ORIGINAL ARTICLE

Assessment of Oral Health, Vitamin B12, and Folic Acid in Parents of Children With Non-syndromic Cleft Lip and Palate

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ABSTRACT

Introduction: Oral health plays a primary role in nutrition intake. Tooth loss can affect mastication, leading to nutritional deficiencies such as vitamin B12 and folic acid which affect fetal development. This study is aimed to assess the oral health, vitamin B12 and folic acid in mothers with children of non-syndromic cleft lip with or without cleft palate (CL±P). **Methods:** This is a quantitative correlational and an observational cross-sectional design. The population was mothers of non-syndromic CL±P children, who attend at Yayasan Pembina Penderita Celah Bibir dan Langit-Langit (YPPCBL), Sekeloa, Bandung. The inclusion criteria was mothers of non-syndromic CL±P children, aged 0-12 months and the exclusion criteria was mothers with a family history of CL±P. Collecting data through the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Oral health was evaluated using the Decayed, Missing, Filled Tooth (DMF-T) index and posterior occlusal support area (POSA) assessed based on the Eichner Index, with classifications A1-A3 and B1-B3. Spearman rank correlation test with a significance level, $p<0.05$. **Results:** A total of 38 subjects participated in this study. High DMF-T index was found in 63.2% of the subjects, mean score was 6.3. POSA with A1-A3 classification were identified in 63.2% of the subjects. Around 60.5% had sufficient vitamin B12 intake and 86.8% had insufficient folic acid intake. There were no significant correlation between the DMF-T index with vitamin B12 ($p>0.05$) and folic acid ($p>0.05$) intake. Similarly, no significant correlation between the POSA with vitamin B12 ($p>0.05$) and folic acid ($p>0.05$) intake. **Conclusion:** There is no correlation between POSA and DMFT index with vitamin B12 and folic acid in this study.
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Keywords: DMFT index; Tooth loss; Vitamin B12; Folic acid; Cleft lip

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INTRODUCTION

Cleft lip and palate (CL±P) are deformity disorders caused by failures in facial structure formation during human embryonic development[1]. The World Health Organization (WHO) states that the current prevalence of cleft lip and palate is approximately 1 in 700 live births. The highest prevalence occurring among Asian populations (14 in 10,000 live births) and the lowest among African populations (4 in 10,000 live births)[2].

CL±P are multifactorial congenital anomalies influenced by genetic, ethnic, socioeconomic status, and environmental factors. Environmental factors such as maternal hormonal disorders, use of psychiatric medications, vitamin and folic acid deficiency, hypoxia, cigarette smoking and malnutrition can affect these abnormalities.[3], [4]. Studies conducted in Thailand by McKinney in 2013 have reported that mothers who consume liver during the periconceptional period have a lower risk of giving birth to children with CL±P compared to those who do not consume it. This finding is linked to the rich content of vitamin A, vitamin B12, folic acid, zinc, and vitamin B6 in the liver[5]. A case-control study in China (2021) reported that mothers who consumed folic supplementation acid had a 0.41 times lower risk of giving birth to children with (CL±P) compared to mothers who did not consume folic acid supplementation during the maternal periconceptional period.[6]

Nutritional intake during pregnancy indirectly depends on the condition of oral health, which plays a role in mastication function. The hormonal changes that occur during pregnancy can affect oral health, particularly in periodontal tissue and the risk of dental caries. If periodontitis and dental caries in pregnant women are not attended to, it can lead to tooth loss[7]. Tooth loss can affect mastication, indirectly leading to nutritional deficiencies due to a tendency to choose soft-textured foods without considering the required nutrients for fetal growth and development during pregnancy.[8]

The oral health during pregnancy can also have an impact on the oral health during the perinatal and postnatal periods. A study conducted in Israel in 2022 by Ben et al. showed that 46.7% of participants experienced tooth or gum pain during pregnancy and 22.6% of participants had a high DMF-T index score. This is believed to be related to the increased acidity levels in the oral cavity and increased carbohydrate intake during pregnancy[9]. Another study conducted by Davis et al. in 2021 on Caucasian women indicated a 20% risk increase in the DMF-T index during the postnatal period due to the consumption of sugary snacks and high-sugar foods during pregnancy. However, this risk decreased in women who consumed more fruits and vegetables[10]. Research related to oral health as well as the nutrient consumption pattern among pregnant women hast not been extensively conducted. Therefore, this research aims to determine the description of oral health condition and the intake of vitamin B12 and folic acid, along with their correlation in mothers of non-syndromic CL±P children.

