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ORIGINAL ARTICLE

The Effect of Postpartum Vitamin A and Beef Liver supplementation on Infant Acute Respiratory Infection and Diarrhea

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ABSTRACT

Background: In Indonesia, Acute respiratory infection (ARI) and diarrhea-related morbidity and mortality in children less than five years old still remain a significant public health concern. In this relation, energy, protein, zinc, and vitamins C, B, D, E, and A are essential nutrients to mitigate morbidity and mortality. Vitamin A was shown to play a crucial role in human development, growth, and immune function that can protect infants against infectious diseases such as ARI and diarrhea. So this study aimed to compare the effect of beef liver and vitamin A supplementation for breastfeeding mothers on the incidence of ARI and diarrhea in infants.

Methods: In a randomized control trial design, 40 participants aged 20-35 years were allocated into two groups of beef liver and vitamin A supplementations. The beef liver supplementation group received eight servings during two months postpartum, or no later than the 7th day after giving birth; while the vitamin A supplementation group received two vitamin A capsules no later than the 7th day postpartum.

Results: The incidence of ARI significantly differed, while there was no significant difference in incidence of infant diarrhea between the two groups.

Conclusion: In breastfeeding mothers, administering beef liver (75 grams/day equivalent to 402,000 IU) could reduce the frequency of ARI and infant diarrhea more effectively than supplementation with two vitamin A capsules (equivalent to 400,000 IU). There was no difference in morbidity of infant diarrhea for mothers who received two vitamin A capsules.

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Introduction

The primary and secondary causes of mortality among infants in Indonesia are Acute Respiratory Infection (ARI) and diarrhea, respectively (1). The prevalence of diarrhea among infants under one year old has decreased from 11.2% in 2013 to 10.6% in 2018, while ARI prevalence has increased from 2.9% in 2013 to 9.4% in 2018 (2, 3). Globally, neonatal mortality accounts for 36% of all deaths in children less than five years; while

infections contributed to 26% of all mortalities (4). Pneumonia (15.9%) and diarrhea (12.1%) are considered as the two most common causes of infant mortality in Indonesia (5). Nutritional deficiencies were mentioned to be among the factors responsible for infant morbidity and mortality. Energy, protein, zinc, vitamins C, B, D, E, and A were demonstrated to be essential nutrients that can reduce the incidence of infant morbidity and mortality. Vitamin A as a fat-soluble micronutrient that is stored in the liver must be obtained from food because the body cannot synthesize the vitamin. This vitamin plays a crucial role in human development, growth, and defense mechanism against infectious diseases such as measles, ARI, and diarrhea (6).

Supplementation is one strategy used in Indonesia to address vitamin A deficiency. According to Regulation of the Ministry of Health (Number 21 of 2015), the government distributes vitamin A at a dose of 100,000 IU as blue vitamin A capsules for infants from six to eleven months old, and 200,000 IU as red vitamin A capsules for toddlers from twelve to fifty-nine months old and also for postpartum mothers to reduce the risk of morbidity and mortality in children under five years to compensate any vitamin A deficiency (7). Several researchers have demonstrated vitamin A supplementation in breastfeeding mothers with no effect or minimal impact on maternal and infant morbidity (8). According to the World Health Organization (WHO) report, postpartum vitamin A supplementation as a public health intervention to prevent infant morbidity and mortality is no longer recommended; while WHO has advocated receipt of vitamin A through a balanced diet rich in various food resources (4).

Preformed retinol is the active form of vitamin A found in animal products, whole milk, and fortified foods. Among animal products, beef liver and chicken liver have the highest vitamin A concentration, with 20,357 µg/100 grams and 11,325 µg/100 grams, respectively (9). Beef liver with its high vitamin A concentration can be an alternative source. It was shown that consumption of 300 grams of beef liver is equivalent to consumption of one vitamin A capsule containing 200,000 IU or 60,000 RE that can be sufficient to meet vitamin A needs for infants until 60 days (10). So this study aimed to compare the effect of postpartum vitamin A and beef liver supplementation on infant ARI and diarrhea.

