ORIGINAL ARTICLE

Effectiveness of android-based educational media on knowledge, dietary intake and hemoglobin levels for prevention of anemia in adolescent females

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ABSTRACT

Compared to other media, such as print, audiovisual, and social media, educational media based on Android applications must be generated more broadly to prevent anaemia in adolescent females. This study compares the effects of e-posters and LADIES, an android-based educational media intervention, on female adolescents' knowledge, dietary intake, and haemoglobin levels. This study was conducted using the quasi-experimental method from July to October 2022. This research utilised a pre-test-post-test and a control group design. This study's sample comprised 49 adolescent females between the ages of 16 and 17, divided into two groups. The intervention group (n = 25) used the LADIES application media; on the other hand, the control group (n = 24) utilised the e-poster media. Results showed the average score of the knowledge (55.60 vs 91.80), nutritional intake (protein (49.41gr vs 54.38 gr), iron (6.42 mg vs 11.50 mg), and vitamin C (12.17mg vs 35.75mg)), and haemoglobin levels (12.34 mg/dl vs 13.21 mg/dl) in the LADIES group before and after the intervention and the average score of the knowledge (52.92 vs 86.46), nutritional intake (protein (50.29 gr vs 67.81 gr), iron (5.88 mg vs 8.96 mg) and vitamin C (11.49 mg vs 33.09 mg)), and haemoglobin levels (12.41 mg/dl vs 12.95 mg/dl) in the e-poster group before and after the intervention. The findings indicated that there were differences between groups in knowledge and nutritional intake (protein and iron) ($p<0.01$). However, there was no difference between groups in vitamin C intake ($p=0.841$) or hemoglobin levels ($p=0.928$). Education using Android-based media (LADIES) is more effective than e-poster media in enhancing female adolescents' knowledge, nutrient intake, and haemoglobin levels.

Key words:
anemia; android-based educational media; dietary intake; hemoglobin levels; knowledge

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INTRODUCTION

Lack of knowledge of nutrition, particularly regarding food intake, is one of the indirect causes of anemia. According to Paputungan's research findings from 2016, 51.4% of young women had low nutritional intake because they were unaware of anemia.[1] According to various estimates, 41% of the 370 million women with iron deficiency anaemia in developing countries are not pregnant. The Riskesdas data demonstates that the prevalence of anaemia among adolescent females increased from 37.1% in 2013 to 48.8% in 2018.[2] Adolescent nutritional issues are caused by an imbalance between nutritional intake and requirements generated by unhealthy eating habits and a lack of nutritional understanding. Adolescents with inadequate education are more prone to anaemia than those with sufficient knowledge.[3] According to the research conducted in Palestine and India, most adolescents had little understanding of the relationship between anaemia and nutrition.[4]

Education is an alternative option for addressing nutritional issues caused by ignorance of nutrition. Health education aims to raise knowledge among individuals, communities, and groups; thus, they may make well-informed decisions regarding their health and behaviour.[5] Compared to supplementation-only intervention programmes, integrated educational intervention programmes (education) play a role in preventing anaemia among adolescents. Positive results can be obtained when an instructional technique is implemented in schools to avoid anaemia in adolescent females. It has been established that prevention of anaemia in young girls through integrated education at a school named MERAJUT (a programme to prevent anaemia in adolescents) increases adolescent females' awareness of anaemia; however, the assessment findings of the instructional methods are less engaging to adolescents since they are solely presented as media presentations and lectures.[6]

Indonesia had the highest number of smartphone users, with over 103 million users in 2018 and 65.34 % of smartphone users were between the ages of 9 and 19. [11] Adolescents have the opportunity to develop their digital health literacy, specifically concerning iron deficiency anaemia. This study aimed to examine how android-based education (LADIES) affects female adolescents' knowledge, nutritional intake, and haemoglobin levels. This study was prompted by the high rate of anaemia in adolescent females and the proclivity of adolescents to use smartphones[11]; thus, the Android-based educational approach (LADIES) is a serious method to enhance adolescent females' knowledge by improving nutritional intake and haemoglobin levels to avoid anaemia in adolescent females.