MATERIALS AND METHODS

This quantitative correlational study utilized an observational cross-sectional design. The research was conducted at Yayasan Pembina Penderita Celah Bibir dan Langit-Langit (YPPCBL) in Bandung from April to June 2023. The study population consisted of mothers with children affected by non-syndromic CL±P who visited YPPCBL Bandung. The research sample was selected using a non-probability sampling technique known as purposive sampling. The total number of participants in this study was 38 individuals. The inclusion criteria were mothers with children aged 0-12 months affected by non-syndromic CL±P, willing to provide informed consent. The exclusion criteria were mothers with children affected by CL±P who had a family history of cleft lip and palate.

The instruments and materials used in this study included forms for oral health examination, the Semi Quantitative-Food Frequency Questionnaire (SQ-FFQ) interview form, informed consent form, a recorder, writing tools, personal protective equipment (masks, gloves, PPE, gown), a headlamp, a set of basic examination tools, a laptop, 70% alcohol, plastic cups, and antiseptic mouthwash.

The vitamin B12 and folic acid intake in the past two years was measured using an in-depth interview method through a Semi Quantitative-Food Frequency Questionnaire (SQ-FFQ), which had been previously used and standardized by previous researchers[11]. The pattern of vitamin B12 and folic acid intake was categorized as sufficient with an indicator of >80% of Recommended Dietary Allowance (RDA) and insufficient with an indicator of <80% of RDA, referring to the RDA according to PMK No. 28 of 2019[12],[13]. The measurement units used to assess the portion of intake for each food item were based on the Unit Reference Table (URT) as guided by the porsimetri book[14].

The oral health condition was measured through clinical examinations using the Decayed, Missing, Filled-Tooth (DMF-T) index as a measure of dental caries and the Eichner index to assess tooth loss, which were then processed into categorical data. The DMF-T index was categorized into three groups based on the index values: low category (scores 0-2), moderate category (scores 3-4), and high category (scores >4)[15]. Tooth loss was evaluated according to the posterior occlusal support area (POSA) based on the Eichner Index with index classifications A1, A2, A3, and B1, B2, B3. Classification of index A (1-2) stated as individu has four POSA and B1 (has three POSA), B2 has two POSA and B3 has one POSA[16]. The inter-examiner reliability in assessing the DMF-T index and tooth loss was measured using the kappa test[17] with a kappa value of 0.808 indicating a high level of agreement among the examiners.

Ethical approval for the research was obtained from the Research Ethics Committee of Padjadjaran University with the number 397/UN6.KEP/EC/2023. Data processing was conducted using NutriSurvey 2006 and Excel MegaStat. Statistical data analysis in this research utilized SPSS and Excel MegaStat. The correlations between the DMF-T index and vitamin B12 intake, the DMF-T index and folic acid intake, the posterior occlusal support area and vitamin B12 intake, as well as the posterior occlusal support area and folic acid intake were examined using bivariate analysis, specifically the Spearman rank test. The obtained and processed data were presented in tables along with descriptive explanations.

RESULT

To observe the inhibition of toothpaste, the diameter The study was conducted on mothers of children aged 0-12 months who had non-syndromic CL±P and were registered at YPPCBL Bandung, with a total sample size of 38 individuals. The distribution of research subjects based on age, occupation, and economic status is presented in the Table I.

Table I. Distribution of Research Subject Frequency Based on Age, Occupation, and Economic Status

Characteristics		Frequency (n=38)	Percentage (%)
Age	<20 years	4	10.5
	20-29 years	21	55.3
	30-39 years	12	31.6
	>39 years	1	2.6
Occupation	Housewife	36	94.7
	Teacher	2	5.3
Economic Status	Low (1.5)*	13	34.2
	Moderate (1.5-2.5)*	13	34.2
	High (2.5-3.5)*	8	21.1
	Very High (>3.5)*	4	10.5

*Average monthly income in million rupiahs based on Badan Pusat Statistik (BPS)

Table I shows the characteristics of the subjects based on age, occupation, and economic status. The majority of subjects were in the age group of 20-29 years, accounting for 55.3%. Most of the subjects worked as housewives, comprising 94.7% of the sample. Based on economic status, the majority fell into the low and moderate economic status groups, each consisting of 13 individuals (34.2%) for both categories.

