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# NUTRITIONAL STATUS AND IRON INTAKE ARE NOT ASSOCIATED WITH BREAST MILK IRON LEVELS IN BREASTFEEDING MOTHERS WITH 0-6 MONTHS OLD BABY IN SELUMA REGENCY

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**Abstract:** Exclusive breastfeeding can reduce the risk of anemia in infants, even though the iron content in breast milk is low, the absorption rate of iron is quite high. The nutritional content of breast milk can be influenced by the mother's diet and nutritional status. This study aims to determine the relationship between nutritional status and iron intake with breast milk iron levels in breastfeeding mothers of infants aged 0-6 months. This study was an analytic observational study with a cross-sectional approach conducted in Seluma Regency. The population in this study were all breastfeeding mothers of infants aged 0-6 months. A total of 78 people were taken with the purposive sampling technique. Nutritional status was obtained by measuring height and weight and calculated by the Body Mass Index formula. Iron intake was measured using the Semi-Quantitative Food Frequency Questionnaire method for the last 1 month, while the measurement of breast milk iron levels was carried out by the spectrophotometric method. Data on characteristics were obtained using a questionnaire. Furthermore, the data were analyzed univariately and bivariately. Nutritional status measurements showed that 87.2% of breastfeeding mothers had normal nutritional status. Iron intake data showed that 82.1% of breastfeeding mothers had low iron intake and the results of measuring Fe levels in breast milk showed that only 16.6% had low breast milk iron levels . The results showed that there was no significant relationship between nutritional status with Fe levels in breast milk (p=0.762>0.05) and iron intake with Fe levels in breast milk (p=0.291). Nutritional status and iron intake are not associated with breast milk iron levels in breastfeeding mothers of 0-6 months old baby. Monitoring maternal health since pregnancy is necessary to obtain adequate breast milk in quality and quantity.

**Keywords:** nutritional status, iron intake, breast milk iron levels

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## Introduction

Children's nutritional needs can be met by exclusive breastfeeding and can ensure the health and survival of children. Breast milk is the most perfect food intake to fulfill the nutrients needed by babies to support their growth and development. This is because breast milk is safe and contains antibodies that help protect against sickness in children and newborns, it is widely acknowledged as the ideal nourishment source for kids. Breast milk is said to be the best meal for babies throughout the first six months of their lives(Eidelman Al, 2012). However, 2 out of 3 infants in the world are not exclusively breastfed for six months, which has been the case for two periods (WHO, 2022).

Exclusive breastfeeding has high levels of iron absorption (Domellof et al., 2014). Exclusive breastfeeding can prevent the risk of anemia in children. Maternal iron consumption during pregnancy might affect an infant's optimal and intense physical development and growth, as well as their emotional and intellectual development. For this reason, moms should attempt to boost the quantity and quality of iron in their breast milk (Lozoff et al., 2013).

A mother's nutritional state is one of the elements that can affect the amount and quality of breast milk that she produces. The nutritional status of mothers who are in the normal category has sufficient nutrient stores. This can help the milk production process smoothly and also the nutritional content of breast milk is sufficient (Bzikowska et.al., 2018). Iron is one of the nutrients that nursing moms require. The heme component of hemoglobin, which is a component of blood and transports oxygen from the lungs to every area of the body as well as carbon dioxide from body tissues back to the lungs, is formed by iron. Myoglobin, which aids in the storage of oxygen, different enzymes, and other body tissues by muscles, also contains iron. Hemosidin, which is found in bodily tissues, ferritin, which is found in the liver, and blood are the three places where iron is deposite (Reddy et al., 2006)

The need for iron intake in breastfeeding mothers is greater than that of pregnant women because babies less than six months of age only get nutritional intake, especially iron, from breast milk. According to Jura, et al. (2021) maternal diet affects iron levels in breast milk of nursing mothers. Insufficient maternal iron intake can result in insufficient iron intake in infants and have an impact on the incidence of iron deficiency anemia in infants (Dumrongwongsiri et.al., 2015). On the contrary, a study finding has shown that maternal anemia did not affect breast milk iron concentration during early lactation (Zavaleta et.al.,1995). Few studies have reported that with maternal anemia, breastfed infants may become iron deficient (WHO, 2001).This study aims to analyze the relationship between

nutritional status and iron intake with breast milk iron levels in breastfeeding mothers of infants aged 0-6 months.

