Enhancing Hemoglobin Levels and Macro-Micronutrient Intake Through the Well-Being Workshop of First 8000 Days of Life

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KEYWORDS
first 8000 days of life; hemoglobin levels; macro-micronutrient intake; the well-being workshop.

ABSTRACT
Introduction: Chronic malnutrition is a major source of concern in the malnutrition community. Addressing nutritional needs that are inappropriate for pre-conception adolescents in the first 8000 days of life is a trigger for anemia and stunting in children later in life. The authors developed The Well-Being Workshop of First 8000 Days of Life. This study compared the hemoglobin levels and macro-micro nutrient intake of female adolescents before and after the well-being workshop of first 8000 days of life and their assistance.
Methods: An experimental design, within group method, with an equivalent time series design, and 3 times interventions were carried out. A hundred female adolescents aged 14-19 years Yogyakarta city were assigned to this study. All respondents underwent a pretest and posttest before and after being given interventions of well-being workshop. On completion of the three times workshop, blood sampling of haemoglobin level and food record were collected analyzed. In total, the data was collected 3 times after each workshop was held. The data generated was processed using a paired t test.
Results: The average hemoglobin level in female adolescents has increased from the first to the fourth examination, with a standard limit value (> 12.0 gr/dL), but the average of macro and micronutrients intake, as assessed using the Nutrisurvey, is below the standard threshold value. A paired T-test revealed a significant difference within the increase in Hb levels on all examinations. The analysis of macronutrients showed that only fiber had a significant difference before and after a series of well-being workshops of first 8000 days of life interventions, i.e. the first and second examinations. Meanwhile the micronutrient analysis, only iron and zinc there were significant differences before and after being given a series of workshops.
Conclusions: "The well-being workshops of first 8000 days of life" can be considered in changing the eating behavior of female adolescents to increase hemoglobin levels.

1. Introduction

Stunting is a nutritional issue receiving much attention, particularly in Indonesia, because it may interfere with children's physical and mental development. Other negative consequences include health and financial challenges (1). According to data from the 2018 Basic Health Research, the percentage of stunting in the Special Province of Yogyakarta was 27.2% (2), even though stunting would become a public health issue if the prevalence were 20% or higher (3).

Yogyakarta will be one of 320 regencies or cities designated as focus locations for integrated stunting reduction interventions in 2022 by the Ministry of National Development Planning and the National Development Planning Agency in 2020. According to data from the Yogyakarta City Health Office's nutrition section, the stunting rate increased during the early days of the COVID-19 pandemic. This was made possible because POSYANDU (Integrated Service Post) operations had been halted for approximately five months at the start of the pandemic, and the rise in poverty affected people's nutritional intake. The target percentage for reducing stunting in Yogyakarta is 2.33%, so the goal for the stunting rate in 2022 is only 12% (4).

Currently, most central and regional governments have overemphasized the concept of the first 1000 days of life in preventing and overcoming stunting, employing both specific and sensitive nutrition interventions, even though fulfilling nutritional needs in pre-conception adolescents in the first 8000 days of life is inappropriate. is also a risk factor for stunting in children later in life. After the first 1000 days of life, systematic efforts toward appropriate interventions can be carried out in three phases of life, one of which is the availability of adequate nutrition at the time of adolescence, with proper preparation, to create a healthy generation free of stunting (5). This is consistent with the findings of other studies, which show that nutritional status before and during pregnancy is another factor that contributes to stunting. These facts served as the foundation for the Yogyakarta City Government to approve a Mayoral Regulation concerning the Regional Action Plan to prepare a superior generation through the first 8000 days of life program in 2021-2025 (Peraturan Walikota Yogyakarta Nomor 41

Tahun 2021, 2021).

