

The effect of nutrition education based on hybrid model on iron deficiency anemia and upper arm circumference among female students

^{1,*}Utama, L.J., ²Yunita, L., ³Syaftariani, N., ¹Suhaema, S., ¹Darni, J. and ¹Laraeni, Y.

¹Nutrition Department, Health Polytechnic of Mataram, West Nusa Tenggara, Indonesia

²Nutrition Department, Bumi Gora University; West Nusa Tenggara, Indonesia

³Nutrition of Utan Public Health Center, Sumbawa, West Nusa Tenggara, Indonesia

Article history:

Received: 29 June 2023

Received in revised form: 2
December 2023

Accepted: 17 December 2023

Available Online: 25

December 2023

Keywords:

COVID-19,

Education,

Iron-deficiency anemia,

Nutrition,

Upper arm circumference

DOI:

[https://doi.org/10.26656/fr.2017.7\(S5\).5](https://doi.org/10.26656/fr.2017.7(S5).5)

Abstract

This study aimed to analyze the impact of nutrition education on anemia and upper arm circumference in adolescent women. A total of 97 adolescent women participated in the cluster-randomized control study. The nutrition education intervention, which included both offline and online sessions, made use of a self-created booklet and was delivered by trained nutrition education personnel. Data on socio-demographics were obtained through the interview method. Nutritional status was determined by measuring upper arm circumference (MUAC), and anemia was diagnosed by health personnel after blood hemoglobin levels were examined. The chi-square test and paired and independent t-tests were used to analyze the data. When compared to the control group, nutrition education using booklets showed significant differences in the parameters of knowledge, attitudes, self-efficacy, reinforcing factors, supporting factors, and anemia prevention behavior with each p-value of 0.05. However, the intervention group's hemoglobin level increased more than the control groups. MUAC in the intervention group increased by 0.31 cm, while in the control group it increased by 0.3 cm. However, the difference in difference (DID) analysis did not show a significant difference between the two parameters ($p=0.296$ and $p=0.084$). Nutrition education for two months did not increase mean hemoglobin or LILA significantly. However, given the decreasing trend of anemia and the prevalence of CED in the intervention group, structured and routine nutrition education can be implemented as part of nutritional interventions in teenagers to prevent anemia and CED, allowing for long-term effects of interventions to be seen.

1. Introduction

The COVID-19 pandemic has disrupted various sectors, including health care. According to studies, the COVID-19 pandemic has reduced the number of nutrition service visits, changed the provision of nutrition services, and impacted access to technology and internet support for nutrition monitoring and consulting in Indonesia (Saputri *et al.*, 2020). Similarly, services for teenagers in schools who are prone to anemia caused by menstrual bleeding are available. The prevalence of iron deficiency anemia (ADB) in women after puberty due to menstrual bleeding increases (Kumari *et al.*, 2017). Iron deficiency anemia is a common health problem in all countries, with the prevalence being approximately three to four times higher in developing countries (WHO, 2006). They suffered from severe iron deficiency during pregnancy and after marriage. Not only is the risk of death during childbirth increased in these mothers, but so

are babies born with low body weight and iron stores. Iron deficiency is the most common cause of anemia, accounting for approximately 50% of all cases (McLean and Cogswell, 2009). Malnutrition, including in teenagers, is linked to a lack of access to nutritious food, as well as a lack of access to essential nutrition services, feeding and dietary practices. Malnutrition practices begin before and continue throughout adolescent development, including insufficient energy intake, nutrient consumption, and micronutrient intakes, such as iron, zinc, calcium, and folic acid (Mousa *et al.*, 2019). Teenage girls' compliance in consuming >90 iron and folic acid tablets remains low.

Iron deficiency anemia in teenagers is associated with cognitive decline, decreased learning, and children's school performance; it also interferes with teenage girls' concentration, reduces educational success, productivity, and physical strength, and increases the risk of infection

*Corresponding author.

