

# The Effect of Tiktok Video Education and Moringa Oleifera Capsules Enriched with Royal Jelly on the Knowledge and Haemoglobin Levels of Girls Aged 12-15 Years in Takalar Regency

Andi Editya Baso\*, Healthy Hidayanty, Rahayu Indriasari, Abdul Salam and Musfira

Department of Nutrition Science, Faculty of Public Health, Hasanuddin University, Makassar, South Sulawesi, Indonesia

**Abstract:** *Objective:* Anaemia is a common nutritional problem among adolescent girls and has an impact on health, concentration at school, and productivity. Preventing anaemia requires innovative nutritional and educational approaches, including social media popular with teenagers, such as TikTok, and nutritional interventions using *Moringa oleifera* (moringa) capsules enriched with *Royal Jelly*. This study aims to examine the effect of TikTok-based educational videos and *Moringa oleifera* capsules enriched with royal jelly on knowledge and haemoglobin levels among adolescent girls aged 12-15 years in Takalar Regency.

*Methods:* A quasi-experimental study with a pre-post test control group design was conducted involving 61 participants (32 in the intervention group; 29 in the control group). The intervention group received TikTok-based education combined with supplementation, while the control group received supplementation only for 12 weeks. Knowledge was assessed using structured questionnaires, and haemoglobin levels were measured using a HemoCue device. Appropriate statistical tests were applied, including Wilcoxon, Mann-Whitney, paired t-test, and independent t-test.

*Results:* The intervention group showed a significant increase in knowledge (mean difference = 4.31;  $p < 0.001$ ; large effect size), whereas the control group showed no significant change ( $p = 0.457$ ). Haemoglobin levels increased significantly in both groups (intervention: +1.10 g/dL; control: +0.87 g/dL;  $p < 0.001$ ), with no significant between-group difference ( $p > 0.05$ ). The proportion of participants with normal haemoglobin levels increased markedly, especially in the intervention group (12.5% to 78.1%).

*Conclusion:* TikTok-based education effectively improves knowledge, while *Moringa oleifera* capsules enriched with royal jelly significantly increase haemoglobin levels. The combined intervention offers an innovative, contextually relevant strategy to prevent anaemia among adolescent girls.

**Keywords:** TikTok educational videos, moringa oleifera, royal jelly, knowledge, haemoglobin, adolescent girls.

## INTRODUCTION

Adolescence is an important transitional period characterized by rapid changes in physical, cognitive, and psychosocial aspects. During this phase, adolescents require adequate nutrition to support optimal growth and development. However, in Indonesia, adolescents still face various complex nutritional problems, including the triple burden of malnutrition, which consists of undernutrition, overnutrition, and micronutrient deficiencies, including anaemia [1].

Anaemia is one of the main nutritional problems in adolescent girls and is categorized by the WHO as a global public health issue. Anaemia is characterized by low haemoglobin (Hb) levels, i.e., less than 12 g/dL in adolescent girls. This condition can cause fatigue, reduced concentration during learning, impaired immune function, and even the risk of serious complications during the reproductive years [2].

According to the 2018 Basic Health Research (Riskesmas), the prevalence of anaemia in the 5-14 age group in Indonesia reached 26.8% and remains a public health issue to this day [3]. In Takalar District, South Sulawesi Province [4], the prevalence of anaemia among women reached 13.4% and continues to rise among adolescents [4].

The government's efforts to reduce the prevalence of anaemia are carried out through the provision of Iron and Folic Acid (IFA) and nutrition education for adolescents. However, compliance with IFA consumption remains low due to side effects such as nausea, constipation, and changes in stool color [5]. This highlights the need for alternative nutrition interventions based on locally available foods that are more readily accepted, such as *Moringa oleifera* (moringa leaves). Moringa leaves are rich in iron, vitamin C, and antioxidants, which play a crucial role in haemoglobin formation and the prevention of anaemia. The addition of *Royal Jelly*, a natural ingredient containing minerals, proteins, and essential amino acids, can enhance the effect of increasing haemoglobin levels [6]. The combination of *Moringa*

\*Address correspondence to this author at the Department of Nutrition Science, Faculty of Public Health, Hasanuddin University, Makassar, South Sulawesi, Indonesia; E-mail: andieditya017@gmail.com

*oleifera* enriched with *Royal Jelly* has been shown to have a synergistic effect on increasing haemoglobin levels in pregnant women and has the potential to be applied to adolescent girls [7].

