Association between betel nut (*Areca catechu* L.) consumption and hemoglobin levels and mid-upper arm circumference in pregnant women in Jayapura Regency, Papua

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Abstract. Anemia is a serious global public health problem that affects pregnant and postpartum women, where the number of red blood cells or hemoglobin concentration is lower than the normal levels. Betel nuts contain high levels of bioactive compounds including alkaloids and polyphenols which are believed to inhibit the absorption of nutrients including iron in the digestive tract. This research analyzes the correlation between betel nuts consumption, Hb levels, and MUAC. This research was conducted on 100 pregnant women using purposive sampling in three health center service areas within Jayapura Regency. Data on betel nut consumption was collected by questionnaire, Hb levels by Hemoglobinmeter, and MUAC by MUAC measuring tape. Data were analyzed using the Pearson correlation. This study's results show a significant negative association between the eating of betel nuts and hemoglobin levels (r=-0.359; p=0.001). Betel nut consumption is not significantly negatively correlated with MUAC (r=-0.022; p=0.830). It is recommended that pregnant women limit their consumption of betel nuts during pregnancy.

1 Introduction

Anemia is a significant global public health problem affecting young children, adolescent girls, menstruating women, and pregnant and postpartum women. It is characterized by a lower-than-normal number of red blood cells or hemoglobin concentration [1]. Currently, anemia affects 37% of pregnant women and 30% of non-pregnant women aged 15–49 worldwide. Despite being a Global Nutrition Target set by the World Health Assembly (WHA) and an important marker of progress towards the Sustainable Development Goals, the global anemia prevalence has shown minimal improvement over the past decade [2].

An estimated 1/3 of the world's population suffers from anemia [3]. Globally, half a billion women aged 15–49 years and 269 million children aged 6–59 months were anemic. In 2019, approximately 30-37% of pregnant and non-pregnant women in this age group were anemic. The African and South-East Asian regions have the highest prevalence in anemia in the world. In Africa, 106 million women and 103 million children were anemic, while in South-East Asia, 244 million women and 83 million children were anemic [4].

According to Riset Kesehatan Dasar (Riskesdas), the proportion of anemia among pregnant women in Indonesia increased from 37.1% in 2013 to 48.9% in 2018, with the highest incidence observed in pregnant women in the 15-24 age group at 84.6% [5, 6]. Data from the Papua Health Service Profile (2021) show that the prevalence of anemia in women of childbearing age in Papua Province was 46% in 2018, 38.6% in 2019, 34% in 2020. In Jayapura Regency, the prevalence of anemia remains high at 31.03%. The persistently high prevalence of anemia in Papua Province continues to pose a serious health problem for women of childbearing age [7].

Jayapura Regency is home to a diverse population comprising 10 tribes and 22 sub-tribes, along with numerous immigrant groups from other regions of Papua and beyond, including Wamena, Sorong, Serui, Biak, Paniai, Merauke, and others. Chewing betel nut is a long-standing cultural tradition in Papua, passed down through generations in Papua [8]. The betel nut or areca nut is the fruit of the areca nut tree (*Areca catechu*), encased in a hard shell that must be removed to access the seed, typically pink in colour. Known for its unique bitter and spicy taste, betel nut is often chewed with betel leaves and lime, a traditional practice common in many cultures around the world, especially in Southeast Asia and parts of Indonesia [9]. Betel nuts are highly popular and widely sold [10]. In Papua, chewing betel nuts is a traditional practice enjoyed like candy by people of all ages, genders, and social statuses [11].

The majority of betel nut chewers experience changes in the oral mucosa, ranging from reddish brown to blackish brown, accompanied by wrinkled texture, striped mucosa, papules, and slight tongue pigmentation [12]. Several studies show that consumption of betel nut increases gingival inflammation, suppresses the immune response, affects osteoblasts and is cytotoxic to periodontal fibroblasts [13]. Frequent and intense chewing of betel nut, especially in certain combinations, can cause dental issues such as calculus buildup, periodontitis, attrition, and tooth loss [14]. These oral health problems may affect appetite and the risk of infections during pregnancy, ultimately impacting their nutritional status.