METHODS

Research design and population sample

This study was a quasi-experimental design with a pre-test post-test and a control group. In this study, respondent adolescent females from two schools, State Islamic High School (MAN) Model Manado and Vocational Islamic High School (MAK) Madani Manado, with a total sample size of 49 participants divided into two groups; the LADIES and the e-poster. Inclusion criteria in this study; class XI students; have Android and Whatsapp applications (active every day); never received anemia education before; signed the informant consent form and exclusion criteria; not willing to be research respondents. The LADIES group (n = 25) obtained application media for the LADIES application (Fig. 1); on the other hand, the e-poster group (n = 24) received e-posters

(Fig. 2) through the Whatsapp application. The sampling method employed purposive sampling. The sample size was determined using a minimal sample formula while accounting for the possibility of a 20% dropout.[12]

Instruments and Data Collection

This study was based on recommendations for permission from Hasanuddin University's ethical commission, its reference number 6632/UN.4.14.8/PT.01.04/2022. The data collected in this study included adolescent knowledge about anemia, causes of anemia, symptoms of anemia, effects of anemia, prevention of anemia, heme and non-heme iron as well as food inhibitors and food enhancers which were obtained by filling out a questionnaire of 20 questions and the measurement results obtained from correct answers were given a value of 1 and incorrect answers were given a value of 0. Nutritional intake data in this study included protein, Fe and vitamin C intake obtained by the interview method using a 2x24 hour food recall with the help of photos from food books which were then analyzed using the nutrisurvey application. Data on hemoglobin levels for young women were collected using the Easy Touch GCHb tool. The research was conducted between July and October of 2022 for 12 weeks. Each week (2 days along 30 minutes), information was submitted, and each month, the same information was repeated three times. The study's objective was to compare the instructional media utilised by the LADIES group, which obtained media through the LADIES application, and the e-poster group, which received e-posters through the WhatsApp application.

Data Analysis

Using the SPSS version 21 programme, all data obtained from questionnaires, 24-hour recall, and haemoglobin level data were extracted and analysed. The ordinal data were statistically evaluated after passing a normality test. In this study, the data were analysed using a paired test to determine the effect of educational interventions on knowledge, nutritional intake, and haemoglobin levels before and after the intervention and an independent sample t-test to determine whether the effect of education differed between groups with the significant level <0.05.

RESULT

Two groups of 49 adolescent females completed the intervention in three months. Table 1 displays the characteristics of respondents with an average age of 16 years. Fathers in the LADIES group were predominantly public servants (28%) and private business owners (29%). Both groups' mothers are primarily homemakers. In Manado City, most parents earned more than the minimum wage, with an average monthly income of Rp 3,377,365 for the LADIES category (88%) and the e-poster group (79%). Consequently, it was concluded that the data was homogenous, as there were no variations between the LADIES group and the e-poster group characteristics compared to the previous study.

Table 1. Frequency Distribution of Respondent Characteristics

Variable	LADIES		e-poster	
	n	%	n	%
Age				
16 Years Old	18	72	16	66.7
17 Years Old	7	28	8	33.3
Total	25	100	24	100
Father's Occupation				
Farmer	1	52	0	0
Fisherman	0	0	1	4.2
Laborer	0	0	3	12.5
Governmental worker	11	28	6	25
Private sector worker	6	12	7	29.2
Entrepreneur	2	8	5	20.8
Unemployment	0	0	2	8.3
Total	25	100	24	100
Mother's Occupation				
Housemaker	13	52	18	75
Governmental worker	7	28	4	16.6
Private sector worker	3	12	1	4.2
Entrepreneur	2	8	1	4.2
Total	25	100	24	100

Using the results of the pre-test and an independent t-test, the homogeneity of the two groups was assessed prior to the intervention. The results showed that the knowledge of the two groups of adolescent females was almost equal, with a p-value of 0.194. Table 2 demonstrates that the LADIES and e-Poster groups had various knowledge levels before and after the intervention. The average knowledge gap between the beginning and conclusion of the intervention for the LADIES group was 36.20±0.40. In the e-Poster group, the average knowledge gap between the groups before and after the intervention was 28.34±1.19. The post-intervention analysis yielded a p-value of 0.004, indicating a difference between the two groups.