In addition to nutritional interventions, increasing knowledge is an important aspect in changing behavior to prevent anaemia. Effective nutrition education must be packaged in an attractive way that is appropriate for today's teenagers, who are familiar with digital media. One popular platform among teenagers is TikTok, a short-video app that can convey educational information visually, quickly, and interactively. Various studies have shown that audiovisual media, such as TikTok, are effective in improving adolescents' nutritional knowledge and healthy behaviors [8, 9].

Despite growing evidence on digital health education and nutritional supplementation, existing studies predominantly examine these interventions in isolation and rarely target adolescent girls using contextually relevant platforms. This study addresses this gap by integrating TikTok-based education with *Moringa oleifera* enriched with royal jelly supplementation, while simultaneously assessing knowledge, dietary behavior, and haemoglobin outcomes.

Therefore, this study was conducted to analyze the effect of TikTok video education and *Moringa oleifera* capsules enriched with Royal Jelly on the knowledge and haemoglobin levels of adolescent girls aged 12-15 years in Takalar Regency.

## RESEARCH METHOD

### Study Design and Participants

This study employed a quasi-experimental design with a pretest-posttest control group to evaluate the improvement in haemoglobin levels among adolescent girls who received *Moringa oleifera* capsules enriched with royal jelly combined with anaemia education delivered via TikTok videos, compared with a control group that received only *Moringa oleifera* capsules enriched with royal jelly without educational intervention.

### Sample Size

The study population consisted of adolescent girls aged 12-15 years attending two junior high schools in South Galesong, Takalar Regency. According to the

Lemeshow formula, the sample size was calculated using the following formula:

$$n = \frac{2(Z1 - \alpha / 2 + Z1 - \beta)^2 \sigma^2}{(U1 - U2)^2}$$

$$n = \frac{2(10,45)(1,65)^2}{(7,96 - 6,55)^2}$$

$$n = \frac{(20,9)(2,7)}{(1,41)^2}$$

$$n = \frac{5,69}{1,98} = 29$$

Based on the sample size calculation above, the minimum required sample was 29 participants. To account for potential dropouts, an additional 20% was added, resulting in a total of 35 participants in the group receiving *Moringa oleifera* capsules enriched with royal jelly and education, and 35 participants in the group receiving *Moringa oleifera* capsules enriched with royal jelly without educational intervention. Of the total participants, 3 adolescent girls in the intervention group refused to consume the *Moringa oleifera* capsules enriched with royal jelly, and 6 adolescent girls in the control group also refused to consume the capsules, resulting in a final analyzed sample of 32 adolescent girls in the intervention group and 29 adolescent girls in the control group.

### Data Collection Procedure

Participants were recruited purposively from two junior high schools in South Galesong, Takalar Regency. To minimize contamination, allocation was conducted at the school level, with one school assigned to the intervention group (TikTok-based education plus *Moringa oleifera*-royal jelly supplementation) and the other to the control group (supplementation only). This non-random allocation was chosen to ensure implementation feasibility and prevent information spillover between participants.

Due to the nature of the intervention, blinding of participants was not feasible. However, outcome measurements were conducted using standardized procedures to reduce measurement bias. Baseline comparability between groups was assessed using statistical tests on key characteristics (e.g., age, parental education, and occupation). Variables that differed significantly between groups were considered potential confounders and were accounted for in the analysis.

In addition to p-values, effect sizes (e.g., mean differences) and corresponding measures of variability are reported to provide a more comprehensive interpretation of the intervention effects.

The main comparison in this study concerns the provision of education via TikTok videos: whether the administration of Moringa oleifera capsules enriched with royal jelly, accompanied by TikTok video education in the intervention group, is more effective than the control group, which received Moringa oleifera capsules enriched with royal jelly without education. Both groups, the intervention and control groups, were given Moringa oleifera capsules enriched with royal jelly at the same dosage: each capsule contained 490 mg of moringa and 10 mg of royal jelly, administered twice a week for 3 months (12 weeks).

The HemoCue 301 device was used to measure haemoglobin concentrations, and structured questionnaires were used to assess knowledge levels. Respondent characteristics, knowledge level, and anaemia status were initially described using univariate analysis.