## Materials and Methods

This study used a cross-sectional methodology and was an analytical observational study. Four of Seluma Regency's operational areas: Tais City Health Center, Masmambang Health Center, Talang Tinggi Health Center, and Rimbo Kedui Health Center were used for the research. The sample in this study were breastfeeding mothers of 0-6 months old infants who were taken with purposive sampling technique totaling 78 samples. Nutritional status was measured based on height and weight and calculated using the Body Mass Index (BMI) formula, and were categorized into thin (BMI <18.5 kg/m²), normal (BMI 18.5-25.0 kg/m²) and obese (BMI>25.0) (Ministry of Health of the Republic of Indonesia, 2019).

Iron intake was obtained by conducting a Semi-FFQ (Semi Quantitative Food Frequency Quotionaire) interview in the last 1 month, and categorized into adequate (80-110%) and deficient (<80%). (AKG, 2019). Measurement of breast milk iron level was done by spectrophotometric method using iron kit (Cat.No.10230; Human Germany). Furthermore, breast milk iron levels were grouped into 2 groups, which were the low category if the value (<27 μ/dL) and the normal category if the value (≥27 μ/dL). Data on the characteristics of breastfeeding mothers including age, occupation, education and economic status were obtained through questionnaires. The data were analyzed univariately and bivariately. The Faculty of Public Health's Health Research Ethics Commission has granted ethical permission for this study under Certificate No. 0152/UN9.FKM/TU.SB5/2023.

## Results and Discussion

*Table 1: Characteristics of breastfeeding mothers in Seluma Regency*

| Characteristic | Frequency | % |
|---|---|---|
| Age | | |
| <20 | 8 | 10.3 |
| ≥20-35 | 63 | 80.8 |
| ≥35 | 7 | 9 |
| Jobs | | |
| Unemployed | 69 | 88.5 |
| Employed | 9 | 11.5 |
| Education* | | |
| Low | 22 | 28.2 |

| | | |
|---|---|---|
| High | 56 | 71.8 |
| Economic Status¥ | | |
| Low | 57 | 73.1 |
| High | 21 | 26.9 |
| Total | 78 | 100% |

*Education: Low if no school, elementary school and junior high school and high if high school and college

¥Economic status: low if receiving regional minimum pay and high if receiving equal to or greater than regional minimum pay

The characteristic data (Table 1) showed that the majority (80.8%) of breastfeeding mothers were in the age range ≥25-35 years and most (88.5%) breastfeeding mothers is unemployed. Based on the level of education, 28.2% of mothers had low education and most (73.1%) breastfeeding mothers had low economic status.

*Table 2: Nutritional status of breastfeeding mothers in Seluma Regency*

| Nutrition Status | Frequency | % |
|---|---|---|
| Skinny | 10 | 12.8 |
| Normal | 68 | 87.2 |
| Fat | 0 | 0 |
| Total | 78 | 100% |

Based on nutritional status measurements (Table 2), 87.2% of breastfeeding mothers had normal nutritional status.

*Table 3: Frequency Distribution of Iron Intake of Breastfeeding Mothers in Seluma Regency*

| Iron Intake | Frequency | % |
|---|---|---|
| inadequate | 64 | 82.1 |
| sufficient | 14 | 17.9 |
| Total | 78 | 100% |

The results of iron intake measurements (Table 3) showed that 82.1% of breastfeeding mothers had inadequate iron intake and only 16.6% of breastfeeding mothers had low breast milk iron levels (Table 4).

*Table 4: Frequency distribution of breast milk iron levels of breastfeeding mothers in Seluma Regency*

| Iron content of breast milk | Frequency | % |
|---|---|---|
| Low | 13 | 16.6 |
| Normal | 65 | 83.4 |
| Total | 78 | 100% |

*Table 5: Relationship between nutritional status and iron levels in breast milk of breastfeeding mothers in Seluma Regency*

| | Fe content of breast milk | | | | | | *p-value* | *OR* |
|---|---|---|---|---|---|---|---|---|
| Nutrition Status | Low | | Normal | | Total | | | |
| | n | % | n | % | n | % | | |
| Skinny | 2 | 20 | 8 | 80 | 10 | 100 | | |
| Normal | 11 | 16,2 | 57 | 83,8 | 68 | 100 | 0.762 | 0.762 |
| Total | 13 | 16,7 | 65 | 83,3 | 78 | 100 | | |

Bivariate analysis (Table 5 and 6) results revealed no significant correlation between breastfeeding mothers' nutritional status and breast milk iron levels (p = 0.762) and no significant correlation between breastfeeding mothers' iron intake and breast milk iron levels (p = 0.291).

