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The Relationship Between Oral Health Conditions of Pregnant Women with Accumulation of *Fusobacterium nucleatum* and the Risk of Low Birth Weight (LBW)

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ABSTRACT

Various physical and physiological changes occur during pregnancy. These changes occur as the body prepares for birth and fetal development. These changes can affect systems in the body that affect the physiology of body parts, including the oral cavity. The increased risk of tooth decay occurs as a result of fear of brushing teeth due to gum conditions that can be inflamed during pregnancy. This study aims to determine the accumulation of *Fusobacterium Nucleatum* bacteria in the oral cavity of pregnant women on the risk of LBW (Low Birth Weight). This type of study is a prospective observational analytical cohort conducted to determine the accumulation of *Fusobacterium Nucleatum* bacteria in the oral cavity of pregnant women on the incidence of low birth weight. Samples were taken using the accidental sampling method to obtain 12 pregnant women in their third trimester, who were then periodically examined for the condition of their oral cavity and a 20 ml saliva sample was taken during the last week of pre-partum check-up. There was no significant relationship between the accumulation of *Fusobacterium Nucleatum* bacteria in the saliva of pregnant women and the incidence of LBW babies ($P > 0.05$). This is because other factors contribute to the incidence of low birth weight (LBW), such as nutritional status, oral health practices, socioeconomic status, infectious diseases, and other external factors. In addition to prenatal checkups during each trimester, oral examinations are also essential. Plaque control and tartar cleaning are essential for pregnant women. Routine oral examinations are essential.

Keywords: Bacteria; oral cavity; pregnant women; low birth weight babies

Introduction

Various physical and physiological changes occur during pregnancy. These changes occur as the body prepares for birth and fetal development. These changes can affect systems within the body, affecting the physiology of various parts of the body, including the oral cavity. The increased risk of tooth decay occurs due to a fear of brushing teeth due to gum inflammation during pregnancy [1].

Changes in behavior or habits, such as neglecting oral hygiene, can also increase the risk of tooth decay. As a result, oral hygiene deteriorates, leading to tooth decay, bad breath, and other periodontal diseases such as gingivitis and periodontitis. In Indonesia, oral problems are found to be as high as 57.6%, while the proportion of people who practice proper brushing is only 2.8%. This indicates that the oral hygiene of most Indonesians, including pregnant women, still

requires special attention. Pregnant women often experience dental and oral problems during pregnancy, such as toothache and bleeding gums due to inflammation [2].

Hormonal changes, also occurring during pregnancy, can influence the gingiva's hyperresponsiveness to plaque, accompanied by vascular changes that make the gingiva more sensitive to bacteria and their products, thus increasing the risk of periodontal disease. This condition can be exacerbated by changes in diet and habits that neglect dental and oral hygiene [3].

Several studies have shown that hormonal changes affect the oral health of pregnant women by 60%, with gingival hyperplasia occurring in 10-27% of cases. Pregnancy-related gingivitis occurs in 60-75% of cases, caused by high levels of female sex hormones and often occurs without local irritants [2]. The prevalence of periodontal disease increases with gestational age, partly due to poor oral health [4]. Previous research has concluded that periodontitis can influence the occurrence of low birth weight (LBW) and prematurity. Offenbacher et al. (1996) stated that maternal periodontal disease is a significant risk factor for premature and low birth weight babies. Lack of knowledge and awareness among pregnant women about maintaining oral hygiene can be a trigger for gingival inflammation. Research from the Academy of General Dentistry also shows that pregnant women with oral health problems are 3-5 times more likely to give birth prematurely. Meanwhile, pregnant women with gingivitis have a higher risk of giving birth to premature babies with low birth weight, as is the case with periodontitis [1]. Babies born prematurely with low birth weight (LBW) have a 40-fold greater risk of death during the neonatal period than babies born with normal birth weight. Meanwhile, babies born with a history of low birth weight and who survive face higher health risks such as stunting, neurological disorders, respiratory disorders, and congenital disorders.

Various studies have demonstrated an association between periodontal disease in pregnant women and the occurrence of preterm birth and low birth weight (LBW) infants. Previous research has reported that periodontal disease is one of the risk factors for LBW and preterm delivery. Other studies have also suggested that the presence of periodontopathogenic bacteria, particularly *Fusobacterium nucleatum*, can trigger a systemic inflammatory response that may impair placental function and fetal growth. However, several recent studies have shown inconsistent results and indicate

that this association is influenced by various confounding factors, such as nutritional status, socioeconomic conditions, education level, and antenatal care history. Thus, there remains a research gap regarding the specific role of *Fusobacterium nucleatum* accumulation in the saliva of pregnant women in relation to the risk of LBW, particularly among pregnant populations in Indonesia [22]

Therefore, this study was conducted to analyze the relationship between the oral health condition of pregnant women, the accumulation of *Fusobacterium nucleatum*, and the risk of LBW as an effort to enrich scientific evidence in the fields of dental health and maternal health.