Email: juntra8686@gmail.com

(Olude, 2011). Iron deficiency anemia decreases red blood cell capacity to deliver oxygen to body tissues, resulting in clinical symptoms such as pale conjunctiva, shortness of breath, dizziness and weakness (Chen *et al.*, 2013). The World Health Organization (2008) reported that 25% of students have iron deficiency anemia, and the prevalence of iron deficiency anemia among the student and adolescent population is 29.2-79.6%. Karkar (2004) studied the prevalence of anemia among nursing students and discovered that 60% of adolescent girls were anemic. Adolescence is a critical period in which humans undergo significant changes. Specific nutrient deficiencies reduce energy supply, reduce muscle strength, and cause disorders such as anemia and immune deficiency. Teenagers have limited decision-making abilities and rely on external factors. Many health problems among teenagers begin with their behavioral choices, and schools have a unique opportunity to influence behavioral choices through health education programs (Justine, 2009).

The economic and social costs of anemia have created a significant challenge in Indonesia. According to the 2018 Indonesian Basic Health Research Survey, chronic energy deficiency (KEK) and anemia are still major nutritional issues in Indonesia. Anemia affects one in every three women, and the figure is expected to rise to 32% in 2018, in addition to anemia, 36.6% of Indonesian teenagers have SEZ (Ministry of Health of the Republic of Indonesia, 2019). Considering the rise in anemia in this country and the importance of promoting anemia control behavior, intervention through the implementation of behavior change patterns is critical. Furthermore, there is a strong desire to educate the public about preventive behavior and lifestyle changes associated with anemia (Ahmad *et al.*, 2015). Nutrition education has been shown to reduce the prevalence of certain diseases, including anemia, in many European, North American, Asian and Australian countries. As a result, nutrition recommendations and the implementation of nutrition education programs appear to be necessary. Given the importance of schools in education, implementing nutrition education programs in schools is recommended as an appropriate intervention to raise nutrition awareness (Zare, 2002).

During the COVID-19 pandemic, the communication strategy for the nutrition program focused on healthy and hygienic food consumption. Furthermore, it emphasized the identification of innovative channels to support culturally appropriate messages about healthy food, hygiene, and physical activity, such as social media, television, radio, digital platforms/mobile phones, and women's needs (WFP/UNICEF/Global Nutrition Cluster, 2020). Nutrition

education required a combination of offline and online nutritional education methods to adapt to the COVID-19 pandemic. Social media interventions were found to be associated with increased levels of physical activity, healthier food choices, and influencing body composition or weight (Goodyear *et al.*, 2021). Nutrition education developed through a combination of offline and online strategies is expected to increase adherence to taking iron and folic acid tablets as well as nutrient intake from daily food, thereby improving nutritional status, particularly anemia and KEK. As a result, the purpose of this study was to investigate the effect of nutrition education on anemia and upper arm circumference in adolescents of childbearing age.

Several studies (Abalkhail *et al.*, 2002; Abedini *et al.*, 2010; Fathizadeh *et al.*, 2016; Mirzaei *et al.*, 2016), have been conducted based on the educational model in preventing iron deficiency anemia among students. Given the importance of preventing iron deficiency anemia, the need for nutrition education for girls, and the scarcity of studies on female high school students in the Sumbawa District, the purpose of this study was to assess the effectiveness of nutrition education based on iron deficiency anemia booklets among junior high school students.

2. Materials and methods

This research was a quasi-experimental conducted on 260 students of Junior High School in Utan, Sumbawa Regency. 97 patients were included in this study and divided into two groups: 49 in the intervention group and 48 in the control group. The 7th, 8th and 9th - grade students of SMPN 1 Utan, Sumbawa Regency, provided written informed consent, and had iron deficiency anemia. Reluctance and absence for more than two sessions were exclusion criteria. To test the validity and reliability of the questionnaire, data collection tools were based on the method described by Eftekhari Ardebili *et al.* (2018) and Shahnazi *et al.* (2012).

In this study, nutrition education combined offline and online strategies tailored to the COVID-19 pandemic, where direct contact between health workers and research subjects was limited. Following nutrition education, upper arm circumference was measured to assess nutritional status. Nutrition education was delivered using a combination of direct and indirect (offline and online) techniques, as well as mobile communication devices (cell phones) and WhatsApp. WhatsApp was used to communicate nutrition information and education, with the previous research stage's youth nutrition booklet serving as a reading reference. There were three types of implementations.