Materials and Methods

This randomized control trial was conducted at public health centers of Mangkang, Karangdoro, Tlogosari Wetan, and Halmahera in Semarang, Central Java, Indonesia from August 2021 to January 2022. Inclusion criteria were a normal delivery of a second or third childbirth, a normal birth weight of infants, a normal nutritional status for both mothers and infants, and possession of a smart phone. Exclusion criteria were maternal hypercholesterolemia and household COVID-19 infection during the research period. So forty participants aged 20-35 years were enrolled and divided into beef liver and vitamin A supplementation groups.

The beef liver supplementation group received 8 servings over two months postpartum or no later than the 7th day after childbirth, while the vitamin A supplementation group received 2 vitamin A capsules no later than the 7th day postpartum. Information on respondent characteristics and the frequency of infant ARI and diarrhea was collected using a systematic questionnaire via Google that was completed weekly by participants for two months. Vitamin A intake was evaluated using a 2x-24-hour food recall questionnaire administered twice, and data on infant body length and weight were obtained through direct measurements taken monthly by the researcher for two months.

Nutri-Survey software was utilized to convert the data on vitamin A and energy intakes into grams per day, which were then compared to the Recommended Dietary Allowance (RDA) for breastfeeding mothers per day. The incidence of ARI and diarrhea was measured by two indicators of 'yes' and 'no'. Frequency of ARI was categorized as frequent (>5 times), rare (<5 times), or never. Diarrhea frequency was similarly grouped as frequent (>2 times), rare (<2 times), or never. Vitamin A intake was classified as inadequate (<77% RDA) or adequate (>77% RDA). Infant nutritional status was divided as wasting (<-3 SD), underweight (-3 SD to <-2 SD), normal (-2 SD to 2 SD), or overweight/obese (>2 SD) sections. The study protocol was approved by the Research Ethical Committee, Faculty of Medicine, Sebelas Maret University, with reference number of 74/UN27.06.6.1/kep/ec/2021.

Data analysis was performed using Statistical Package for Social Sciences (SPSS for Windows, version 16, Chicago, IL, USA). Variables were presented as mean±standard deviation (SD) for each measurement. The Mann-Whitney test determined differences in infant morbidity between the two groups, while ordinal regression analysis assessed the effects of vitamin A and maternal energy intakes, and infant nutritional status. A p value less than 0.05 was considered statistically significant.

Results

The demographic characteristics of respondents were presented in Table 1 revealing most of participants to be 20-25 years old (37.5%), unemployed or only worked as housewives (62.5%), to have male infants (60%), to complete the education at the senior high school level (57.5%), and a higher proportion of them to be in the vitamin A supplementation group in comparison to the beef liver supplementation group.

Table 2 shows the frequency of breastfeeding >8 x/day to be as many as 30 respondents (75%) for both the vitamin A and liver supplementation groups that is in accordance with international recommendation for breastfeeding mothers. The average duration of breastfeeding was 10-20 minutes in 19 respondents (47.5%). A total of 18 respondents (45%) reported smoking habits and 36 mothers (90%) had the habit of hand washing before breastfeeding.

Table 1: Distribution of demographic variables in beef liver and vitamin A supplemented groups.

Characteristics	Group		Total
	Vitamin A n (%)	Beef liver n (%)	n (%)
Age			
20-25 years old	7 (35)	8 (40)	15 (37.5)
26-30 years old	6 (30)	7 (35)	13 (32.5)
31-35 years old	7 (35)	5 (25)	12 (30)
Education			
Elementary school	1 (5)	0 (0)	1 (2.5)
Junior high school	2 (10)	3 (15)	5 (12.5)
Senior high school	14 (70)	9 (45)	23 (57.5)
Diploma/Bachelor	3 (15)	8 (40)	11 (27.5)
Job/Employment status			
Unemployed	11 (55)	14 (70)	25 (62.5)
Employee	3 (15)	5 (25)	8 (20)
Entrepreneur	5 (25)	0 (0)	5 (12.5)
Farmer/Labor	1 (5)	0 (0)	1 (2.5)
Other	0 (0)	1 (5)	1 (2.5)
Infant's gender			
Male	13 (65)	11 (55)	24 (60)
Female	7 (35)	9 (45)	16 (40)

Primary data, 2021.