*Table 6: Relationship between iron intake and iron level in breast milk of breastfeeding mothers in Seluma Regency*

| | Fe content of breast milk | | | | | | *p-value* | OR |
|---|---|---|---|---|---|---|---|---|
| Iron Intake | Low | | Normal | | Total | | | |
| | n | % | n | % | n | % | | |
| Less | 12 | 18,8 | 52 | 81,2 | 64 | 100 | | |
| Simply | 1 | 7,1 | 13 | 92,9 | 14 | 100 | 0.291 | 0.312 |
| Total | 13 | 16,7 | 65 | 83,3 | 78 | 100 | | |

The study's findings demonstrated that there was no correlation (p=0.762>0.05) between breast milk's iron levels and nutritional status. This is because based on the measurement of nutritional status, 87.2% of breastfeeding mothers have normal nutritional status. According to Valentine and Wagner (2013), breastfeeding mothers still have residual fat that was stored during pregnancy that can affect the nutritional status of mothers during breastfeeding. Normal maternal nutritional status has sufficient nutritional stored to produce breast milk that has good nutritional content (Ukegbu et al., 2012).

This statement is also supported by the results of breast milk iron levels measurement in this study which showed that 83.8% of mothers who have normal nutritional status have normal or sufficient breast milk iron levels. Adequate nutritional intake can help in breast milk production and can meet the nutritional intake needs of infants (Kolasa et al., 2015).

Maternal nutritional status can affect the quality and quantity of breast milk. Breast milk has a more optimal nutritional content if the mother is in a normal nutritional status than a mother with a poor nutritional status. Mothers with nutritional status in the normal category have sufficient nutritional reserves so that they can produce breast milk smoothly (Ukegbu et al., 2012).

The results of this study also showed that there was no relationship between iron intake and breast milk iron levels in breastfeeding mothers with 0-6 months old babies. This is because 81.2% of mothers who have low iron intake have normal breast milk iron levels. This study is supported by Bzikowska-jura et al (2021) which states that there is no relationship between mother's iron intake and iron in breast milk.

According to a number of studies (Domellof et al., 2004; Celada et al., 1982; Dorea, 2000), the iron concentration in breast milk is not affected by the mother's iron status and cannot be raised by the mother's diet or iron supplements. Because human breastfeeding epithelial cells lack the primary iron-exporting membrane, human mammary gland epithelial cells do not secrete iron into breast milk (Cai et al, 2017). This supports the widely held belief that absorption, rather than excretion, regulates the body's iron content (Lönnerdal et al., 2015).

Maternal iron status during pregnancy will affect the iron content in breast milk (Hampel et al.,2017). Iron in breast milk is significantly reduced if the mother has severe anemia (Chen et al., 2018).

Compared to mother serum iron, breast milk has less iron in it. Human colostrum has an iron concentration of about 0.8 μg/mL, while mature breast milk has a value of 0.2–0.4 μg/mL (Lonnerdal et al., 1981). Even though breast milk has a low iron content, it is best for an infant's development since newborns' intestines contain receptors specifically designed to absorb iron from lactoferrin (Suzuki et al., 2001).

**Conclusion**

There was no significant relationship between nutritional status and breast milk iron levels in breastfeeding mothers ($p = 0.762$) and there was no significant relationship between iron intake and breast milk iron levels in breastfeeding mothers.Nutritional status and iron intake were not associated with breast milk iron levels in breastfeeding mothers of infants aged 0-6 months in Seluma Regency.

There is limitation in this study, which is the small sample size does not allow the results to be generalized to a larger population. Therefore, more research is needed with a larger sample and adding the variables of maternal serum iron and hemoglobin levels. So that the factors that influence breast milk iron levels can be known clearly. Monitoring maternal health since pregnancy is necessary to obtain adequate breast milk in quality and quantity. Iron sufficiency during pregnancy will determine the iron content of breast milk.

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## References

Amare, B., Moges, B., Moges, F., Fantahun, B., Admassu, M., Mulu, A., & Kassu, A. (2012). Nutritional status and dietary intake of urban residents in Gondar, Northwest Ethiopia. http://www.biomedcentral.com/1471-2458/12/752

Amin T, Hablas H, Al Qader AA. Determinants of initiation and exclusivity of breastfeeding in Al Hassa, Saudi Arabia. Breastfeed Med. 2011;6:59–68.

