, bleeding gum, and halitosis had significantly lower OHRQoL compared to those without symptoms.

### DISCUSSION

Antenatal mothers in this study had a high prevalence of oral symptoms associated with dental caries. The self-perceived cavitated tooth in this study was slightly lower compared with the finding of 62% reported by Sari *et al.* (2020). The high prevalence of caries could be attributed to impaired oral hygiene due to nausea and vomiting, as well as frequent intake of sugary foods and drinks to alleviate pregnancy cravings (Sari *et al.*, 2020). In addition,

**Table 3.** Prevalence and severity of oral impact among antenatal mothers (N=124)

<i>S-OHIP(M) domain and item</i>	<i>Prevalence of impact (%)</i>	<i>S-OHIP Mean±SD</i>
Functional limitation		1.29±1.48
Difficulty chewing any foods	2.4	0.50±0.84
Problems caused bad breath	5.6	0.79±0.95
Physical pain		1.19±1.29
Discomfort eating any food	2.4	0.54±0.84
Ulcers in mouth	2.4	0.65±0.84
Psychological discomfort		1.95±1.89
Discomfort due to food getting stuck	11.3	1.15±1.07
Felt shy	10.5	0.81±1.09
Physical disability		1.02±1.54
Avoided eating certain foods	4.0	0.58±0.88
Avoided smiling	5.6	0.00 (0.00, 0.75) <sup>†</sup>
Psychological disability		0.00 (0.00, 1.00) <sup>†</sup>
Sleep been disturbed	4.0	0.00 (0.00, 0.00) <sup>†</sup>
Concentration been disturbed	4.0	0.00 (0.00, 0.00) <sup>†</sup>
Social disability		0.39±1.07
Avoided going out	0.8	0.00 (0.00, 0.00) <sup>†</sup>
Problems in carrying out daily activities	2.4	0.00 (0.00, 0.00) <sup>†</sup>
Handicap		0.94±1.31
Had to spend a lot of money	2.4	0.00 (0.00, 0.00) <sup>†</sup>
Felt less confident	4.8	0.65±0.90

<sup>†</sup>Median (25th, 75th), Kolmogorov-Smirnov ( $p<0.05$ )

untreated caries before pregnancy may worsen and progress to advanced stage, which may lead to dental pain.

Among the common symptoms of periodontal disease reported by antenatal mothers in this study were bleeding gum, followed by gum pain and gum swelling. The finding of self-perceived bleeding gum in this study was slightly higher than the finding of 28% reported by Sari *et al.* (2020). Pregnancy gingivitis was included in the new classification of periodontal and peri-implant diseases and conditions in 2017 as a dental plaque induced gingival condition modified by systemic condition of sex hormones. With the high levels of oestrogen and progesterone, gingival oedema and gingivitis are prevalent in most antenatal mothers, even to a minimal amount of plaque accumulation (Rathee & Jain, 2022). Untreated gingivitis may further

progress to periodontitis, characterised by irreversible bone loss and tooth mobility.

In this study, the intakes of vitamin D and calcium were found to be inadequate. The insufficient vitamin D intake in this study was much higher compared to a study by Basha *et al.* (2021) in Malaysia, where the prevalence of vitamin D deficiency in late pregnancy was about 92 percent. This can be attributed to the relatively low awareness on vitamin D intake among antenatal mothers, which is related to lower educational background (Bukhary *et al.*, 2016). In addition, the sun avoidant lifestyles and also Muslims who cover themselves (especially ladies) during outdoor activities have been shown to be related to vitamin D insufficiency (Mohamed *et al.*, 2022). Meanwhile, majority of antenatal mothers in this