Table 2: Distribution of mother's personal hygiene, breastfeeding and smoking habits in beef liver and vitamin A supplemented groups.

Characteristics	Group		Total
	Vitamin A n (%)	Beef liver n (%)	n (%)
Frequency of breastfeeding			
≥8x/day	14 (70)	16 (80)	30 (75)
<8x/day	6 (30)	4 (20)	10 (25)
Duration of breastfeeding			
<10 minute	6 (30)	7 (35)	13 (32.5)
10-20 minute	11 (55)	8 (40)	19 (47.5)
>20 minute	3 (15)	5 (25)	8 (20)
Smoking habits			
Never	9 (45)	9 (45)	18 (45)
No, but previously smoked every day	2 (10)	1 (5)	3 (7.5)
Yes, sometimes	6 (30)	4 (20)	10 (25)
Yes, every day	3 (15)	6 (30)	9 (22.5)
Mother's personal hygiene (Washing hands before breastfeeding)			
Yes	18 (90)	18 (90)	36 (90)
No	2 (10)	2 (10)	4 (10)

Primary data, 2021.

The frequency of infant ARI and diarrhea was illustrated in Figure 1, while was higher in vitamin A supplementation group than the beef liver supplementation group.

Figure 2 displays the mothers' intake of vitamin A and energy; while the majority of participants in vitamin A supplementation group received adequate vitamin A (95%) in comparison to the beef liver supplementation group (8%). Mothers' energy intake was lower in the vitamin A supplementation group (50%) in comparison to the beef liver supplementation group (65%). As Figure 3 exhibits, the nutritional status of infants based on weight/age was good in both groups (90%).

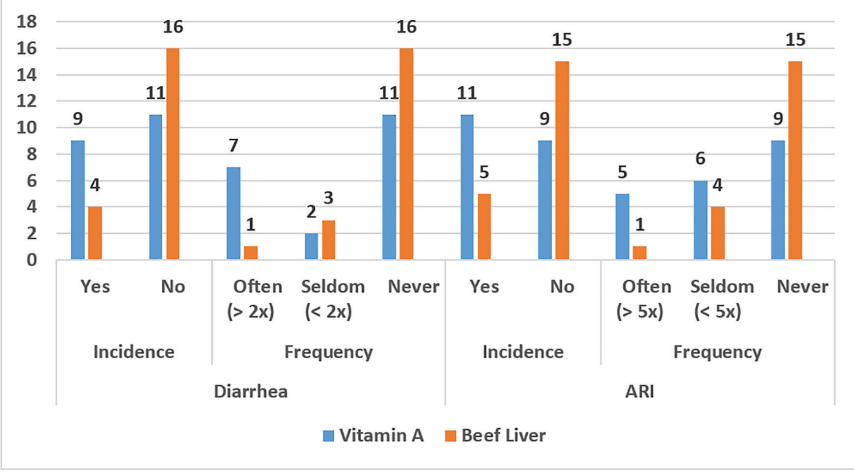

Figure 1: Frequency of infant diarrhea and ARI in beef liver and vitamin A supplemented groups. ARI: Acute respiratory infection.