First, trained nutrition education staff and nutrition workers acting as field supervisors distribute educational media. During this activity, the team distributed and explained how to use youth nutrition pocketbooks. Direct and face-to-face activities were only carried out at the beginning and end of intervention activities by both parties, that is, the youth and the research team, by implementing health protocols (using masks, maintaining distance, and washing hands with soap or using hand sanitizers before and after direct contact with participants). Second, online nutrition education, namely delivering key nutrition education messages in the form of booklets and sharing them on the WhatsApp group in stages; the researcher sent the booklet to the teenagers and then to the education staff in the WhatsApp group.

Questionnaires were completed by both groups before the intervention. Blood samples were taken using finger prick capillary blood with the student's written consent and coordination with the school, and were performed and interpreted by trained laboratory personnel at the Public Health Center. The intervention group received booklet material over four sessions lasting 20-30 minutes each. The experimental group participants were divided into six-person groups. This program was organized by nutrition professionals with the assistance of two nutritionists and laboratory personnel from the Utan District Health Center. The importance of nutrition was discussed, as well as the prevalence of anemia and its risk factors, as well as nutritional behavior to prevent iron deficiency anemia. As subjective norms and social supports, sessions were held four times a week with teachers and Public Health Center staff.

Session 1: Understanding the role of red blood cells and iron in the body, symptoms of iron deficiency anemia and its prevalence in young women, reasons for girls' iron needs, and different types of iron in food. Session 2: Understanding the prevalence of iron deficiency anemia in adolescents, risk factors for iron deficiency, and the consequences of iron deficiency. Session 3: A healthy diet, the importance of a healthy diet, the impact of an iron-rich diet on fatigue, a happy life, and introducing students to iron tablets. Session 4: Strengthening the supporting role in providing proper nutrition, correct cooking methods, substituting inexpensive iron-rich foods for expensive iron-rich foods, solutions to eliminating the incorrect habit of taking iron pills at school, forming WhatsApp groups to exchange information, and holding sessions with parents, school officials, and public health center nutrition workers. Session 5: Finding nutritional information and accessing sources, the importance of student diets, and

lectures by patients with iron deficiency anemia about complications and disease burden.

To participate in these activities, educational sessions were conducted four times a week for students, and a WhatsApp group was formed to exchange information with parents, with at least five educational and encouraging messages sent to parents each week. An educational session for the control group was held at the end of the study to address ethical concerns. Blood sampling and questionnaires were completed eight weeks after the intervention. SPSS software was used to analyze the data, which included paired or independent t-tests, chi-square tests, and a significant level of $p < 0.05$. The Health Research Ethics Commission of the Health Polytechnic of Mataram No: LB.01.03/6/3178/2022 dated 4 April 2022 granted ethical approval.

3. Results and discussion

In this study, 97 female students in the 7th, 8th and 9th grades of SMPN 1 Utan participated. The average age of the students in the intervention group was 14.35 ± 1.72 years and 14.60 ± 1.54 years in the control group. The independent t-test revealed no significant difference between the two groups ($p = 0.158$). In terms of household monthly income ($p = 0.236$), father's education ($p = 0.159$), mother's education ($p = 0.173$), mother's occupation (0.425), and father's occupation ($p = 0.236$) were significantly different. Both groups had no statistically significant difference (Table 1). Before the intervention, there was no significant difference between the two groups in terms of knowledge, attitudes, self-efficacy, reinforcing factors, supporting factors, and nutritional behavior for preventing iron deficiency anemia. These findings suggested that the characteristics of the research subjects in the intervention and control groups were similar. As a result, the intervention's effect is not expected to be affected.

However, 5 weeks after the intervention, the experimental group showed a significant improvement (Table 2). According to the study's findings, there was no significant difference in the mean hemoglobin score between the two groups before the intervention. However, 5 weeks after the intervention, there was a small but significant increase in hemoglobin levels in the experimental group.

3.1 Effect of nutrition education on teenagers' anemia and nutritional status

The results (Table 2) revealed no significant difference in mean hemoglobin (Hb) levels between the intervention and control groups at baseline ($p = 0.084$) or after the intervention ($p = 0.069$). However, the

Table 1. Comparison of the frequency distribution of demographic variables in the experimental and control groups.