**Table 4.** Differences in mean nutrient intake by oral symptoms in antenatal mothers (n=124)

Nutrients	With at least one oral symptom	No oral symptoms	t statistic (df)	p-value
	Mean±SD	Mean±SD		
Energy (kcal)	1,629±351	1,592±364	-0.50 (122)	0.618
Carbohydrate (%)	50.8±6.1	52.9±6.2	1.58 (122)	0.116
Fat (%)	29.7±4.6	27.9±4.8	-1.75 (122)	0.082
Protein (%)	19.4±3.6	19.1±3.1	-0.41 (122)	0.683
Vitamin A (µg)	778.2±394.0	665.1±337.1	-1.43 (122)	0.155
Iron (mg)	75.5±39.6	86.6±39.3	1.35 (122)	0.178
Folate (µg)	1,923±2,008	1,727±1,884	-0.35 (122)	0.729
Vitamin C (mg)	176.9±148.9	175.1±133.5	-0.06 (122)	0.970
Vitamin D (µg)	2.1 (1.1, 3.7) <sup>†</sup>	1.7 (0.9, 3.3) <sup>†</sup>	1,257.5 <sup>‡</sup>	0.288
Calcium (mg)	568.4±222.4	549.3±256.3	-0.39 (122)	0.691
Iodine (µg)	75.8±48.1	69.4±42.8	-0.66 (122)	0.508
Zinc (mg)	9.3±7.1	12.3±8.9	1.69 (43.45)	0.098
Fluoride (mg)	0.0 (0.0, 0.0) <sup>†</sup>	0.0 (0.0, 0.0) <sup>†</sup>	1,309.5 <sup>‡</sup>	0.311

<sup>†</sup>Median (25th, 75th), Kolmogorov-Smirnov ( $p < 0.05$ )

<sup>‡</sup>U statistics by Mann-Whitney U test

study had inadequate dietary calcium intake. The result is comparable with the findings from Hamid *et al.* (2019), where only 2.6% of antenatal mothers in suburban MCH clinics in Selangor, Malaysia achieved the RNI for calcium. It was reported that most Asians were not aware of the importance of calcium for their health and thus, authors suggested that their negative attitude must be corrected (Chan *et al.*, 2018).

Both vitamin D and calcium complement each other and are important in maintaining healthy bones and teeth, which is crucial for healthy periodontium during pregnancy. Besides that, adequate intakes of vitamin D and calcium are essential in the development, formation, and mineralisation of primary teeth starting at the 13th week of pregnancy (Suárez-Calleja *et al.*, 2021). It was found that maternal vitamin D insufficiency was associated with greater caries experience in primary dentition (Beckett *et al.*, 2022). Therefore, antenatal mothers should be educated on the importance of adequate intakes

of vitamin D and calcium through diet.

According to the American Dental Association (2021), oral health and nutrition have a bi-directional relationship. However, in this study, there was no significant difference in all the selected nutrient intakes between antenatal mothers with and without oral symptoms. The insignificant results in this study may be attributed to the changes in dietary intake associated with food cravings, and the multivitamin and mineral supplements taken during pregnancy, which was irrelevant with pre-existing oral symptoms before pregnancy. Furthermore, food intake pattern, which is affected by food availability and affordability, culture and belief, and food taboos were not investigated in this study.

This study revealed that the OHRQoL was lower among antenatal mothers with at least one oral symptom compared to those without oral symptoms. The result of this study is in line with Fakheran *et al.* (2020) that antenatal mothers' perceptions of their OHRQoL were

**Table 5.** Differences in mean S-OHIP (M) score by oral symptoms in antenatal mothers (N=124)

Variable	S-OHIP score Mean±SD	t statistic (df)	p-value
Presence of oral symptom			
With at least one oral symptom	7.00 (2.50, 14.00) <sup>†</sup>	757.00 <sup>‡</sup>	<0.001
No oral symptom	2.00 (0.00, 5.00) <sup>†</sup>		
Toothache			
Yes	12.27±9.79	-2.57 (122)	0.011
No	6.82±7.37		
Cavitated tooth			
Yes	7.00 (3.00, 14.00) <sup>†</sup>	1326.00 <sup>‡</sup>	0.003
No	3.00 (1.00, 8.00) <sup>†</sup>		
Gum pain			
Yes	11.88±10.04	-2.01 (18.76)	0.058
No	6.78±7.27		
Bleeding gum			
Yes	7.50 (3.25, 15.75) <sup>†</sup>	1132.50 <sup>‡</sup>	0.003
No	4.00 (1.00, 8.75) <sup>†</sup>		
Swollen gum			
Yes	11.50±11.69	-1.02 (7.40)	0.337
No	7.19±7.52		
Halitosis			
Yes	9.00 (4.75, 14.50) <sup>†</sup>	911.50 <sup>‡</sup>	0.001
No	4.00 (1.00, 8.00) <sup>†</sup>		

<sup>†</sup>Median (25th, 75th), Kolmogorov-Smirnov ( $p<0.05$ )

<sup>‡</sup>U statistics by Mann-Whitney U test

significantly impacted by the presence of oral symptoms resulting from dental caries and periodontal disease. Dental caries in the advanced stage usually causes dental pain, food stuck in cavitated tooth, and difficulty in eating and chewing. To a greater extent, it may disturb sleep and affect daily living activities like absence from class or work (WHO, 2017).