Table 2. Analysis of the Average Difference in Knowledge of Respondents Before and After the Intervention

Knowledge	Pre-Test (mean±SD)	Post-Test (mean±SD)	(Δ)	*p-value*[a]
LADIES	55.60±6.50	91.80±6.10	36.20±0.40	<0.001
e-Poster	52.08±8.83	80.42±7.64	28.34±1.19	<0.001
p-value[b]	0.194	0.004		

Source: Primary Data (2022)

Table 3. Analysis of the Average Difference in Nutritional Intake of Respondents Before and After Intervention

Nutrition Intake	Pre (mean±SD)	Post (mean±SD)	(Δ)	p-value[a]
Protein				
LADIES	49.41±7.82	54.38±9.93	4.97±2.11	0.030
e-poster	50.29±8.10	67.81±8.43	17.52±0.33	<0.001
p-value[b]	0.711	<0.001		
Iron				
LADIES	6.42±2.46	11.50±2.57	5.08±0.15	<0.001
e-poster	5.88±1.36	8.96±1.61	3.08±0.25	<0.001
p-value[b]	0.818	<0.001		
Vitamin C				
LADIES	12.17±3.55	35.75±24.29	23.58±20.68	<0.001
e-poster	11.49±6.23	33.09±22.13	21.60±15.90	<0.001
p-value[b]	0.936	0.841		

The haemoglobin level in the LADIES group was 13.212±1.45, after the intervention. Following an educational intervention utilising an e-poster medium, the e-poster group's average level of knowledge increased to 12.958±0.86. The analysis revealed no difference between the two groups following the intervention, as the p-value was 0.92 (p>0.05). (Table 4).

Table 4. Analysis of the Average Difference in Hemoglobin Levels of Respondents Before and After Intervention

Hemoglobin Levels	Pre-test (mean±SD)	Post-test (mean±SD)	P Value	(Δ)	P Value
LADIES	12.340±1.78	13.212±1.45	0.87±0.33		<0.001
e-poster	12.417±1.16	12.958±0.86	0.54±0.30		<0.001
p-value[b]	0.860	0.928			

Figure 1. LADIES APP

Figure 2. e-Poster

DISCUSSION

Gaining knowledge is one of the first steps toward altering behaviour. Knowledge is significant since it affects an individual's awareness of his actions. Increasing adolescents' understanding of anaemia through education may have a bearing on their behaviour.[13] According to studies conducted in Ghana, Ethiopia, and India, most adolescents are unaware of iron deficiency anaemia, its causes, effects, and prevention methods, which affects the prevalence of anaemia among adolescent females.[14] Media, such as visual or audio-

visual media, must play a role in initiatives to prevent anaemia through the dissemination of knowledge. A previous study demonstrated that those who obtained their education through the audiovisual media were more successful than those who did not.[15]

The study's findings demonstrated that knowledge increased before and after receiving an education using Android-based and e-poster media, with a p-value of <0.001. However, the group (LADIES) that received Android-based media exhibited a more significant average rise of 36.20±0.4. The statistical analysis yielded a p-value of <0.001, indicating that the LADIES group and the e-poster group have a knowledge gap. According to Malaysian research, the average knowledge score of adolescents educated by audiovisual video media and visual media in the form of posters and brochures increased.[16] This is consistent with Mulyono and Wekke's[17] findings that adolescents are currently the predominant mobile phone users, allowing the health sector to provide information and health services through mobile phones. The provision of nutrition counselling through the media and dialogues, which attempts to develop understanding and provide information on nutritional issues in adolescents, can alter adolescents' levels of knowledge.[18]