Various bioactive compounds have been identified in areca nut, including alkaloids, polyphenols, polysaccharides, and fatty acids, which exhibit a variety of bioactive functions, such as antibacterial, antiparasitic, antiviral, antioxidant, anti-inflammatory, and antitumor effects [15] High levels of catechin, arginine, and phenylalanine are found in the betel nut kernel, while the betel nut skin contains high levels of 32 arginine, arecoline, and aminobutyric acid [16]. These compounds can inhibit the absorption of nutrients including iron in the small intestine [17, 18]. This study aims to determine the correlation between betel nut consumption, with Hb levels and the MUAC of pregnant women in Jayapura Regency.

2 Materials and methods

This quantitative study employed a cross-sectional design, and was conducted in the three health centers working areas of Jayapura Regency, Papua Province. The research took place from May 2023 to July 2023 in Harapan Primary Health Center, Sentani Primary Health Center, and Waibhu Primary Health Center which is representative of Jayapura Regency. The total sample of 100 pregnant women was calculated using Slovin's Formula. Sample were selected using a purposive sampling method with following inclusion criteria: not suffering from specific illness, not taking medication for particular diseases, and not consuming herbal medicines.

Betel nut consumption served as the independent variable in this study, while the dependent variables were hemoglobin level and mid-upper arm circumference (MUAC). The characteristics of respondents including age, education level, occupational status, and parity were collected using questionnaires. Hemoglobin levels data were measured using a hemoglobin meter, while mid-upper arm circumference was assessed with MUAC measuring

tape. Betel nut consumption was collected using questionnaire with a scoring system: Never = 1; Rare = 2; Sometimes = 3; Often = 4; and Always = 5. Data were analyzed using the Pearson correlation test in IBM SPSS Statistics 27. This study received ethical approval from the Health Research Ethics Committee of the Public Health Faculty, Cenderawasih University, under the ethical approval letter number: 121/KEPK-FKMUC/2023.

3 Results and discussion

Table 1. Characteristics of subjects

Characteristics	**n**	**%**
Total subject	100	100
Age		
<20 years old	6	6
20-35 years old	44	44
≥35 years old	50	50
Pregnancy distance		
First pregnancy	32	32
<2 years	13	13
≥2 years	46	46
Parity		
0	41	41
1-4	53	53
>4	6	6
Education level		
Low education (≤ Middle High School)	13	13
High education (≥ Senior High School)	87	87
Occupation		
Not having a job (inside and/or outside the home and not generating income)	67	67
Have a job (> 8 hours inside and/or outside the home that generates income)	33	33
Body mass index		
Normal	54	54
Underweight	17	17
Overweight	29	29
MUAC		
<3.5 cm	17	17
≥23.5 cm	83	83
Hb Levels		
<11 g/dL	44	44
≥11 g/dL	56	56
Betel nut consumption		
Never	56	56
Rare	1	1
Sometimes	5	5
Often	3	3
Always	35	35

Table 1 shows that among the 100 participants in this study, the majority of pregnant women were aged ≥ 35 years, had a pregnancy interval of ≥ 2 years, and a parity range of 1 to 4. Most participants had a high level of education and were unemployed. The nutritional status of pregnant women, as assessed by body mass index, revealed that 17% were underweight. Similarly, 17% were identified as being at risk of chronic energy deficiency

based on MUAC. According to the 2023 Indonesian Health Survey (SKI), 10% of pregnant women in Papua had an upper arm circumference <23 cm [19].

More than half of the participants in this study (56%) had normal hemoglobin (Hb) levels, and 55.2% of subjects did not consume betel nuts. Almost half of subjects (44%) had anemia (with hemoglobin levels <11 mg/dL), while data from the Public Health Office of Jayapura Regency showed that 31.04% of pregnant women in Jayapura Regency were anemic [7]. Our findings show a higher percentage compared to national figures, as the 2023 SKI reported that 27.7% of pregnant women in Indonesia had anemia [19].

Table 2. Correlation between Betel nut consumption with Hb levels and MUAC[1]

Variable	**Hb Levels**		**MUAC**	
	r	p-value	r	p-value
Betel nut consumption	-0.359	0.001*	-0.022	0.830

[1]Pearson Test, $\rho < 0.01$

The findings of this study (Table 2) showed a significant moderate negative correlation (r=-0.359) between Betel nut consumption and hemoglobin (Hb) levels in pregnant women (p value=0.001). Pregnant women who frequently consume Betel nuts tend to experience anemia [20]. As the score for Betel nut consumption increases in pregnant women, their Hb levels generally decrease. Phenolic compounds, such as tannins, found in Betel nuts can interfere with nutrient absorption in these women [21, 22]. Increased tannin intake is associated with increased serum transferrin receptor levels and lower hemoglobin levels [23]. Although tannins inhibit iron absorption, they do not cause severe iron deficiency anemia. The impact of tannins on iron absorption is dose-dependent, and moderate consumption does not lead to anemia [24].