Variables	Experimental group		Control group		P-value
	Number	Percentage	Number	Percentage	
Educational stage					
7th grade	13	27.1	15	30.6	0.158
8th grade	17	35.4	16	32.7	
9th grade	18	37.5	18	36.7	
Household monthly income					
Less than 2 million rupiah	20	41.7	19	38.8	0.236
2-5 million rupiah	17	35.4	20	40.8	
More than 5 million rupiah	11	22.9	10	20.4	
Mother's occupation					
Housewife	30	62.5	33	67.3	0.425
Government employed	0	0	0	0	
Others	18	37.5	16	32.7	
Father's occupation					
Government employed	5	10.4	3	6.1	0.236
Self-employed	24	50	25	51	
Others	19	39.6	21	42.9	
Mother's education					
Primary school	16	33.3	14	28.6	0.173
Secondary school	12	0.25	13	26.5	
High school	16	33.3	17	34.7	
College	4	8.3	5	10.2	
Father's education					
Primary school	14	29.2	9	18.4	0.159
Secondary school	14	29.2	11	22.4	
High school	18	37.5	23	46.9	
College	2	4.2	6	12.3	

Table 2. Comparison of mean score of booklet model constructs in the experimental and control groups before and after the intervention.

Variable	Group	Before Intervention	5 weeks after the intervention	p-value
Knowledge	Experimental	7.34±1.26	12.98±1.35	< 0.001
	Control	7.78±1.81	8.14±1.70	0.327
	P-value	0.164	P < 0.001	
Attitude	Experimental	20.34±4.11	42.25±4.55	< 0.001
	Control	21.62±4.08	22.53±4.26	0.258
	P-value	0.173	P < 0.001	
Self-efficacy	Experimental	11.32±3.62	33.39±3.74	< 0.001
	Control	11.96±3.87	12.70±3.89	0.147
	P-value	0.347	P < 0.001	
Reinforcing factors	Experimental	14.40±2.65	28.18±2.09	< 0.001
	Control	14.12±2.80	15.22±2.46	0.169
	P-value	0.228	P < 0.001	
Enabling factors	Experimental	9.42±1.16	20.35±1.29	< 0.001
	Control	8.84±1.72	9.16±1.79	0.164
	P-value	0.256	P < 0.001	
Preventive behaviors	Experimental	6.51±1.25	17.65±1.09	< 0.001
	Control	6.86±1.12	7.50±1.18	0.192
	P-value	0.317	P < 0.001	
MUAC	Experimental	20.74±2.18	21.05±2.36	< 0.089
	Control	20.31±2.32	20.61±2.12	0.748
	P-value	0.296	P < 0.127	
Hemoglobin	Experimental	10.34±0.86	10.78±0.85	< 0.065
	Control	10.58±0.82	10.46±0.79	0.188
	P-value	0.084	P < 0.069	

Values are presented as mean±SD.

intervention group's average increase in Hb levels was slightly higher (0.44 g/dl) than the control group. There was no significant effect of nutrition education on hemoglobin levels before and after the intervention after 5 weeks of intervention (DID: 0.069; 95% CI: 0.19 - 0.95). Similarly, LILA at the start and end of the group was not statistically significant ($p > 0.05$), and the analysis of LILA before and after was not significant (DID: 0.748; 95% CI: 0.89 - 3.15). However, the average LILA increased by 0.31 cm in the intervention group and 0.31 cm in the control group, but this difference was not statistically significant ($p = 0.065$).

The results showed that nutrition education using a combination of offline and online strategies using booklets did not significantly increase the average hemoglobin and LILA levels. Teenagers typically have a decrease in hemoglobin due to the menstrual cycle. Because the concentration of red blood cells in the blood decreases during menstruation, the blood volume increases by up to 50% to provide red blood cells. Given the increase in anemia in the country and the importance of promoting anemia control behaviors, intervention through the implementation of behavior change patterns is critical. There is also a need to educate the public about anemia prevention and lifestyle changes. The purpose of this study was to assess the effectiveness of a nutrition education model on iron deficiency anemia in students in the seventh, eighth, and ninth grades at SMP 1 Utan. In this study, there were no significant differences between study groups in demographic status, questionnaire means score, iron deficiency anemia prevention behavior, or hemoglobin before educational intervention.

The results also revealed that the average knowledge and attitudes score in the experiential group increased significantly 5 weeks after the intervention, demonstrating the effect of the booklet model on increasing knowledge and positive attitudes toward eating behavior to prevent anemia.