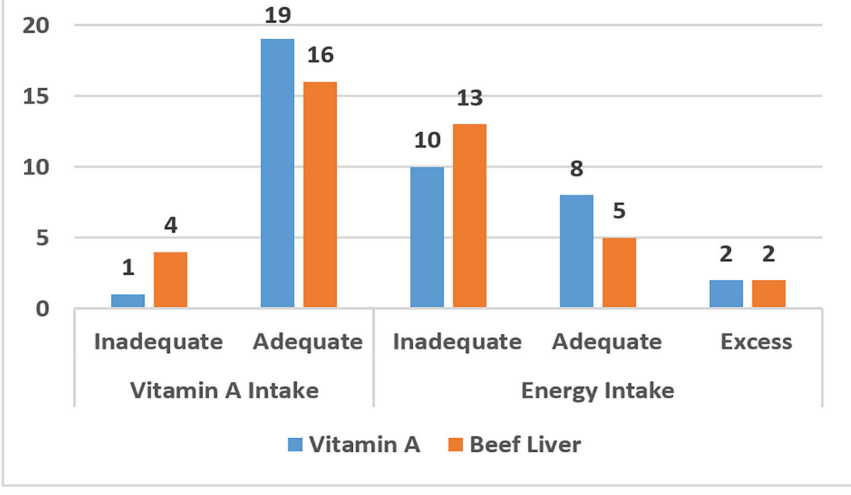

Figure 2: Vitamin A and energy intake in beef liver and vitamin A supplemented groups.

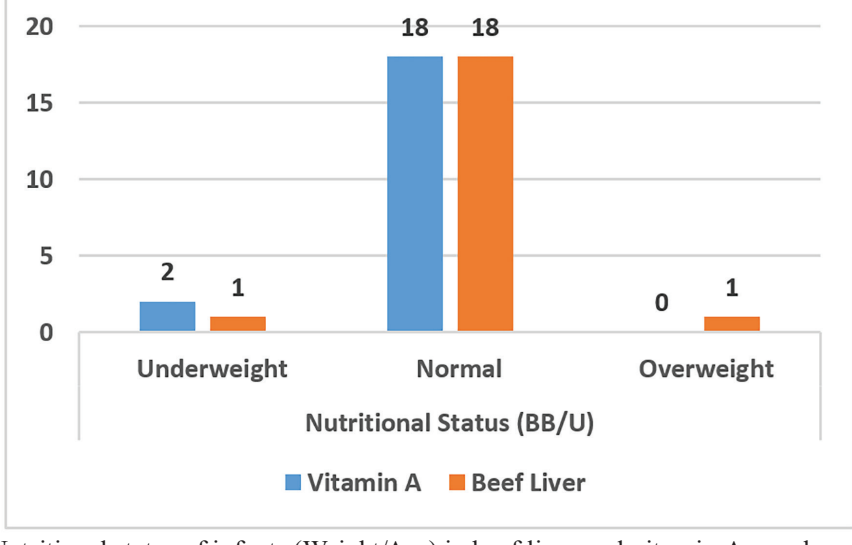

Figure 3: Nutritional status of infants (Weight/Age) in beef liver and vitamin A supplemented groups.

Table 3: Infant ARI and diarrhea differences in beef liver and vitamin A supplemented groups.

Variable	Vitamin A group		Beef liver group		*P* value
	Median	SD	Median	SD	
ARI Frequency	2.00	0.83	3.00	0.57	0.038
Diarrhea Frequency	3.00	0.95	3.00	0.55	0.051

Mann Whitney test. ARI: Acute respiratory infection.

Table 4: The effect of energy and vitamin A intakes and nutritional status on infant morbidity.

Variable	*P* value						
	Energy intake	Vitamin A intake	Nutritional status	Breastfeeding		Smoking habit	Maternal hygiene
				Frequency	Duration		
ARI	1.540	1.099	0.241	0.772	0.880	0.987	0.507
Diarrhea	0.573	0.508	0.330	0.281	0.463	0.418	0.730

Simple logistic regression. ARI: Acute respiratory infection.