Methods

This study is a prospective, analytical, observational cohort study conducted to determine the association between the accumulation of *Fusobacterium Nucleatum* bacteria in the oral cavity of pregnant women and the incidence of low birth weight. The population involved in this study were third-trimester pregnant women who underwent antenatal check-ups at the Tamalanrea Community Health Center in Makassar City in September, October, and November 2024. Samples were collected using an accidental sampling method, resulting in 12 third-trimester pregnant women. These women underwent periodic oral examinations and 20 ml of saliva were collected during the last week of pre-partum check-ups. This limited sample size was due to several factors, including the reluctance of many pregnant women to have their teeth checked after the COVID-19 pandemic. Furthermore, some women no longer attended prenatal check-ups in the last week before delivery, and some even delivered elsewhere, making it difficult for researchers to obtain data. Other factors, such as discomfort during dental check-ups due to nausea, also contributed to the limited sample size. This study has received ethical approval from the Health Research Ethics Committee with Ethical Clearance Number 0814/M/KEPK-PTKMS/XII/2023. All participants were informed about the objectives and procedures of the study and provided their informed consent prior to participation.

Gingivitis screening is performed by directly examining the pregnant woman's oral cavity and using the Gingival Index (GI) to determine the degree of gingival inflammation (gingivitis). The GI calculation formula is as follows:

$$GI = \frac{\text{Total score}}{\text{Number of teeth examined}}$$

The GI clinical scores and criteria are as follows:

- 0 = good/no gingivitis
- 0.1–1.0 = mild gingivitis
- 1.1–2.0 = moderate gingivitis
- 2.1–3.0 = severe gingivitis.

These saliva samples were then taken to the Microbiology Laboratory at Hasanuddin University, Makassar, to be examined for the accumulation of *Fusobacterium nucleatum* bacteria. The instrument used was a checklist of pregnant women containing their names, ages, and the dates of their health center visits, as well as their babies' birth weight. The data obtained were then tabulated and statistically analyzed using a t-test to determine the relationship between *Fusobacterium nucleatum* accumulation and the incidence of low birth weight (LBW).

GI	Baby Birth Weight			
	<2.500	2.500-2.700	2.800-3.000	3.000-3.500
Very good	0	0	0	1
Mild gingivitis	0	1	0	3
Moderate gingivitis	0	0	2	1
Severe gingivitis	0	1	1	1
Total	0	2	4	6

Results

As mentioned above, this study involved 12 pregnant women. Saliva samples were taken and tested in the laboratory to determine the accumulation of *Fusobacterium nucleatum* bacteria in their oral cavities. In addition to bacterial accumulation, a Gingival Index (GI) test was also performed to assess the severity of gingivitis.

Table 1. Distribution of Gingival Index Values of Pregnant Women's Samples Against Birth Weight of Babies at Tamalanrea Jaya Community Health Center

Table 1 shows that no babies were born weighing less than 2,500 grams. Meanwhile, only 6 babies were born weighing 3,000-3,500 grams. The results of the Gingival Index examination can be seen in Table 1. Mothers with a very good Gingival Index gave birth to babies weighing 3,000-3,500 grams. Furthermore, there was one pregnant woman with a severe Gingival Index who gave birth to a

baby weighing 2,500-2,700 grams, and one pregnant woman gave birth to a baby weighing 2,800-3,000 grams.

Table 2 Distribution of the Number of Fusobacterium Nucleatum Bacteria in the Saliva of Pregnant Women Against the Birth Weight of Babies

NUM BER.	NAME	INTERPRETATION	CFU <2500 gr	BABY WEIGHT			
				<2500 gr	2.500-2.700 gr	2.800-3.000 gr	3000-3500 gr
1	A	<i>Fusobacterium Nucleatum</i>	170 Cfu	0	2,6	0	0
2	B	0	0	0	0	0	3,1
3	C	0	0	0	0	2,9	0
4	D	0	0	0	0	2,9	
5	E	0	0	0	0	0	3,2
6	F	0	0	0	0	0	3,5
7	G	0	0	0	0	2,8	0
8	H	<i>Fusobacterium Nucleatum</i>	167 Cfu	0	0	0	3,3
9	I	<i>Fusobacterium Nucleatum</i>	156 Cfu	0	0	0	3,3
10	J	<i>Fusobacterium spesies aquatile</i>	130 Cfu	0	0	0	3,2
11	K	<i>Fusobacterium Nucleatum -</i>	185 Cfu	0	2,6	0	0
12	L	<i>Fusobacterium Nucleatum</i>	165 Cfu	0	0	2,8	0