Nutrition education increased knowledge, attitudes, and experimental performance regarding eating behavior to prevent anemia 6 weeks after the intervention, according to Mansourian *et al.* (2013) in a quasi-experimental study. Vaezi *et al.* (2018) examined the impact of a multimedia education package on preventing iron deficiency anemia on female students' health literacy. The results showed a significant increase in the average scores of students' knowledge, attitudes, and performance in the experimental group and one month after the intervention. Teachers, medical and health teams, and friends are the most important sources of information about iron deficiency anemia. Educational

interventions increased women's knowledge about iron deficiency anemia (Abd Elhameed *et al.*, 2012; Ayub *et al.*, 2015; Otoo and Adam, 2016; Robertson and Ladlow, 2017).

Ghaderi *et al.* (2017) found that educational interventions increased knowledge, self-efficacy, and anemia-prevention behavior. According to the supporting factors, there was a significant difference between the experimental and control groups after the intervention. Furthermore, educational sessions for the experimental group included small group discussions and iron deficiency anemia booklets, which increased students' knowledge and positive attitudes toward eating behavior to prevent anemia. Ardebili *et al.* (2018) found that the mean factor enabling score in the experimental group increased significantly within 3 months of the intervention. In the study of Shahnazi *et al.* (2012) the intervention for the experimental group consisting of three 60-minute educational sessions, the average score of supporting factors and behavior to prevent iron deficiency anemia increased significantly in the experimental group within 3 months after the intervention. In a quasi-experimental study by Jalambadani *et al.* (2015) the mean scores of knowledges, attitude, perceived behavioral control, intention, and use of iron tablets increased significantly in the experimental group 3 months after the intervention.

This study also found that in the experimental group, the average change in LILA scores did not show a significant increase after the educational intervention for two months, and there was no significant variation in the control group. The results also revealed that the experimental group's hemoglobin level was not significantly different from the control group two months after the intervention. LILA and hemoglobin levels in the experimental group revealed that knowledge, attitude, self-efficacy, reinforcing factors, and supporting factors did not influence encouraging nutritional behavior to prevent iron deficiency anemia. This is due to the study's short duration and length. Mehrabian *et al.* (2016) found that the BASNEF model educational intervention improves nutritional behavior to prevent iron deficiency anemia and increases hemoglobin levels in the intervention group. Jalambadani *et al.* (2015) found that the theory of planned behavioral education interventions increased iron supplementation behavior and ferritin levels in a study. In a study conducted by Alaofe *et al.* (2009), the mean score of knowledge, iron intake, hemoglobin, and ferritin increased significantly after the intervention in the experimental group.

Chau *et al.* (2018) found that social media is a

promising nutrition intervention platform for adolescents and young adults in a systematic review. Another study conducted in Purwokerto, Indonesia by Zaki (2019) found that social media-based nutrition education increased knowledge of nutrition, energy intake, and protein intake in both rural and urban areas. A study by Khotimah (2019) found that nutrition education on Facebook significantly increased participants' knowledge of anemia, protein consumption, iron consumption, and vitamin C consumption. A systematic review by Laroche et al. (2020) found that social media might be perceived as a possible means of communication to promote healthy lifestyle habits in organizations; however, several authors have recommended additional research on this technology to evaluate the additional impact of social media and promoting a healthy lifestyle.

The nutrition pocketbook or booklet served as a self-evaluation tool for daily nutrition practices. While online education was carried out in a structured and systematic manner by distributing nutritional information in the form of pamphlets on social media platforms such as WhatsApp. During a pandemic, such as the current COVID-19 pandemic, the hybrid learning education method is best suited. To prevent disease transmission, only limited direct individual contact is required. As a result, teenagers with lower levels of anxiety can access health services, particularly nutrition education. Essentially, the strategy model can be used under normal conditions after the pandemic is over to optimize limited resources and costs. This can help increase the reach of educational materials via alternative communication channels such as social media. Despite the rigorous sampling and systematic approach to nutrition education, this study only included a small population with a small sample size. The short educational intervention lasted only 5 weeks and consisted of only four live sessions per week. As a result, the effect of education on Hb and LILA levels may be insufficient.

4. Conclusion

Nutrition education did not significantly increase the mean hemoglobin and middle arm levels in student women in the intervention group. The public health centers are expected to develop a structured educational model.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

The research work was funded by the Faculty of Nutrition, Health Polytechnic of Mataram, West Nusa Tenggara, Indonesia.