A lack of nutritional knowledge regarding anaemia is merely one condition that indirectly causes anaemia. Protein intake, the propensity to consume foods that hinder iron absorption (inhibitors), breakfast habits, nutritional status, and the menstrual cycle duration are all factors that cause anaemia.[19] According to another study, educational interventions provided varying degrees of knowledge even when there was no difference in nutritional consumption.[20] However, this study's findings indicated that an Android-based educational media intervention called LADIES had a positive impact on the dietary intake of protein, iron, and vitamin C among young women residing in Manado City. This is due to a feature in the LADIES application called a food diary, which allows users to monitor changes in young women's dietary patterns.

Before the education was implemented, many teenagers continued to drink tea and coffee together with their main meals, but after it was implemented, the teenagers only drank orange juice or mineral water. From these findings, it can be inferred that the LADIES program, when used with e-posters that only concentrate on educational information, has the power to alter young women's consumption habits through the food diary feature. This study's findings are consistent with those of Japanese and English studies, which revealed that a high degree of nutritional knowledge positively affected the consumption of iron-rich fruits and vegetables. [21] This is because gaining knowledge necessitates the adoption of a process into behaviour.

Education must persist in order for it to become an accepted and straightforward value. Moreover, the condition of adolescents still adjusting to standard eating patterns is of concern. During the educational intervention of this study, adolescent females were made aware of their nutritional intake three times. A study indicates that nutritional knowledge affects how people select their dietary decisions.[22] Another consequence of education is the alteration of adolescent eating habits. The prevalence of anaemia may be affected by adolescent iron deficiency or consuming foods that inhibit iron absorption. [23] According to a previous study, by enhancing nutritional knowledge, attempts have been made to improve the balance of energy and nutrient intake in adolescents, such as carbohydrates, protein, fats, vegetables, and fruit.[24] A lack of

nutrition knowledge will allow an individual to consume a daily balanced and diverse diet.

The findings of this study demonstrate that the Android-based educational media intervention (LADIES) enhances teenage females' haemoglobin levels with a p-value of 0.000<0.05. This results from the intervention's encouragement of balanced nutritional intake for adolescent females.[25] In addition to enhancing comprehension, nutrition education has been utilised to ensure adequate assessment intake. [26] The haemoglobin level rises when iron, protein, and vitamin C intake increases. With an increase in iron, protein, and vitamin C, haemoglobin levels will rise, resulting in a low prevalence of anaemia. These findings are consistent with other nutrition education/counselling research, particularly those on iron and haemoglobin levels, which indicate that nutrition education increases awareness of iron nutrition and haemoglobin levels.[27] This inspired researchers to create the LADIES application, an Android-based educational medium, which has numerous advantages over e-posters, including the ability to be accessed by teens anytime and anywhere through an application making it easier for teenagers to obtain facts about anemia. Any teenagers, including those in rural and metropolitan places with limited network connectivity, can use the LADIES program because it doesn't require internet access or a certain number of downloads. The findings of this study allow us to draw the conclusion that the existence of Android-based educational media (LADIES) can influence adolescents' knowledge levels, resulting in changes in their behavior with regard to their dietary intake and hemoglobin levels, allowing us to use this application as a potential preventative measure against anemia in young women.

LIMITATION OF THE STUDY

The limitations of this study are the lack of control over the factors that cause an increase in hemoglobin levels.

CONCLUSION

Android-based educational media (LADIES) has been demonstrated to be superior to e-poster media regarding knowledge gains, protein and iron intake, and haemoglobin levels among female adolescents. The LADIES application can help the government to increase knowledge of young women about anemia and can be paired with giving iron tablets to young women.

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