Based on previous research studies conducted in 2022, the average energy intake of 10 young women aged 15-19 years at the Tegalrejo Kemantren Yogyakarta City is 1514.4 kcal (RDA: 2125 kcal) and 5.08 mg iron (RDA: 26 mg). This figure is significantly lower than the 2019 nutritional adequacy rate. If these issues fail to be addressed immediately, they will result in poor nutritional status and a negative impact on physical health during the pre-conception period, which is the initial cause of stunting in children. Based on the problems associated with the preparation of a stunting-free generation through the City of Yogyakarta's first 8000 days of life program, the researchers developed a strategy in the form of the "Remaja Bergerak 8000" using the design thinking that the research team had done the previous year, its orientation towards users, and human values. The purpose of this intervention is to compare the macro-micronutrient intake of youth cadres before and after the well-being workshops and mentoring, and it also involves evaluation monitoring in the application "Remaja Bergerak 8000." This intervention, which was designed with the needs of adolescents and preconceptions in Yogyakarta in mind, is expected to contribute to the Government's target of achieving zero (new) cases of stunting by 2025.

2. Methods

Study Design

This study employed an experimental design, within group method, with an equivalent time series design, and was intervened three times. All participants were given a pretest and a posttest before and after receiving interventions such as hemoglobin checks and food consumption surveys using the food record method. Pretest, intervention, and posttest were all performed three times. The well-being workshops and the “Remaja Bergerak 8000 HPK” mobile application were the independent variables in this study. The dependent variables are hemoglobin levels and macro-micronutrient intake. The confounding variables are family income and recent education. Hemoglobin levels and macro-micronutrient intake are measured using a ratio scale. Normal hemoglobin levels in children and early adolescents range from 10 to 14 g/dL; in adolescents and adult males, from 13 to 17 g/dL; and in adolescents and adult females who are not pregnant, from 12 to 16 g/dL (13.14). Energy, carbohydrates, protein, and fat are all assessed in the macronutrient intake, while vitamin A, iron, and zinc are assessed in the micronutrient intake.

Sample/Participants

This study took 100 female adolescents aged 14 to 19 in Yogyakarta city who met the criteria. Healthy female adolescents who have a smartphone and are willing to participate in the entire research series, including taking blood samples for hemoglobin check and attending the well-being workshops of 8000 first days of life, are eligible. Adolescents who were sick and needed treatment were excluded, and they were said to have dropped out if the female adolescents stopped in the middle of the research series.

Interventions

Three workshops were run from July to September 2022. A total of 100 female adolescents as the youth cadres, joined four concurently run sessions of the “Well-being Worskhops of 8000 first days of life”. It is a training model developed by the authors' team in the prevention and early detection of stunting by youth cadres since 2021. The projects are as follows: education about the concept of the 8000 first days of life; stunting and anemia, their effects and prevention; self-care, empathy and communication; the development and cooking of functional food with a high nutritional intake to prevent stunting and anemia; and coaching youth cadres and their peer groups through the "Remaja Bergerak 8000 HPK" mobile application.

Data Collection

Four research assistants collected data from all participants for blood sampling and nutritional intake survey on pre-intervention 1 and post-intervention 1,2,3. During the intervention and data collection process, there was no unintentional harm or program-related negative effects among the participants.

Data Analysis

All statistical analysis were conducted using IBM SPSS version 26.0. Descriptive statistics were used to describe the characteristics of the participants. The Wilcoxon test were used to examine the differences between pre-intervention and post-intervention.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of Universitas Sebelas Maret. Each participant willingly signed a consent from after learning about the goal of the study, the processes involved, and their rights to confidentiality and withdrawal autonomy. Permission to use the instruments was granted by the original authors before data collection.

3. Results

Characteristics of the Respondents

This study involved 100 female adolescents who lived in the Kricak subdistrict as respondents, with an average age of 15 years and a normal body mass index (BMI), calculated by weight divided by height squared, as detailed in Table 1.

Based on the same table, the average hemoglobin (Hb) level in female adolescents has increased from the first to the fourth examination, with normal limit values (> 12.0 gr/dL). However, there are still respondents who are diagnosed with moderate anemia, with Hb levels ranging from 9.3 gr/dL to 9.9 gr/dL (7). In response to the 2019 Nutrition Adequacy Rate (RDA) table, the average intake of both macro and micronutrients, as measured by Nutrisurvey, is below the normal threshold value. Particularly a small percentage of respondents had favorable energy and protein analysis results (energy > 2100 kcal; protein > 65) (Kemenkes RI, 2019).