The examination of oral health conditions was conducted using the DMF-T index and posterior occlusal support area assessment. Table II shows that the highest number of subjects falls under the high DMF-T index criteria, with 24 individuals (63.2%), and the average DMF-T index score for all subjects is 6.3 (high). The posterior occlusal support area in the subjects were most commonly found to meet the criteria of the Eichner index A1, A2, and A3 accounting for 63.2%. Table III shows that out of 38 subjects, 60.5% had a sufficient vitamin B12 intake according to the RDA, while 86.8% had an insufficient folic acid intake compared to RDA.

Table II. Distribution of Research Subject Frequency Based on Oral Health Conditions

Oral Health Conditions	Criteria	Frequency (n=38)	Percentage (%)
DMF-T Index	Low (0-2)	7	18.4
	Moderate (3-4)	7	18.4
	High (>4)	24	63.2
Posterior Occlusal Support Area	A1, A2, A3	24	63.2
	B1, B2, B3	14	36.8

DMF-T: decayed missing filled teeth

Table III. Distribution of Research Subject Frequency Based on Micronutrient Intake

Micronutrient Intake	Criteria	Frequency (n=38)	Percentage (%)
Vitamin B12	Sufficient	23	60.5
	Insufficient	15	39.5
Folic Acid	Sufficient	5	13.2
	Insufficient	33	86.8

The DMF-T index, posterior occlusal support area, vitamin B12 and folic acid intake were statistically analyzed using the Spearman rank test for correlation. Table IV shows the results of the Spearman rank correlation analysis. For the correlation between the DMF-T index and vitamin B12 intake, the p-value is 0.807 (>0.05). This indicates that there is no statistically significant correlation between the DMF-T index and the vitamin B12 intake. Similarly, for the correlation between the posterior occlusal support area and vitamin B12 intake, the p-value is 0.093 (>0.05). This also indicates that there is no statistically significant correlation between the posterior occlusal support area and vitamin B12 intake.

Table IV. Statistical Correlation Analysis Results

Variable	r	*p-value**
DMF-T & Vitamin B12	-0,041	0,847
Posterior Occlusal Support Area & Vitamin B12	-0,276	0,093
DMF-T & Folic Acid	-0,141	0,399
Posterior Occlusal Support Area & Folic Acid	0,187	0,261

DMFT: decayed missing filled teeth.
Spearman rank correlation analysis.
*α = 0,05.

The results of the Spearman rank correlation analysis regarding the correlation between the DMF-T index and folic acid intake show a value of p-value = 0.399 (>0.05). This indicates that there is no statistically significant correlation between the DMF-T index and the folic acid intake. The Spearman rank correlation analysis regarding the correlation between the posterior occlusal support area and the folic acid intake yielded a result of p-value = 0.261 (>0.05). This also indicates that there is no statistically significant correlation between the posterior occlusal support area and the folic acid intake.

DISCUSSION

The current study showed that the most of subjects have a high DMF-T index (Table II). A Research conducted in

Israel in 2022 showed that 22.6% of postnatal mothers had a high DMF-T index[9]. A high DMF-T index is caused by increased consumption of sweet foods during pregnancy, poor oral health habits such as incorrect brushing frequency and technique, lack of dental visits, and low awareness of the importance of maintaining oral health[18], [19]. These results is supported by another study conducted in Portugal in 2020, which found that women tend to experience enamel demineralization during pregnancy, marked by pre-cavitated caries lesions at risk of developing into cavitated lesions in the postnatal period if left untreated.[20]

The present study found that most subjects have Eichner indexes with A1, A2, and A3 classifications suggested that dental status in most of respondents in good condition cause still have four POSA. A study conducted on pregnant women in China in 2015 reported that 20% of pregnant women experienced tooth loss[21]. Surveillance data from the United States in 2010 stated that 21.2% of pregnant women had one or more missing teeth[22]. Tooth loss is influenced by various risk factors, such as periodontal tissue/periodontitis condition, hormones, dental caries, stress, oral health care habits, knowledge levels, and age[23], [24]. Tooth loss during pregnancy in this study is attributed to severe dental caries leading to radicular gangrene. Economic factors are believed to play a role in the subjects' decision-making regarding dental and oral health care. A low economic status may lead to a tendency to neglect the treatment of decayed teeth.[25]