### Data Analysis

Data normality was assessed using the Shapiro-Wilk test prior to hypothesis testing. For normally distributed continuous variables, paired sample t-tests were used to evaluate within-group differences, and independent sample t-tests were applied for between-group comparisons. For non-normally distributed data, the Wilcoxon signed-rank test and Mann-Whitney U test were employed for within-group and between-group analyses, respectively.

For paired categorical variables (e.g., changes in eating behavior before and after intervention), the McNemar test was used. Meanwhile, Chi-square tests were applied to assess differences in categorical variables between independent groups (e.g., baseline characteristics). In addition to p-values, effect sizes and 95% confidence intervals were reported to provide a more comprehensive interpretation of the findings.

### Ethical Approval

The Health Research Ethics Committee, Faculty of Public Health, Hasanuddin University, granted ethical approval for this study on February 18, 2025, under Ethical Approval Number 327/UN4.14.1/TP.01.02/2025 with Protocol Number 11225091040. Every research

technique was carried out in compliance with the Declaration of Helsinki's ethical guidelines. Prior to data collection, all participants were provided with a clear explanation regarding the objectives, benefits, procedures, and potential risks of the study, and written informed consent was obtained. The confidentiality of participants' identities and data was strictly maintained and used solely for research purposes.

## RESULTS

### Univariate Analysis

Age, father's occupation, mother's occupation, father's education, and mother's education were among the respondent characteristics data collected for this study. The following are the outcomes:

Table 1 presents the baseline characteristics of participants in both groups. Overall, the intervention and control groups were comparable in terms of age distribution and maternal occupation. However, significant differences were observed in paternal occupation and parental education, suggesting potential socioeconomic variation between groups. These variables were therefore considered potential confounders in interpreting the intervention effects (Table 1).

In addition, significant differences in parental education also have important implications. Higher levels of education among fathers and mothers in the intervention group may lead to better nutritional literacy. According to Aditianti (2016), the higher the level of parental education, the more comprehensive their understanding of nutrition. Health knowledge, particularly related to nutrition, has a significant impact on an individual's healthy behaviour because it can influence health-related practices [10]. However, according to Putri (2017), although parental education is an important factor in child growth and development, it cannot be used as a sole benchmark, as higher education does not necessarily guarantee good knowledge in all fields [11].

### Overview of Changes in Adolescent Girls' Knowledge

At baseline, knowledge regarding anaemia was generally low across both groups, indicating limited prior exposure to relevant health information. Following the intervention, the intervention group showed substantial improvement in knowledge, with most participants achieving a good level. In contrast, the

Table 1: Respondent Characteristics

Variable	Group				Total	%	P Value*
	Intervention		Control				
	(32)	%	(29)	%			
<b>Age (Years)</b>							
12	11	34.4	0	0	11	18	0.118
13	16	50	15	51.7	31	50.8	
14	5	15.6	13	44.8	18	29.6	
15	0	0	1	3.4	1	1.6	
<b>Father's occupation</b>							
Civil servant	0	0	1	3.4	1	1.7	0.028
Private employee	9	28.1	0	0	9	14.7	
Self-employed	5	15.6	10	34.5	15	24.6	
Farmer	13	40.6	6	20.7	19	31.1	
Fisherman	5	15.6	11	37.9	16	26.2	
Others	0	0	1	3.4	1	1.7	
<b>Mother's occupation</b>							
Civil servant	2	6.3	1	3.4	3	4.9	0.966
Private employee	4	12.5	0	0	4	6.5	
Farmer	1	3.1	0	0	1	1.7	
Housewife	25	78.1	28	96.6	53	86.9	
<b>Father's Highest Level of Education</b>							
No schooling	0	0	5	17.2	5	8.2	0.117
Primary	5	15.6	12	41.4	17	27.9	
Junior High School	6	18.8	4	13.8	10	16.3	
Senior High School	17	53.1	6	20.7	23	37.7	
D3/D4/S1	4	12.5	2	6.9	6	9.9	
<b>Mother's highest level of education</b>							
No schooling	0	0	2	6.9	2	3.2	0.640
Primary	7	21.9	8	27.6	15	24.6	
Junior High School	4	12.5	12	41.4	16	26.2	
Senior High School	16	50	6	20.7	22	36.1	
D3/D4/S1	5	15.6	1	3.4	6	9.9	

Source: Primary Data, 2025.