Asfaw MM, Argaw MD, Kefene ZK. Factors associated with exclusive breastfeeding practices in Debre Berhan District, Central Ethiopia: a cross sectional community based study. Int Breastfeed J. 2015;10:23

Berihun, S., Kassa, G. M., & Teshome, M. (2017). Factors associated with underweight among lactating women in Womberma woreda, Northwest Ethiopia; A cross-sectional study. BMC Nutrition, 3(1). https://doi.org/10.1186/s40795-017-0165-z

Butte NF, Lopez-Alarcon MG, Garza C. Nutrient Adequacy of Exclusive Breastfeeding for the Term Infant During the First Six Months of Life. Geneva: World Health Organization; 2002. Available at: http://www.who.int/nutrition/publications/infantfeeding/9241562110/en/. Accessed November 17, 2013.

Bzikowska-Jura, A., Sobieraj, P., Michalska-Kacymirow, M., & Wesołowska, A. (2021). Investigation Of Iron And Zinc Concentrations In Human Milk In Correlation To Maternal Factors: An Observational Pilot Study In Poland. Nutrients, 13(2), 1–16. Https://Doi.Org/10.3390/Nu13020303

Cai C., Eck P., Friel J.K. Gene Expression Profiles Suggest Iron Transport Pathway in the Lactating Human Epithelial Cell. J. Pediatr. Gastroenterol. Nutr. 2017;64:460–464.

Cai, C. , H. S. , & F. J. (2015). Access/Breast-Milk-Iron-Concentrations-May-Be-Lower-Than-Previously-Reported-Implications-For-Exclusively-Breastfed-Infants-Mpn-1000104.Php?Aid=67824 Maternal And Pediatric Nutrition Journal. Https://Doi.Org/10.4172/Mpn.1000104

Celada A., Busset R., Gutierrez J., Herreros V. No correlation between iron concentration in breast milk and maternal iron stores. Helv. Paediatr. Acta. 1982;37:11–16.

Clark S, Berrang-Ford L, Lwasa S, Namanya DB, Edge VL, Harper S. The burden and determinants of self-reported acute gastrointestinal illness in an Indigenous Batwa Pygmy population in southwestern Uganda. Epidemiol Infect. 2015; 143(11):2287–98. Epub 2014/12/17. https://doi.org/10.1017/ S0950268814003124 PMID: 25500189.

Domellof M., Lonnerdal B., Dewey K.G., Cohen R.J., Hernell O. Iron, zinc, and copper concentrations in breast milk are independent of maternal mineral status. Am. J. Clin. Nutr. 2004;79:111–115. doi: 10.1093/ajcn/79.1.111.

Domellof, M.; Braegger, C.; Campoy, C.; Colomb, V.; Decsi, T.; Fewtrell, M.; Hojsak, I.; Mihatsch, W.; Molgaard, C.; Shamir, R.; et al. Iron requirements of infants and toddlers. J. Pediatr. Gastroenterol. Nutr. 2014, 58, 119–129. [CrossRef]

Dorea J.G. Iron and copper in human milk. Nutrition. 2000;16:209–220. doi: 10.1016/S0899-9007(99)00287-7.

Dumrongwongsiri O, Suthutvoravut U, Chatvutinun S, Phoonlabdacha P, Sangcakul A, Siripinyanond A, et al. Maternal zinc status is associated with breast milk zinc concentration and zinc status in breastfed infants aged 4-6 months. Asia Pac J Clin Nutr 2015;24(2):273-280 [FREE Full text] [doi: 10.6133/apjcn.2015.24.2.06] [Medline: 26078244]

Dumrongwongsiri, O., Winichagoon, P., Chongviriyaphan, N., Suthutvoravut, U., Grote, V., & Koletzko, B. (2020). Determining The Actual Zinc And Iron Intakes In Breastfed Infants: Protocol For A Longitudinal Observational Study. JMIR Research Protocols, 9(11). Https://Doi.Org/10.2196/19119

Eidelman AI. Breastfeeding and the use of human milk: an analysis of the American Academy of Pediatrics 2012 Breastfeeding Policy Statement. Breastfeed Med. 2012;7(5):323–4

ENA Counselor's guide: Key behaviors for optimal breast feeding, complementary feeding and maternal nutrition at critical stages in the life cycle of women and children_ draft for discussion_ linkages project. 2008. http:// motherchildnutrition.org/...nutrition/.../mcn-ena-key-messages-bookl.