In this study, the posterior occlusal support area were predominantly found in the classification categories of Eichner index A1, A2, and A3. The findings of this research are consistent with a study conducted by Tarigan et al. on pregnant women in Depok City, where 88.5% had posterior occlusal support area categorized as A1, A2, and A3 according to the Eichner index[26]. A study conducted in Brazil in 2015 showed that there were differences in factors related to tooth loss based on the position and number of missing teeth[24]. Good occlusal support in the posterior area in current study is though to be related to maternal age, because most were in the young adult age group. The risk of periodontitis increases with age. Periodontitis is an inflammation of the periodontal tissue that weakens the support of the teeth, leading to tooth loss[27]. However, the periodontal status was not examined in present study.

Meanwhile, the results of the study using SQ-FFQ showed that most of subjects had a sufficient intake of vitamin B12. Most of subjects routinely consumed eggs and milk as the main source of vitamin B12 because they are relatively easy to obtain, process, and consume. A small number chose meat occasionally. This is proven by data on adequate intake of vitamin B12. Subsequently, most of them had an insufficient intake of folic acid. The results is similar with a study conducted by Vivienne on mothers with CL±P children, which found that sufficient folic acid consumption could reduce the risk of CL±P by 0.97 times[28].

The low intake of vitamin B12 is influenced by several factors such as food preference based on taste, low socioeconomic status, and limited knowledge regarding the importance of consuming foods rich in essential micronutrients during pregnancy and postpartum periods[29], [30]. Additionally, the consumption of vitamin B12 as a supplement was not recorded in the present study[31]. Vitamin B12 is commonly found in animal-based food products such as meat, eggs, fish, milk, and other dairy products.[32]

The insufficient intake pattern of folic acid in the subjects is mainly influenced by food preferences and socioeconomic status. During pregnancy, some subjects experience loss of appetite and tend to prefer savory and sweet-tasting foods over vegetables, which are often perceived as bland [33], [34]. Some subjects also do not regularly consume fruits due to socioeconomic factors and their knowledge about nutritional content[34]. This study also revealed a significant difference in socioeconomic status between the group with insufficient folic acid intake and the group with sufficient intake. This finding in line with the research conducted by Enyew et al., indicating a positive relationship between socioeconomic status and micronutrient intake among pregnant women.[35]

Insufficient folic acid intake can also be influenced by food processing methods. The primary sources of folic acid consumed by most subjects are spinach, water spinach, tofu, and tempeh, often prepared through boiling and frying. High-temperature cooking processes such as frying and boiling can cause the loss of vitamins and minerals in food items. Excessive heating during frying can lead to the evaporation of water content in the food, causing folic acid to degrade, and folic acid is also sensitive to high temperatures during boiling, leading to its solubility in hot water. Prolonged cooking, prolonged storage, and continuous reheating of food can slowly deplete its folic acid content.[36]

Nausea and vomiting in early pregnancy can also affect the mother's nutritional intake. Research conducted in Nepal by Wallin showed that as many as 60.6% of pregnant women experienced nausea, vomiting, and loss of appetite during first trimester of pregnancy[37], [38]. In addition, embryogenesis in the maxillofacial part occurs in the fourth to twelfth week of pregnancy hence if the nutrition of pregnant women in the first trimester is not adequate, it can disrupt the embryogenesis process[39]. In this study, the experience of nausea and vomiting during pregnancy was not recorded.