The distribution of the presence of *Fusobacterium Nucleatum* bacteria from the 12 saliva samples examined can be seen in Table 2. The mother who gave birth to a baby weighing 2600g was seen to have the highest accumulation value of *Fusobacterium Nucleatum* bacteria, namely 185 Cfu. Meanwhile, the mother with the lowest accumulation value of *Fusobacterium Nucleatum* bacteria gave birth to a baby weighing 3200g. There were 5 pregnant women in whom no accumulation of *Fusobacterium Nucleatum* bacteria was found in their saliva samples, even though their babies weighed only around 2800-2900g. The mother who gave birth to a baby weighing 300-3500g was also found to have accumulation of *Fusobacterium Nucleatum* bacteria in her oral cavity.

Table 3 Distribution of the Presence of Fusobacterium Nucleatum Bacteria in the Oral Cavity of Pregnant Women in Relation to the Weight of Babies Born (LBW)

NO	BABY WEIGHT	BACTERIA	
		YES	NO
1	2.500	0	0
2	2.500-2.700	2	0
3	2.800-3.000	1	0
4	3.000-3.500	3	0
TOTAL		6	0

Table 3 shows that no mothers gave birth to babies weighing <2,500 grams despite the presence of bacterial accumulation in their mouths. *Fusobacterium nucleatum* was only found in saliva samples from pregnant women who gave birth to babies weighing 2,500-2,700 grams and 3,000-3,500 grams.

The results of the analysis test of the presence of *fusobacterium nucleatum* bacteria in the oral cavity of pregnant women on the incidence of LBW can be seen in table 4. The average birth weight value in conditions where bacteria are present is 2,920g with a standard deviation of 0.356, while the average birth weight value in conditions where there are no bacteria is 3,086g with a standard deviation of 0.241. This shows that the average birth weight value in conditions where there are bacteria is smaller than in conditions where there are no bacteria. The results of the comparison test show a p-value of 0.356 which is greater than 0.05 (p-value > 0.05), this indicates that there is no direct relationship between the conditions where there are bacteria and the incidence of LBW (Low Birth Weight).

Table 4 Relationship between *Fusobacterium nucleatum* bacteria in the oral cavity of pregnant women and the incidence of LBW

	Bacteria	N	Mean	Std. Deviation	p-value
BBLR	Ada	5	2.920	0.356	0.356
	Tidak ada	7	3.086	0.241	

Independent T-test, *significant (p<0.05)

Discussion

Based on saliva samples examined on 12 pregnant women in their third trimester at the Tamalanrea Jaya Community Health Center, only six women were found to have *Fusobacterium Nucleatum* bacteria in their saliva. *Fusobacterium*

Nucleatum is a species found in the oral cavity. This species and subspecies are often identified in amniotic fluid and are frequently found in the subgingival region of healthy individuals and those with periodontal disease [2].

Periodontal disease during pregnancy can lead to preterm birth, with or without low birth weight (LBW). The mechanism of preterm birth, with or without low birth weight, begins with bacteremia caused by gingival bleeding. This leads to the transfer of bacteria and their products, such as lipopolysaccharide (LPS), and the activation of inflammatory mediators from the oral cavity to the uterus. Lipopolysaccharide produced by bacteria triggers the release of immune modulators such as IL-1 α , IL-1 β , and PGE2. Bacteria and their products circulate in the bloodstream and penetrate the placental barrier, triggering preterm birth due to impaired cytokine function, which regulates uterine contractions and nutrient distribution to the fetus [6]

This study showed no significant association between pregnant women with *Fusobacterium Nucleatum* bacteria in the oral cavity and the incidence of low birth weight (LBW). Results obtained by other researchers are in line with the researcher [8] who stated that there is no significant association between periodontal disease and premature birth with low birth weight. Studies on periodontal disease and the incidence of low birth weight are still pro and con due to several factors that also play a role in the incidence of low birth weight. There are several factors underlying the differences in each study, including risk factors such as low socio-economic status, education, ethnicity, nutritional status, attitudes and behavior, and systemic diseases are also responsible for the birth of babies with low birth weight which also influence the results of the study [10][12]