References

- Abalkhail, B. and Shawky, S. (2002). Prevalence of daily breakfast intake, iron deficiency anaemia and awareness of being anaemic among Saudi school students. *International Journal of Food Science and Nutrition*, 53(6), 519-528. <https://doi.org/10.1080/09637480220164370>
- Abd El Hameed, H., Mohammed, A. and Abd ElHameed, L. (2012). Effect of nutritional educational guideline among pregnant women with iron deficiency anemia at rural area in Kalyobia Governorate. *Life Science Journal*, 9(2), 1212-1217.
- Abedini, Z., Lotfi, M.M. and Parvizi, F. (2010). Prevalence of iron deficiency anemia and its related factors in school age children. *Pejouhandeh Journal*, 15(5), 208-212.
- Ahmad, M.M., Dardas, L.A. and Ahmad, H. (2015). Cancer prevention and care: a national sample from Jordan. *Journal of Cancer Education*, 30(2), 301-311. <https://doi.org/10.1007/s13187-014-0698-7>
- Al-Tell, M.A., El-Guindi, F.K., Soliman, N.M. and El-Nana, H. (2010). Effect of nutritional interventions on anemic pregnant women's health using health promotion model. *Medical Journal of Cairo University*, 78(2), 109-118.
- Alaofè, H., Zee, J., Dossa, R. and O'Brien, H.T. (2009). Education and improved iron intakes for treatment of mild iron deficiency anemia in adolescent girls in southern Benin. *Food Nutrition Bulletin*, 30(1), 24-36. <https://doi.org/10.1177/156482650903000103>
- Ardebili, H., Bagheri, F. and Shahnazi, H. (2018). The effect of PRECEDE model in preventing iron deficiency anemia in high school students. *Journal of Research and Health*, 8(4), 339-345. <https://doi.org/10.29252/jrh.8.4.339>
- Ayub, R.A., Jaffery, T., Aziz, F. and Rahmat, M. (2015). Improving health literacy of women about iron deficiency anemia and civic responsibility of students through service learning. *Education and Health (Abingdon)* 28(2), 130-137. <https://doi.org/10.4103/1357-6283.170122>
- Benoist, B., McLean, E., Cogswell, M., Egli, I. and Wojdyla, D. (2008). Worldwide prevalence of anemia 1993–2005, WHO global database on anemia. Geneva: World Health Organization. p. 1-4.
- Chau, M.M., Burgermaster, M. and Mamykina, L. (2018). The use of social media in nutrition