\*Chi-Square Test.

Table 2: Distribution of Correct Answers on the Adolescent Girls Knowledge Question

Knowledge Question	Intervention				Control				
	Pre		Post		Pre		Post		
	n (32)	%	n (32)	%	n (29)	%	n (29)	%	
<b>P1</b>	What is anaemia?	21	65.6	32	100	22	75.9	13	44.8
<b>P2</b>	What is the normal haemoglobin level for adolescent girls?	17	53.1	32	100	9	31	10	34.5
<b>P3</b>	In your opinion, which group is most at risk of anaemia?	22	68.8	32	100	22	75.9	27	93.1
<b>P4</b>	What causes adolescent girls to be at higher risk of anaemia?	15	46.9	25	78.1	13	44.8	8	27.6
<b>P5</b>	What are the symptoms of anaemia?	30	93.8	29	90.6	23	79.3	23	79.3

(Table 2). Continued.

Knowledge Question		Intervention				Control			
		Pre		Post		Pre		Post	
		n (32)	%	n (32)	%	n (29)	%	n (29)	%
P6	What causes anaemia?	5	15.6	24	75	15	51.7	7	24.1
P7	What are the effects of anaemia?	2	6.3	21	65.6	1	3.4	6	20.7
P8	What food sources contain iron (Fe) to prevent anaemia?	15	46.9	25	78.1	20	69	13	44.8
P9	What are the benefits of moringa capsules and royal jelly for teenage girls?	6	18.8	31	96.9	7	24.1	15	51.7
P10	What behaviours can hinder iron absorption?	5	15.6	27	84.4	3	10.3	4	13.8

Source: Primary Data, 2025.

Table 3: Distribution of Knowledge Levels among Adolescent Girls

Knowledge Level	Intervention				Control			
	Pre		Post		Pre		Post	
	n	%	n	%	n	%	n	%
Good	1	3.1	32	100	0	0	1	3.1
Low	31	96.9	0	0	29	100	28	96.9
	32		32		29		29	

Source: Primary Data, 2025.

control group showed minimal change, with the majority of participants remaining in the low knowledge category (Table 2 and Table 3).

These findings suggest that a TikTok-based educational intervention was effective in improving adolescents' knowledge, whereas supplementation alone did not produce meaningful cognitive changes (Table 2 and Table 3).

**Overview of Anaemia Incidence among Respondents**

At baseline, most participants in both groups were classified as mildly anemic, with a smaller proportion

experiencing moderate anaemia or normal haemoglobin levels. After the intervention period, a clear shift toward normal haemoglobin levels was observed in both groups, accompanied by a reduction in cases of mild and moderate anaemia. This pattern indicates that supplementation with Moringa oleifera enriched with royal jelly improved anaemia status in both groups (Table 4).

**Changes in Eating Behavior**

Prior to the intervention, participants' dietary habits were generally suboptimal, particularly in breakfast consumption and intake of protein, vegetables, and

Table 4: Distribution of Anemia Prevalence among Adolescent Girls

Anaemia Category	Intervention				Control			
	Pre		Post		Pre		Post	
	n	%	n	%	n	%	n	%
Mild	16	50	5	15.6	15	51.7	4	13.8
Moderate	12	37.5	2	6.3	6	20.7	2	6.9
Not anaemic	4	12.5	25	78.1	8	27.6	23	79.3
	32		32		29		29	

Source: Primary Data, 2025.

**Table 5: Changes in Eating Behaviour of the Intervention Group**

Eating Behaviour	Pre-Test		Post-Test		p-Value*
	n (32)	%	n (32)	%	
<b>Breakfast</b>					
Yes	11	34.4	24	75	0.018
No	21	65.6	8	25	
<b>Plant Protein</b>					
Yes	9	28.1	25	78.1	0.061
No	23	71.9	7	21.9	
<b>Animal protein</b>					
Yes	20	62.5	25	78.1	0.000
No	12	37.5	7	21.9	
<b>Vegetables</b>					
Yes	13	40.6	21	65.6	0.009
No	19	59.4	11	34.4	
<b>Fruit</b>					
Yes	14	43.8	20	62.5	0.000
No	18	56.2	12	37.5	

Source: Primary Data, 2025.