Table 1. Distribution of Respondents' Characteristic

Characteristic	n = 100		
	mean±SD	median	min-max
Age	15.9±1.25	16	14 – 19
Weight	51.2±11.36	46.0	36 – 84
Height	153.1±6.25	154	133 – 172
Upper arm circumference	24.9±2.74	25	20 – 32
Nutritional status	21.8±4.50	20.3	16.4 – 34.5
Hemoglobin level (Hb level)			
Hb level 1 (first check)	12.0±1.53	12.1	9.3 – 15.3
Hb level 2 (second check)	12.5±1.27	12.6	9.6 – 15.2
Hb level 3 (third check)	12.7±1.33	12.9	9.8 – 15.0
Hb level 4 (fourth check)	12.9±1.37	13.0	9.9 – 15.0
Macronutrient analysis			
Energy 1 (first check)	1499.5±631.24	1309.3	608.6 – 2574.9
Protein 1	39.6±19.04	38.6	3.4 – 82.5
Fat 1	45.9±21.89	41.7	15.9 – 107.6
Carbohydrate 1	142.8±26.99	151.4	80.9 – 187.5
Energy 2 (second check)	1598.9±638.94	1358.9	608.6 – 2737.7
Protein 2	41.9±16.73	38.6	17.0 – 82.5
Fat 2	46.1±24.07	39.7	14.0 – 107.6
Carbohydrate 2	149.1±30.69	151.5	94.8 – 234.4
Energy 3 (third check)	1616.6±619.35	1336.4	608.6 – 2737.7
Protein 3	39.8±18.77	38.8	3.4 – 82.5
Fat	46.4±22.13	41.7	15.9 – 107.6
Carbohydrate 3	143.9±25.83	151.4	80.9 – 187.5
Energy 4 (fourth check)	1620.2±622.62	1339.2	608.6 – 2737.7
Protein 4	42.7±16.81	38.9	17.0 – 82.5
Fat 4	46.5±24.19	39.9	14.0 – 107.6
Carbohydrate 4	149.7±30.92	151.5	94.8 – 234.3
Micronutrient analysis			
Calcium 1 (first check)	112.4±57.41	85.6	42.7 – 204.9
Iron 1	3.5±0.99	3.4	1.4 – 5.3
Zinc 1	3.7±1.59	3.7	1.7 – 8.2
Calcium 2 (second check)	114.9±81.7	83.0	42.5 – 424.5
Iron 2	4.2±1.7	4.0	1.7 – 11.2
Zinc 2	4.1±1.9	3.5	1.7 – 8.2
Calcium 3 (third check)	115.5±57.22	87.7	42.7 – 204.9
Iron 3	3.6±1.04	3.4	1.4 – 5.3
Zinc 3	3.7±1.60	3.1	1.7 – 8.2
Calcium 4 (fourth check)	115.9±81.14	83.4	42.5 – 424.5
Iron 4	4.3±1.73	4.1	1.7 – 11.2
Zinc 4	4.2±1.88	3.6	1.7 – 8.2

Differences in Hb Levels and Analysis of Macro-Micronutrients Before and After the Well-Being Workshops of first 8000 days of life 1, 2, 3, and 4

As stated in Table 2, there is a significant difference in the increase beyond Hb levels between the first and second, second and third, or third and fourth examinations. The fiber content had a significant difference before and after a series of capacity-building workshop interventions, namely at the first and second examinations, according to the results of the macronutrient analysis. Meanwhile, iron and zinc showed significant differences before and after a series of well-being workshops of 8000 first days of life, including the first vs second, second vs third, and third vs fourth iron examination, as well as the first zinc examination. vs second, second vs third, and third vs fourth.