- interventions for adolescents and young adults-A systematic review. *International Journal of Medical Information*, 120, 77-91. <https://doi.org/10.106/j.ijmedinf.2018.10.001>
- Chen, M., Su, T., Chen, Y., Hsu, J., Huang, K.L., Chang, W.H., Huang, K.L., Ji Chen, T. and Bai, Y.M. (2013). Association between psychiatric disorders and iron deficiency anemia among children and adolescents: a nationwide population-based study. *BMC Psychiatry*, 4(13), 161. <https://doi.org/10.1186/1471-244X-13-161>
- Falahi, E., Rashidi, M., Ebrahimzadeh, F., Karbasi, S. and Shokrollahi, N. (2010). Effect of nutritional education on iron-deficiency anemia in high schools girls. *Journal of Shahrekord University of Medical Science*, 12(1), 37-45.
- Fathizadeh, S.H., Shojaeizadeh, D., Mahmoodi, M., Garmarodi, G.H., Amirsardari, M., Azadbakht, M. and Gheysvandy, K. (2016). The impact of health education based on PRECEDE model on knowledge, attitude and behavior of grade nine female students about iron deficiency anemia in Qazvin. *Journal of Health*, 7(3), 321-30.
- Ghaderi, N., Ahmadpour, M., Saniee, N., Karimi, F., Ghaderi, C. and Mirzaei, H. (2017). Effect of education based on the Health Belief Model (HBM) on anemia preventive behaviors among Iranian girl students. *International Journal of Pediatric*, 5(6), 5043-5052. <https://doi.org/10.22038/ijp.2017.22051.1844>.
- Glanz, K., Rimer, B.K. and Viswanath, K. (1998). Health behavior and health education: theory, research, and practice. New York: Wiley.
- Goodyear, V.A., Wood, G., Skinner, B. and Thompson, J.L. (2021). The effect of social media interventions on physical activity and dietary behaviours in young people and adults: a systematic review. *International Journal Behavior Nutrition Physical Activity*, 18, 72. <https://doi.org/10.1186/s12966-021-01138-3>
- Jalambadani, Z., Shojaei, Z.D., Hoseini, M. and Sadeghi, R. (2015). The effect of education for iron consumption based on the theory of planned behavior in pregnant women in Mashhad. *Journal Clinical Nursing and Midwifery*, 4(2), 59-68.
- Justine, L. (2009). Empowering our youth. Using school-based programs to increase knowledge and self-efficacy among youth to make positive behavior choices (MA thesis). University of Pittsburgh; p. 9: 04-13.
- Karkar, P.D. and Kotecha, P.V. (2004). Prevalence of anemia among students of Nursing School of Vadodara. *Nursing Journal of India*, 95(11), 257-258. <https://doi.org/10.48029/NJI.2004.XCV1103>
- Khalafallah, A.A. and Dennis, A.E. (2012). Iron deficiency anaemia in pregnancy and postpartum: pathophysiology and effect of oral versus intravenous iron therapy. *Journal Pregnancy* 2012, 2012, 630519. <https://doi.org/10.1155/2012/630519>
- Khotimah, H. (2019). Pengaruh edukasi gizi melalui media facebook terhadap pengetahuan anemia dan konsumsi protein, zat besi, dan vitamin C pada remaja putri desa Tebas Kuala. *Pontianak Nutrition Journal*, 2(1), 477. <https://doi.org/10.30602/pnj.v2i1.477> [In Bahasa Indonesia].
- Kumari, R., Bharti, R.K., Singh, K., Sinha, A., Kumar, S., Saran, A. and Kumar, U. (2017). Prevalence of iron deficiency and iron deficiency anaemia in adolescent girls in a tertiary care hospital. *Journal of Clinical and Diagnostic Research*, 11(8), BC04-BC6. <https://doi.org/10.7860/JCDR/2017/26163.10325>
- Laroche, E., Espérance, S.L. and Mosconi, E. (2020). Use of social media platforms for promoting healthy employee lifestyles and occupational health and safety prevention: A systematic review. *Safety Science*, 131, 104931. <https://doi.org/10.1016/j.ssci.2020.104931>
- Mansourian, M., Shafieyan, Z., Qorbani, M., Rahimzadeh, H., Bazraki, H., Charkazi, A., Asayesh, H., Rastgari, B. and Rezapoor, A. (2013). Effect of nutritional education based on HBM model on anemia in Golestan girl guidance school students. *Iranian Journal of Health Education and Health Promotion*, 2013, 1(2), 51-56.
- McLean, E. and Cogswell, M. (2009). Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993–2005. *Public Health of Nutrition*, 12(4), 444-454. <https://doi.org/10.1017/S1368980008002401>
- Mehrabian, F., Valipour, R., Kasmaei, P., Atrkar Rohan, Z. and Mahdavi, R.M. (2016). The effect of education based on BASNEF model on promoting of nutritional behavior to prevent iron deficiency anemia. *Journal of Holistic Nursing and Midwifery*, 26(1), 89-98.
- Ministry of Health Republic of Indonesia. (2019). Laporan Nasional Riset Kesehatan Dasar Tahun 2018. Retrieved on March 5, 2021 from Badan Penelitian dan Pengembangan website: http://labdata.litbang.kemkes.go.id/images/download/laporan/RKD/2018/Laporan_Nasional_RKD2018_FINAL.pdf [In Bahasa Indonesia].