During pregnancy, Hb levels may decrease at every stage of pregnancy due to physiological conditions. Maternal blood and plasma volume increase, while iron bioavailability decreases, which can lead to a reduction in hemoglobin concentration [25]. Consumption of iron and betel nuts before pregnancy affects Hb levels during pregnancy. Therefore, further research is needed to explore the impact of betel nut consumption among adolescent girls and women of childbearing age on the outcome of their pregnancy.

The results showed that betel nut consumption behavior did not show a significant correlation with Upper Arm Circumference (MUAC), as indicated by a p-value=0.830 and a very weak negative correlation coefficient r=-0.022. This indicates that the amount of betel nut consumed did not significantly affect the nutritional status of participants, as measured by MUAC. A different study shows that higher betel nut consumption was associated with increased body mass index (BMI) and waist circumference, suggesting that the betel nut consumption may contribute to adverse impact on body composition and obesity risk [26]. This contrasts with our findings, which showed no significant correlation between areca nut consumption and nutritional status based on MUAC in pregnant women. This discrepancy may be attributed to demographic factors such as age and gender

Recent studies have shown that betel nut chewing significantly increases the risk of metabolic syndrome, including central obesity, hypertension and dyslipidemia among Taiwanese residents [27]. In our study, betel nut consumption did not appear to directly affect nutritional status as measured by MUAC. MUAC is a reliable indicator of muscle mass and nutritional status. The lack of a significant relationship implies that consumption of betel nut alone does not significantly improve nutritional status. Other dietary or lifestyle factors may have a greater impact on increasing nutritional status.

4 Conclusion

In conclusion, this study found a significant negative association between the eating of betel nuts and hemoglobin levels (r=-0.359; p=0.001). However, no significant correlation was observed between betel nut consumption and MUAC (r=-0.022; p=0.830). It is recommended for pregnant women in Jayapura Regency to limit their consumption of betel nuts during pregnancy.

References

1. WHO. Call for expression of interest – Consultant: Anemia. In: WHO. Available from: https://www.who.int/health-topics/anaemia#tab=tab_1. (2023)
2. WHO. WHO Global Anemia. (2024)
3. Rati Astuti (2023) Literature Review: Factors Causes Anemia In Adolescent Women
4. WHO. Anemia. Available from: https://www.who.int/news-room/fact-sheets/detail/anaemia. (2023)
5. Riskesdas. Riset Kesehatan Dasar 2013. (2013)
6. Riskesdas. Riset Kesehatan Dasar 2018. (2018)
7. Dinkes Prov Papua. Profil Dinas Kesehatan Provinsi Papua. (2021)
8. Indonesia Kaya, "Mengenal Pinang Permen Masyarakat," Indonesia Kaya.
9. N.S. Fakdawer, B. Yoseb, M. Walilo, Identifikasi sumber dan dampak buah pinang dalam budaya papua (studi kasus pedagang pinang di pasar youtefa Kota Jayapura). KRITIS. **32**, 164–175 (2023). https://doi.org/https://doi.org/10.24246/kritis.v32i2p164-175
10. M.S. Rumeten, T.N. Lina, R. Paknawan, Penerapan metode simpleks untuk menghasilkan keuntungan maksimum pada penjual buah pinang. J. Dedication Papua Com. **2**, 75–86. https://doi.org/https://doi.org/10.34124/jpkm.v2i1.17 (2019)
11. R.V. Kamisorei, S.R. Devy, Gambaran kepercayaan tentang khasiat menyirih pada masyarakat papua di Kelurahan Ardipura Distrik Jayapura Selatan Kota Jayapura. Jurnal Promkes: The Indonesian J. Health Prom. Health Edu. **5**, 232–244 (2017). https://doi.org/https://doi.org/10.20473/jpk.V5.I2.2017.232-244
12. S. Pintauli, M. Nainggolan, Betel nut chewing practice and oral health impact in karo batak women of sumatera utara province, in: Prosiding Forsila IV FKG UNISSULA. Fakultas Kedokteran Gigi Universitas Sultan Agung (2021)
13. C. Ngadilah, A. Leu Obi, M.O. Nubatons MO, The relationship of pregnant woman who consume betel nut to periodontal disease which will affect pregnancy outcome. Jurnal Ilmiah Permas: Jurnal Ilmiah STIKES Kendal. **12**, 157–164 (2022). https://journal2.stikeskendal.ac.id/index.php/PSKM/article/view/124.
14. S.M. Alaydrus, M.D. Artaria, Y.F. Chen, The impact of chewing betel nuts on human dentition in Indonesia: A literature review. Dent J. **56**, 273–279 (2023). https://doi.org/10.20473/J.DJMKG.V56.I4.P273-279
15. H. Sun et al., Bioactive components of areca nut: an overview of their positive impacts targeting different organs. Nutrients. **16**, 5 (2024). https://doi.org/10.3390/nu16050695
16. Y. Yang et al., UPLC–MS/MS and network pharmacology-based analysis of bioactive anti-depression compounds in betel nut. Drug Des Devel Ther **15**, 4827–4836 (2021). https://doi.org/10.2147/DDDT.S335312