Gatica-Domı´nguez G, Neves PAR, Barros AJD, Victora CG. Complementary Feeding Practices in 80 Low- and Middle-Income Countries: Prevalence of and Socioeconomic Inequalities in Dietary Diversity, Meal Frequency, and Dietary Adequacy. The Journal of Nutrition. 2021; 151(7):1956–64. https://doi. org/10.1093/jn/nxab088 PMID: 33847352

Glanz K, Rimer BK, Viswanath K. Health behavior and health education: theory, research, and practice. San Francisco: Wiley; 2008.

Haileslassie, K., Mulugeta, A., & Girma, M. (2013). Feeding practices, nutritional status and associated factors of lactating women in Samre Woreda, South Eastern Zone of Tigray, Ethiopia. http://www.nutritionj.com/content/12/1/28

Hampel D., Shahab-Ferdows S., Gertz E., Flax V.L., Adair L.S., Bentley M.E., Jamieson D.J., Tegha G., Chasela C.S., Kamwendo D., et al. The effects of a lipid-based nutrient supplement and antiretroviral therapy in a randomized controlled trial on iron, copper, and zinc in milk from HIV-infected Malawian mothers and associations with maternal and infant biomarkers. Matern. Child Nutr. 2017:e12503. doi: 10.1111/mcn.12503.

Hurrell RF, Reddy MB, Juillerat MA, Cook JD. Degradation of phytic acid in cereal porridges improves iron absorption by human subjects. Am J Clin Nutr. 2003;77(5):1213–9

Kolasa KM, Firnhaber G, Haven K. Diet for a healthy lactating woman. Clin Obstet Gynecol. 2015;58(4):893–901.

Lönnerdal B., Georgieff M.K., Hernell O. Developmental Physiology of Iron Absorption, Homeostasis, and Metabolism in the Healthy Term Infant. J. Pediatr. 2015;167(Suppl. 4):S8–S14.

Lonnerdal B., Keen C.L., Hurley L.S. Iron, copper, zinc, and manganese in milk. Annu. Rev. Nutr. 1981;1:149–174. doi: 10.1146/annurev.nu.01.070181.001053

Lozoff B, Smith JB, Kaciroti N, Clark KM, Guevara S, Jimenez E. Functional significance of early-life iron deficiency: outcomes at 25 years. J Pediatr. 2013;163(5):1260–6

McDermid JM, Lonnerdal B. Iron. Adv Nutr. 2012;3(4):532–3.

Nakamori M, Ninh NX, Isomura H, Yoshiike N, Hien VTT, Nhug BT, et al. Nutritional status of lactating mothers and their breast milk concentration of iron, zinc and copper in rural Vietnam. J Nutr Sci Vitaminol (Tokyo) 2009 Aug;55(4):338-345 [FREE Full text] [doi: 10.3177/jnsv.55.338] [Medline: 19763035]

Nikniaz L, Mahdavi R, Gargari BP, Gayem Magami SJ, Nikniaz Z. Maternal body mass index, dietary intake and socioeconomic status: differential effects on breast milk zinc, copper and iron content. Health Promot Perspect 2011;1(2):140-146 [FREE Full text] [doi: 10.5681/hpp.2011.015] [Medline: 24688910]

Reddy MB, Hurrell RF, Cook JD. Meat consumption in a varied diet marginally influences nonheme iron absorption in normal individuals. J Nutr. 2006;136(3):576–81

Takimoto H, et al. Nutritional status of pregnant and lactating women in Japan: a comparison with non-pregnant/non-lactating controls in the National Nutrition Survey. J Obstet Gynaecol Res. 2003;29(2):96–103.

Ukegbu P, et al. Influence of maternal anthropometric measurements and dietary intake on lactation performance in Umuahia urban area, Abia state, Nigeria. Niger J Nutr Sci. 2012;33(2):31–9.

Valentine CJ, Wagner CL. Nutritional management of the breastfeeding dyad. Pediatr Clin N Am. 2013;60(1):261–74.

World Health Organization. The Optimal Duration of Exclusive Breastfeeding: Report of the Expert Consultation; 2001.

Zavaleta, N., Nombera, J., Rojas, R.M., Hambraeus, L., Gíslason, J., & Lönnerdal, B. (1995). Iron and lactoferrin in milk of anemic mothers given iron supplements. Nutrition Research, 15, 681-690.