Table 3 depicts a *p* value of 0.03 in relation to infant ARI indicating a significant difference between intake of vitamin A capsules and supplementation of beef liver. Additionally, a *p* value of 0.05 was obtained in relation to infant diarrhea without any significant difference between the two groups. Table 4 reveals the confounding variables not to impact the interventions of beef liver or vitamin A supplementation in both groups.

Discussion

Vitamin A and beef liver supplementation in breastfeeding mothers can impact the infant ARI and diarrhea morbidities. Our findings showed on incidence of ARI and diarrhea among infants suggests that beef liver supplementation may be more effective than vitamin A supplementation to decrease the infant ARI and diarrhea. This could be attributed to the presence of additional nutrients in beef liver, such as fat, protein, and zinc. The fat ingredient can aid absorption of retinyl esters to enable efficient absorption of vitamin A, while protein and zinc contribute to the synthesis of functional retinol binding protein that can further facilitate the transport of vitamin A from liver stores to cells or organs in need (11). The difference in the mean or median of diarrhea frequency of our study was not significant ($p>0.05$); however, the meaningful difference in the mean or median of ARI frequency ($p<0.05$) was visible suggesting the impact of vitamin A and beef liver supplementation on reduction of infant ARI. This finding aligns with another study (12) finding that beef liver supplementation during childbirth in comparison to administration of vitamin A was more effective to decline infant ARI and diarrhea. Nevertheless, the study did not find any significant difference in the incidence of infant diarrhea.

Vitamin A can play an important role in formation, morphology, stratification, differentiation, and maturation of epithelial cells. Vitamin A is an integral part of the mucous layer in the respiratory and gastrointestinal tracts too. Its involvement in mucin secretion enhances the function of the antigen non-specific immunity network. Vitamin A was also shown to boost the defense mechanisms of the oral mucosa, maintain the integrity of intestinal mucus, and enhance the morphology of urothelial cells (9, 13). A strong correlation was demonstrated between the deficiency of micronutrients, especially for vitamin A, and the spread of diseases through the respiratory and digestive systems in children, because vitamin A plays an important role in the formation and maintenance of the immune system (14); and its deficiency can hamper the function of the immune system, cause keratinization of tracheal and lung tissues, and reduce mucus production that in turn facilitates the entry of microorganisms and leads to respiratory tract infections (15).

Vitamin A in foods mainly exists in the form of retinyl esters that can bind to long-chain fatty acids. It has primary active forms such as retinal and retinoic acid that both are derivatives of retinol (16). These active forms are commonly found in animal products such as beef liver, chicken liver, fish eggs, egg yolks, milk, and their derivatives. In our study, beef liver was utilized due to its rich content of the active form of vitamin A. Various factors were shown to contribute to infant ARI and diarrhea, including the nutritional status of infants and breastfeeding mothers. Nutritional status can significantly impact the incidence of infant ARI and diarrhea for both vitamin A and beef liver supplementation groups. These findings align with a previous research indicating a strong correlation between nutritional status and infant ARI occurrence; while malnourished toddlers developed 27.5 times more likely ARI in comparison to those with an adequate nutrition (17).

Conclusion

Our findings revealed no difference for infant diarrhea between breastfeeding mothers who received vitamin A capsules or consumed beef liver. However, administering beef liver in breastfeeding mothers could reduce infant ARI and diarrhea more than vitamin A supplementation.

Acknowledgment

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Author's Contribution

A.D.W.P: Data collection, data analyses and interpretation, writing the original draft. D.G.T: Sample size determination, consulting for Data analyses and interpretation. B.W: Conceptualization, methodology, interpretation data, review and editing the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

None declared.

References

1 Elvandari M, Briawan D, Tanziha I. Hubungan Asupan Zat Gizi Dan Serum Retinol Dengan Morbiditas Pada Anak 1-3 Tahun Dijawa Tengah. *Media Kesehatan Masyarakat Indonesia*. 2016;12:201–7. DOI: 10.30597/mkmi.v12i4.1537.