17. M.S. Swallah et al., The impact of polyphenol on general nutrient metabolism in the monogastric gastrointestinal tract. J Food Qual. **2020** 5952834 (2020). https://doi.org/10.1155/2020/5952834
18. Q. Ma, E.Y. Kim, E.A. Lindsay, O. Han O, Bioactive dietary polyphenols inhibit heme iron absorption in a dose-dependent manner in human intestinal caco-2 cells. J Food Sci. **76**, 5 (2011). https://doi.org/10.1111/j.1750-3841.2011.02184.x
19. Tim Penyusun SKI 2023 Dalam Angka. Survei Kesehatan Indonesia 2023 Dalam Angka. (2023)
20. K.k. Sznajder, M.k. Shenk, N. Alam et al., Betel quid use is associated with anemia among both men and women in Matlab, Bangladesh. PLOS Global Public Health. **3**, 6. (2023). https://doi.org/10.1371/journal.pgph.0001677
21. N.M. Delimont, M.D. Haub, B.L. Lindshield, The impact of tannin consumption on iron bioavailability and status: A narrative review. Curr Dev Nutr **1**, 1–12 (2017). https://doi.org/10.3945/cdn.116.000042
22. A.C. Sitanggang. Optimasi ekstraksi tanin dari biji pinang sirih (Areca catechu l.) dengan metode microwave assisted extraction (mae) sebagai teknologi alternatif (Kajian Konsentrasi Pelarut Dan Lama Ekstraksi), Thesis, Universitas Brawijaya. (2021)
23. L. Mani, S. Fatimah-Muis, A. Kartini, The correlation of intake phytate and tannin on serum transferrin receptor and hemoglobin in stunted overweight adolescents. Potravinarstvo Slovak J. Food Sci. **13**, 870–874 (2019). https://doi.org/10.5219/1191
24. K. Afsana, K Shiga, S. Ishizuka, H. Hara, Reducing effect of ingesting tannic acid on the absorption of iron, but not of zinc, copper and manganese by rats. Biosci Biotechnol Biochem **68**, 584–592 (2004). https://doi.org/10.1271/bbb.68.584
25. M. Sun, T. Gu, T. Wu et al., Variation patterns of hemoglobin levels by gestational age during pregnancy: a cross-sectional analysis of a multi-center retrospective cohort study in China. Nutrients. **15,** 6 (2023). https://doi.org/10.3390/nu15061383
26. W.Y. Lin, F.X. Pi-Sunyer, C.S. Liu et al., Betel nut chewing is strongly associated with general and central obesity in chinese male middle-aged adults. Obesity. **17**, 1247–1254 (2009). https://doi.org/10.1038/oby.2009.38
27. Y.C. Huang, J.H. Geng, P.Y. Wu et al., Betel nut chewing increases the risk of metabolic syndrome and its components in a large Taiwanese population follow-up study category: original investigation. Nutrients. **14**, 5 (2022). https://doi.org/10.3390/nu14051018