- Ministry of Health Republic of Indonesia. (2020). Guidelines for nutrition service during the COVID-19 emergency response period for health workers. Retrieved on November 7, 2021 from Ministry of Health Republic of Indonesia website: <https://COVID19.go.id/edukasi/tenaga-kesehatan/pedoman-pelayanan-gizi-pada-masa-tanggap-darurat-pandemi-COVID-19> [In Bahasa Indonesia].
- Mousa, A., Naqash, A. and Lim, S. (2019). Macronutrient and micronutrient intake during pregnancy: An overview of recent evidence. *Nutrients*, 11(2), 443. <https://doi.org/10.3390/nu11020443>
- Mirzaei, H., Shojaeizadeh, D., Tol, A., Ghasemi, G.G. and Shirzad, M. (2018). Application of Health Belief Model (HBM) to promote preventive behaviors against iron-deficiency anemia among female students of high school Fereydan City: a quasi-experimental study. *Iranian Journal of Health Education and Health Promotion*, 5(4), 260-269. <https://doi.org/10.30699/acadpub.ijhehp.5.4.260>
- Nyberg, G., Sundblom, E., Norman, A. and Elinder, S. (2011). A healthy school start Parental support to promote healthy dietary habits and physical activity in children: design and evaluation of a cluster-randomised intervention. *BMC Public Health*, 11, 185. <https://doi.org/10.1186/1471-2458-11-185>
- Olude, O. (2011). Impact of nutrition education and counseling on anemia prevalence and iron status in women of reproductive age. USA: Oklahoma Panhandle State University, MSc Thesis. https://doi.org/10.1096/fasebj.25.1_supplement.989.18
- Otoo, G. and Adam, Y. (2016). Effect of nutrition education with an emphasis on consumption of iron-rich foods on hemoglobin levels of pregnant women in Ghana. *The FASEB Journal*, 30(1), 410-412. https://doi.org/10.1096/fasebj.30.1_supplement.410.2
- Robertson, N. and Ladlow, B. (2017). Effect of individual dietetic intervention on gestational weight gain and associated complications in obese pregnant women. *Australian and New Zealand Journal of Obstetrics and Gynecology*, 58(3), 274-277. <https://doi.org/10.1111/ajo.12711>
- Saputri, N.S., Anbarani, M.D., Toyamah, N. and Yumna, A. (2020). Dampak pandemi COVID-19 pada layanan gizi dan kesehatan ibu dan anak (Kia): Studi kasus di lima wilayah di Indonesia. *The SMERU Research Institute*, 5, 1-8.
- Shahnazi, H., Isfahani, M.T., Azarbin, S., Hassanzadeh, A., Charkazi, A. and Moodi, M. (2012). Impact of education based on PRECEDE model on knowledge, attitude and behavior of grade two guidance school girls regarding iron deficiency anemia (IDA) in Isfahan, Iran. *Health System Research*, 8(5), 773-781.
- Shakouri, S., Sharifi, G.R., Hassanzade, A., Golshiri, P. and Shakouri, M.S. (2009). Effect of health education program base on PRECEDE model for controlling iron- deficiency anemia among high school girl students in Talesh. *Journal of Arak University of Medical Sciences*, 12(3), 41-50.
- United Nations Children's Fund. (2020). Maternal and Child Nutrition: Unicef programming priorities to respond to the socio-economic impacts of the COVID-19 pandemic-respond, recover, and reimagine. Retrieved on November 20, 2021 from website: https://www.nutritioncluster.net/Resources_UNICEF_COVID-19 [Accessed 20th November 2021].
- Vaezi, M., Niknami, S.H., Hidarnia, A. and Goodarzi, A. (2018). Visual media education for prevention of iron deficiency anemia among high school girls in Chabahar City. *Military Caring Science Journal*, 5 (2), 156-162. <https://doi.org/10.29252/mcs.5.2.156>
- World Food Programme, United Nations Children's Fund, Global Nutrition Cluster G. (2020). Protecting maternal diets and nutrition services and practices in the context of COVID-19. Retrieved on November 10, 2021 from website; <https://www.unicef.org/laos/media/4136/file/Protecting%20maternal%20diets%20and%20nutrition%20services%20.pdf>
- WHO. (2006). Regional office for the Eastern Mediterranean region: Guidelines for the control of iron deficiency. Vol. 11, p. 25-27. Washington, DC, USA: WHO.
- Zaki, I., Sari, H.P. and Farida, S.A. (2019). Nutrition education based on multi-media can improve nutrition knowledge and unhealthy snacking habits in adolescents. *Annals of Tropical Medicine and Public Health*, 22(11), S343. <https://doi.org/10.36295/ASRO.2019.221133>
- Zare, H. (2002). The effect of education on high school girls 'knowledge on healthy nutrition and iron deficiency anemia in Mehrize region (Doctoral dissertation, Thesis for graduating of MSC of health education).