2 Kemenkes RI. Riset Kesehatan Dasar. Proceedings, Annual Meeting - Air Pollution Control Association; 2013.

3 Riskesdas Kemenkes RI. Laporan Nasional Riset Kesehatan Dasar. *Kementrian Kesehatan RI.* pp. 1-582.

4 Ahmad SM, Hossain MI, Bergman P, et al. The effect of postpartum vitamin A supplementation on breast milk immune regulators and infant immune functions: Study protocol of a randomized, controlled trial. Trials. 2015;16:1-9. DOI: 10.1186/s13063-015-0654-9. PMID: 25872802.

5 Kemenkes RI. Profil Kesehatan Indonesia. Short Textbook of Preventive and Social Medicine. Jakarta: Kementrian Kesehatan Republik Indonesia; 2020.p.28.

6 Hardiansyah IDNS. Ilmu Gizi Teori dan Aplikasi. Hardinsyah, Supariasa IDN, editors. Jakarta: EGC; 2017.p.194.

7 Kemenkes RI. Peraturan Menteri Kesehatan Republik Indonesia Nomor 21 Tahun 2015 Tentang Standar Kapsul Vitamin A Bagi Bayi, Anak Balita dan Ibu Nifas. 2015.

8 Bando H, Mujianti C. Analisis Suplementasi Vitamin A pada Ibu Nifas, Kelengkapan Imunisasi Dasar, dan PHBS Terhadap Morbiditas Bayi. *Media Kesehatan Masyarakat Indonesia*. 2018;7:1-11. DOI: 10.30597/mkmi.v14i3.4348.

9 Huang Z, Liu Y, Qi G, et al. Role of Vitamin A in the Immune System. *J Clin Med.* 2018;7:258. DOI: 10.3390/jcm7090258.

10 Kementerian Kesehatan RI. Panduan Manajemen Terintegrasi Suplementasi Vitamin A. Kementerian Kesehatan Republik Indonesia. 2016;1-84.

11 Cahyawati PN. Transport, Metabolisme Dan Peran Vitamin a Dalam Imunitas. *WICAKSANA: J Lingkungan dan Pembangunan.* 2018;2:43-7.

12 Salam A, Briawan D, Martianto D, et al. Efek Suplementasi Vitamin A , Minyak Fortifikasi dan Edukasi Gizi Ibu Nifas terhadap Morbiditas Ibu dan Bayi Effect of Vitamin A Supplementation, Oil Fortification and Nutrition Education to Postpartum Mother on Morbidity of Mother and Infant. *J MKMI.* 2018;14:209-16. DOI:10.30597/mkmi.v14i3.4348.

13 Mehrabani D, Masoumi SJ, Masoumi AS, Rasouli-Nia A, Karimi-Busheri F, Mehrabani G. Role of diet in mesenchymal stem cells' function: A review. *Int J Nutr Sci.* 2023;8:9-19. DOI: 10.30476/IJNS.2023.97788.1221.

14 Mujtaba A, Sahar A, Ahmad N. Vitamin A supplement: a key strategy to prevent vitamin A deficiency among young children in Afghanistan. *Food Therapy Health Care*. 2022;4:8. DOI:10.53388/FTHC20220501008.

15 Pratiwi YS. Kekurangan Vitamin a (Kva) Dan Infeksi. *Indonesian J Health Sci*. 2013;3:207-10. DOI: 10.52298/ihsj.v2i2.32.

16 Maryani D. Suplementasi Vitamin a Bagi Ibu Post Partum Dan Bayi. *OKSITOSIN : Jurnal Ilmiah Kebidanan*. 2019;6:9-15. DOI: 10.35316/oksitosin.v6i1.339.

17 Widodo P, Anang G, Hardiana SYM. Hubungan Status Gizi dengan Angka Kejadian Infeksi Saluran Pernapasan Akut (ISPA) pada Balita Usia 1-5 Tahun di Surakarta. *Smart Med J* . 2020. DOI: 10.13057/smj.v3i2.35649.