An adequate intake of vitamin B12 and folic acid is required by women since the periconception period

for good fetal growth and development. Research by Jayarajan et al. in 2019 stated that consumption of high folic acid intake may play a role in reducing the risk of CL±P[40]. Another study conducted by Czeizel et al. in 2013 stated that folic acid supplementation since periconception can prevent the risk of neural tube defects and congenital abnormalities by 90%.[41] Adequate intake of vitamin B12 and folic acid has long-lasting effects until the postpartum period, suggesting that for lactating mothers, adequate intake during pregnancy is an effective way to improve vitamin B12 and folic acid intake.[42]

Table IV showed that the results of the Spearman rank test indicate no correlation between the DMF-T index and vitamin B12 and folic acid intake in current study. These findings are consistent with a study conducted by Sanders on adults, which stated that there was no correlation between the consumption patterns of vegetables, fruits, and meat with dental caries. This lack of correlation is attributed to poor dietary quality among most subjects due to socioeconomic factors.[43]

The absence of a correlation between the DMF-T index and vitamin B12 and folic acid intake due to other factors such as knowledge, height and weight, health status, and food processing methods, which were not examined in this study. Prolonged food processing can reduce the nutrient content in the food, resulting in lower nutrient intake received by the body[44]. A study by Pyo et al. on young adult women showed no difference in chewing activity based on the presence or absence of dental damage and fractures[45]. However, dental treatments for cavities can improve fruit and vegetable intake, ensuring optimal daily nutrient intake.

The statistical test results in Table 6 indicate that there is no correlation between the posterior occlusal support area and the intake of vitamin B12 and of folic acid. There have been no similar studies in pregnant women discussing these correlations. A study by Felicita et al. in 2016 showed no significant relationship between tooth loss and nutritional status in adults[46]. The study by Tarigan et al. in Depok showed a correlation between tooth loss and masticatory ability with macronutrient intake but did not explain its impact on micronutrients[26].

The absence of a correlation between the posterior occlusal support area and vitamin B12 and folic acid intake in this study is because the posterior occlusal support area alone cannot fully represent the masticatory process. Mastication is influenced by occlusal forces, tongue pressure, lip-tongue motor function, the number of functional teeth, and anthropometric measurements (body weight and height), while this study only focused on the aspect of functional teeth[47].

The mastication process affects the texture of food before digestion and the absorption of nutrients by the body. Food hardness decreases with better chewing cycles. The most influential factors in reducing food hardness are occlusal factors and saliva. Saliva contains mucin glycoproteins that function in bolus formation, providing viscosity, and cohesion to the food[48]. The speed and amount of chewing can also affect the size of food particles. One factor believed to influence chewing speed is the amount of saliva, which provides moisture to food particles for further digestion. Smaller food particles produced during chewing make it easier for digestive enzymes to work on the food substrate.[49]

CL±P are multifactorial congenital anomalies influenced by genetic, ethnic, socioeconomic status, and environmental factors such as nutritional deficiencies. Nutritional status is influenced by dietary habits. There are no recent studies that explain the relationship between dietary pattern and oral health with the incidence of CL±P. The study by Vujkovic suggested that inadequate micronutrient intake was experienced by mothers of CL±P children compared to mothers with children without CL±P. The use of dietary patterns to analyze the association of environmental factors risk of CL±P is recommended to be supported with biomarkers and control group subjects to improve the identification of potential risks[50]. The use of dietary patterns to analyze the association of environmental risk factors for CL±P and contributing needs to be explored by increasing the number of research subjects in further study.

The limitations of this study are that it was conducted in a single location, which means it cannot represent the entire population. The sampling process was time-dependent and limited, resulting in a relatively small sample size compared to the population size. The researchers did not include other factors that may influence vitamin B12 and folic acid intake, such as knowledge level, height and weight, health status, and food preferences. The data collection method on vitamin B12 and folic acid intake relied on the patient's memory, which may lead to recall bias. Suggestions for future research include using a case-control study design, conducting the research in multiple locations with a sample size that can represent the population size, adding other factors that influence the mastication process, including variables that can measure pain during mastication, and exploring other factors that affect the patterns of micronutrient intake of vitamin B12 and folic acid.

CONCLUSION

Based on the conducted research, the average DMF-T index in mothers with children aged 0-12 months with non-syndromic CL±P at YPPCBL is 6.3, and the majority of them have A1, A2, A3 posterior occlusal support area. About 60.5% have a sufficient intake of

vitamin B12 according to RDA, while 86.8% have an insufficient intake of folic acid according to RDA. There is no correlation between oral health conditions and the intake of vitamin B12 and folic acid in mothers with children aged 0-12 months with non-syndromic CL±P at YPPCBL, suggesting that oral health condition is unlikely to be an indirect risk factor for the occurrence of non-syndromic CL±P.

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