The high impact of dental caries among antenatal mothers might be due to the practice of deferring dental extraction and restorative treatment to protect the foetus and keeping it safe and healthy (Fakheran *et al.*, 2020). Furthermore, antenatal mothers may become anxious when their gingiva bleeds during routine toothbrushing and it gets worse when oral hygiene practices are impaired due to nausea

and vomiting (Fakheran *et al.*, 2020). Besides that, halitosis can significantly lower their self-esteem and result in impaired social interactions with other people. Most of the time, halitosis could be a consequence of periodontal disease, deep dental caries, dry mouth, and impaired oral hygiene practices causing dental plaque accumulation and food debris in cavitated tooth (Izidoro *et al.*, 2022).

Diet and nutrition should be seen as one of the common risk factors affecting oral health and pregnancy outcomes. More oral health and nutritional promotion programmes should be conducted at the community level to raise the awareness on the importance of nutrients towards positive pregnancy outcomes and oral health. Besides that, the dental referral pathway by antenatal

healthcare providers and monitoring mechanism should be strengthened. Clinical interventions like basic diet intervention and prompt dental treatments including preventive dental treatment, such as topical fluoride therapy, should be prioritised for all antenatal mothers. Tailored oral health education by emphasising effective dental plaque removal and use of fluoride toothpaste should be emphasised to all antenatal mothers.

The family wellness concept should be utilised in promoting oral health by using mothers as the agent of change in the family. Interventions could enhance positive preventive behaviours of mothers, who can then further good eating habits and oral health practices within the family unit and in turn the community at large. Through this, community wellness can be achieved (Oral Health Programme, 2019).

This study had several limitations. The study design was cross-sectional in nature and thus, had limitation in establishing the causal relationship between variables. The information from 24-hour diet recall assessment had limitations where antenatal mothers may unintentionally under-report their actual diet intake, including the dietary supplements taken. Using self-reported oral symptoms had limitations of biases. Often a discrepancy exists between a person's perceived oral health status and a professional's assessment found in clinical examination (Sari *et al.*, 2020). Future studies that measure oral health status using clinical examination is therefore recommended.

## CONCLUSION

In this study, most antenatal mothers had inadequate nutrient intakes, particularly vitamin D and calcium. Majority of them had at least one oral symptom. The most prevalent symptom was cavitated tooth,

followed by bleeding gum and halitosis. The most affected OHRQoL domain was psychological discomfort, followed by functional limitation and physical pain. Nutrient intake was not significantly associated with oral symptoms. The presence of at least one oral symptom was significantly associated with a lower OHRQoL among antenatal mothers. The presence of toothache, tooth cavitation, bleeding gum, and halitosis were found to be significantly associated with lower OHRQoL. This study highlighted the importance of reinforcing dental referral by antenatal healthcare providers and preventive dental care including use of topical fluoride and fluoride toothpaste, as well as incorporating diet and nutrition in oral health education and promotion activities for antenatal mothers. Through family wellness concept, mothers could play a role as the agent of change for better oral health, diet and nutrition in the family.

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## Authors' contributions

Tiong IT, principal investigator, conceptualised and designed the study, conducted data collection, data management and analyses, data interpretation, and prepared the draft of the manuscript; Ruhaya H, conceptualised and designed the study, conducted data management and analyses, data interpretation, reviewed and edited the manuscript; Norkhafizah S, conceptualised and designed the study, conducted data management and analyses, data interpretation, reviewed and edited the manuscript; Tham H, conducted data collection. All authors have read and agreed to the manuscript.

## Conflicts of interest

This research was self-funded. The authors declare no conflict of interest.

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