This *Fusobacterium* also occupies other organs besides the oral cavity, such as the intestines and female genital tract, lungs, and has been found in pelvic bone abscesses [9]. Clinically, this *Fusobacterium* bacteria is often found in the oral cavity, namely in periodontal pockets and normal crevicular gingiva. *Fusobacterium* has several species and is identified in different habitats, *Fusobacterium nucleatum* subspecies *Polymorphum* is found in good crevicular gingiva, *Fusobacterium Nucleatum* subspecies in periodontal pockets and *Fusobacterium nucleatum* subspecies *vincentii* is usually found in internal body infections, However, research by Fyvie et al found *Fusobacterium* bacteria species *Polymorphum*, *nucleatum*, *vincentii* in

supragingival and subgingival plaque but the number is very small compared to the bacterial habitat [12]

Lindawati's research also states that the growth of *Fusobacterium Nucleatum* bacteria is in a CO₂ environment of 7.91 ± 0.05 CFU / ml. and in the same environment with 10% oxygen, the growth is 8.52 ± 0.06 CFU / ml, while at 20% oxygen levels, it can still grow 7.76 ± 0.16 CFU / ml. Without CO₂ gas in the growing environment, anaerobically, *Fusobacterium Nucleatum* bacteria can grow $7.98 \pm 0.18\%$ CFU / ml. At 10% oxygen levels, the growth is 8.52 ± 0.12 CFU / ml. while at 20% oxygen levels, *Fusobacterium Nucleatum* can still grow although with less growth, namely 7.36 ± 0.31 CFU / ml. *Fusobacterium Nucleatum* bacteria can be cultured from supragingival plaque and subgingival plaque by direct counting (cell counting) or by DNA identification [20]

Laboratory tests also found *Fusobacterium* bacteria with the Aquatile species. Further tests on the number of bacteria in the saliva of pregnant women showed varying results. This difference in results occurs due to the varying conditions of the pregnant women studied, one of which can be due to hormonal imbalances that cause gum inflammation by suppressing the function of T lymphocytes as a gingival defense mechanism, making the gingiva more susceptible to inflammation [1][16]. According to Offenbacher, periodontal disease is a risk factor for preterm low birth weight (LBW). The gingivitis status of mothers with periodontal disease is higher in giving birth to LBW babies than giving birth to normal babies. This is because the inflammatory response occurs due to infection or bacteria through systemic spread, an increase in inflammatory mediators that cause birth that begins with symptoms of cervical dilation or dilation, rupture of membranes, and uterine contractions. This is different from Noack B's research which concluded that periodontal disease suffered by pregnant women is not the cause of LBW [6][19]

Various other researchers' views state that there is no relationship between pregnant women suffering from periodontal disease and the birth of low birth weight babies (LBW). Researchers mention the possibility of confounding factor analysis of the level of education of pregnant women, history of antenatal care and socioeconomic status, but pregnant women who were respondents in the study routinely checked their pregnancy (> 4 times during pregnancy). seen in terms of how to maintain dental hygiene and

carry out routine plaque control which makes the number of bacterial growth vary which causes problems in periodontal tissue [11][14]

The influence of periodontal tissue has not been determined, due to various factors such as gestational age, pregnant women who are still relatively young and the occurrence of preeclampsia during pregnancy, obesity before pregnancy. Although periodontal treatment carried out by pregnant women to prevent LBW is still pro-contra, then research conducted by Pirie et al in an RCT in Northern Ireland concluded that non-surgical periodontal treatment does not reduce the risk of LBW and premature babies, but treatment for periodontal tissue or periodontal tissue therapy must be carried out by controlling plaque followed by cleaning plaque both supragingival and subgingival, carrying out debridement of the tooth root using additional chemical agents [7][18]

Furthermore, providing adequate health education regarding low birth weight (LBW) for pregnant women is crucial. This includes monitoring, calculating, and preparing health measures (antenatal care), and monitoring the condition of babies who have experienced intrauterine growth retardation [13]. The study concluded that there was no significant association between the presence of *Fusobacterium nucleatum* bacteria in the oral cavity of pregnant women and the risk of low birth weight (LBW).

Conclusion

There was no significant association between the accumulation of *Fusobacterium nucleatum* in the saliva of pregnant women and the incidence of low birth weight (LBW) ($p > 0.05$). The findings indicate that LBW is likely influenced by multiple factors beyond the presence of *Fusobacterium nucleatum* in the oral cavity. Maintaining oral health during pregnancy remains important to prevent periodontal disease and support maternal health

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