Table 2. Differences in Hb Levels and Analysis of Macro-Micronutrients Before and After the Well-Being Workshops of first 8000 days of life 1, 2, 3, and 4

Variable	P value
Hb Level	
Hb level 1 vs Hb level 2	<0.001*
Hb level 2 vs Hb level 3	<0.001*
Hb level 3 vs Hb level 4	<0.001*
Macronutrient analysis 1 vs 2	
Energy 1 vs energy 2	0.148
Protein 1 vs protein 2	0.194
Fat 1 vs fat 2	0.675
Carbohydrate 1 vs carbohydrate 2	0.079
Macronutrient analysis 2 vs 3	
Energy 2 vs energy 3	0.594
Protein 2 vs protein 3	0.236
Fat 2 vs fat 3	0.425
Carbohydrate 2 vs carbohydrate 3	0.170
Macronutrient analysis 3 vs 4	
Energy 3 vs energy 4	0.237
Protein 3 vs protein 4	0.098
Fat 3 vs fat 4	0.883
Carbohydrate 3 vs carbohydrate 4	0.096
Micronutrient analysis 1 vs 2	
Calcium 1 vs calcium 2	0.586
Iron 1 vs iron 2	0.001*
Zinc 1 vs zinc 2	0.031*
Micronutrient analysis 2 vs 3	
Calcium 2 vs calcium 3	0.345
Iron 2 vs iron 3	0.010*
Zinc 2 vs zinc 3	0.014*
Micronutrient analysis 3 vs 4	
Calcium 3 vs calcium 4	0.391
Iron 3 vs iron 4	0.001*
Zinc 3 vs zinc 4	0.003*

*) significant $p<0.05$ based on the Wilcoxon test

4. Discussion

The results revealed that the average hemoglobin (Hb) level in female adolescents increased from the first to the fourth examination, with normal limit values (> 12.0–15.0 gr/dL), but there were respondents with moderate anemia with Hb levels ranging from 9.3 gr/dL to 9.9 gr/dL. Based on the World Health Organization, in its report through the vitamin and mineral nutrition information system, children aged 12–14 and women aged 15 years and older have a normal Hb level of 12.0–15 gr/dL, are mildly anemic if their Hb level is 11.0–11.9 gr/dL, are moderately anemic if their Hb level is 8.0–10.9 gr/dL, and are severely anemic if their Hb level is less than 8.0 gr/dL (7).

This study discovered significant differences in the increase in Hb levels between the first and second, second and third, and third and fourth examinations. Iron is stored in the muscles and the spinal cord. When iron stores in the spinal cord, which are used to produce hemoglobin (Hb), are depleted (9). Hb transports oxygen from the lungs throughout (10). When Hb levels fall, free protoporphyrin erythrocytes rise, resulting in decreased heme synthesis and shrinking erythrocyte size (microcytic erythrocytes). Iron anemia will result from conditions such as these (9). Aside from causing iron anemia, iron deficiency can impair the body's immune system, allowing

infectious diseases to enter the body more easily. Children's linear growth will be affected by iron anemia and prolonged infectious diseases (11).

In response to the 2019 Nutrition Adequacy Rate (RDA) table, the average intake of both macro and micronutrients, as measured by the 3x24-hour food recall method over four examinations, was below the normal threshold value. Only a portion of the respondents obtained the energy analysis results. and protein in the good category. According to the Minister of Health's Regulation, the adequacy rates for energy, protein, fat, carbohydrates, fiber, calcium, iron, and zinc for young women aged 13–18 years are as follows: 2050–2100 kcal; 65g; 70g; 300g; 29g; 1200mg; 15mg; and 9 mg (Kemenkes RI, 2019).

The macronutrient analysis revealed that there was no significant difference between before and after the intervention series of capacity-building workshops (p value of 0.05). Meanwhile, only iron and zinc showed significant differences before and after being given a series of well-being workshops of 8000 first days of life, including the first vs second, second vs third, and third vs fourth iron and zinc examinations.

Only a small proportion of respondents in this study had adequate energy intake based on the 2019 RDA, as the majority of them had less than 2100 kcal on average. Inadequate energy intake can result in decreased plasma insulin synthesis, resulting in decreased performance of IGF-binding protein-1, thyroid hormone, and other systemic factors involved in fibroblast growth factor (FGF-21), despite the fact that all of them play a role in linear growth (12).

Consumption of both vegetable and animal protein ranged from 39.6 g/day to 42.7 g/day in female adolescents who participated in this study from the first to fourth examinations. Because protein functions to modify the secretion and action of the osteotropic hormone IGF-I, protein intake can modulate the genetic potential for achieving peak bone mass. Low protein consumption has been shown to impair bone mineral acquisition by interfering with IGF-I production and its effects. IGF-I stimulates chondrocyte proliferation and differentiation in the epiphyseal growth plate and has a direct effect on osteoblasts. Furthermore, IGF-I promotes the kidney's conversion of 25 hydroxyvitamins D3 to the active hormone 1,25 dihydroxy vitamin D3, which contributes to increased calcium and phosphorus absorption in the intestine (13). When compared to branched-chain amino acids, increased intake of aromatic amino acids results in higher serum IGF-I levels. Intake of certain protein foods containing aromatic amino acids plays a greater role in bone modeling and peak bone mass acquisition. The aromatic amino acids consist of phenylalanine, tyrosine, and tryptophan (14). Furthermore, meeting the need for quality micronutrients is closely related to protein consumption, particularly animal protein, in relation to overcoming micronutrient problems, particularly the minerals iron, zinc, selenium, calcium, and vitamin B12, which are linked to stunting (15). In addition to essential amino acids and micronutrients, protein provides energy in low-energy conditions via carbohydrates and fats (16,17).

This study found that the average respondent's calcium intake was 1200 mg, with the highest intake being only 424.5 mg/day. According to other research studies, the concentration of calcium in the plasma, particularly free calcium ions, is very carefully maintained in order to transmit nerve impulses and muscle contractions, as well as to act as a catalyst for various biological reactions such as vitamin B12 absorption, the action of fat-breaking enzymes, pancreatic lipase, insulin secretion by the pancreas, and the formation and breakdown of acetylcholine. Calcium homeostasis is primarily regulated by integrated hormonal systems that regulate calcium transport in the intestine, kidney, and bone. This process involves the two major calcium-regulating hormones, PTH and PTH receptors, as well as 1,25(OH)2D and vitamin D receptors, serum ionized calcium, and calcium-sensing receptors. By transporting calcium to and from bone stores, serum calcium homeostasis evolves to keep extracellular calcium ion levels within normal ranges (18). The demands on bone mineralization are very high during growth; despite maximal secretion from the parathyroid glands, a very low calcium intake can lead to hypocalcemia, which can result in undermineralization of the new bone deposit matrix and osteoblast dysfunction. If the calcium content in the bones is less than 50% of the normal content, linear growth will be affected. Rickets can occur in infants due to a lack of calcium in the bones, whereas growth retardation can occur in children due to a lack of deposits (18). Calcium deposits in the organic matrix as hydroxyapatite crystals during the mineralization process, providing bone strength. Milk and milk products are the main sources of calcium, but fish and seafood also have more calcium than beef or chicken. The consumption of milk by teenagers provides adequate calcium. Calcium deficiency during growth can reduce the mass and hardness of the bones that are being formed. Calcium deficiency affects the immune system, nervous system barriers, and heart muscle contraction power, in addition to affecting bone and tooth growth. Adequate calcium intake is required for adolescent bone mass development and maintenance. Lack of calcium intake during adolescence disrupts bone health and metabolism, causing growth and peak bone mass to be disrupted, affecting linear

growth.

5. Limitations of the Study

This research was only conducted in three districts in one municipality. Additionally, this study was conducted from July 2022 to September 2022 due to COVID restrictions. Thus, only participants with complete vaccinations were enrolled.

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