\*McNemar Test.

fruit. Following the intervention, the intervention group demonstrated improvements in several dietary behaviors, especially in breakfast consumption and intake of animal protein, vegetables, and fruit. However, changes in plant-based protein intake were not statistically significant, suggesting that the intervention had a selective effect on certain dietary behaviors (Table 5).

### Compliance Profile for Consuming *Moringa oleifera* Capsules Enriched with Royal Jelly

Compliance with the consumption of *Moringa oleifera* capsules enriched with royal jelly was high in both groups. This high level of adherence indicates that the supplementation protocol was well accepted by participants and supports the reliability of the observed intervention effects (Table 6).

### Normality Test Results

Normality testing using the Shapiro-Wilk test indicated that knowledge scores were not normally

distributed ( $p < 0.05$ ), whereas haemoglobin levels were normally distributed ( $p > 0.05$ ). Therefore, nonparametric tests (Wilcoxon signed-rank test and Mann-Whitney U test) were used for knowledge variables, whereas parametric tests (paired and independent-samples t-tests) were used for haemoglobin levels.

### Bivariate Analysis

Statistical analysis using the Wilcoxon signed-rank test showed a significant improvement in knowledge scores in the intervention group, with mean scores increasing from  $4.38 \pm 1.45$  to  $8.69 \pm 0.78$ . This corresponds to a mean difference of 4.31 (95% CI: 4.08-4.54), with a large effect size ( $r = 0.75$ ), indicating a strong practical impact of the TikTok-based educational intervention (Table 7).

In contrast, the control group showed no meaningful improvement, with mean scores slightly decreasing from  $4.62 \pm 1.04$  to  $4.34 \pm 1.65$ . The mean difference was  $-0.28$  (95% CI:  $-0.50$  to  $-0.06$ ), with a small effect

**Table 6: Distribution of Compliance in Consuming *Moringa Oleifera* Capsules Enriched with Royal Jelly**

Compliance with Consumption	Intervention		Control		Total	%
	n	%	n	%		
<b>Compliant</b>	29	90.6	27	93.1	56	91.8
<b>Non-compliant</b>	3	9.4	2	6.9	5	8.2
	32		29			

Source: Primary Data, 2025.

**Table 7: The Effect of TikTok Video Education on Adolescent Girls Knowledge**

Group	n	Pre-Test		Post-Test		Mean Difference (95% CI)	Effect Size (r)	p-Value <sup>a</sup>
		Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)			
Intervention	32	4.38 ± 1.45	5 (2-7)	8.69 ± 0.78	8.50 (8-10)	4.31 (4.08-4.54)	0.75 (large)	0.000
Control	29	4.62 ± 1.04	5 (2-6)	4.34 ± 1.65	5 (1-7)	-0.28 (-0.50-0.06)	0.10 (small)	0.457
p-Value <sup>b</sup>		0.607		0.000		0.000		

<sup>a</sup>Wilcoxon.<sup>b</sup>Mann-Whitney.**Table 8: The Effect of Moringa Oleifera Capsules Enriched with Royal Jelly on Haemoglobin Levels in Adolescent Girls**

Group	n	Pre-Test	Post-Test	Mean Difference (95% CI)	Effect Size (d)	p-Value <sup>a</sup>
		Mean ± SD	Mean ± SD			
Intervention	32	11.26 ± 0.82	12.36 ± 0.87	1.10 (1.08-1.12)	1.30 (large)	0.000
Control	29	11.60 ± 1.06	12.47 ± 0.95	0.87 (0.83-0.91)	0.86 (moderate-large)	0.000
p-Value <sup>b</sup>		0.168	0.630	0.120		

<sup>a</sup>Paired Sample T Test.<sup>b</sup>Independent Sample T Test.

size ( $r = 0.10$ ), and the change was not statistically significant ( $p = 0.457$ ) (Table 7).

Between-group analysis confirmed that post-test knowledge scores were significantly higher in the intervention group compared to the control group, demonstrating the effectiveness of TikTok-based education in improving adolescents' knowledge (Table 7).

As shown in Table 8, both groups experienced significant increases in haemoglobin levels following the intervention period. Paired sample t-test analysis demonstrated a statistically significant increase in haemoglobin levels in the intervention group, from  $11.26 \pm 0.82$  g/dL to  $12.36 \pm 0.87$  g/dL, corresponding to a mean difference of 1.10 g/dL (95% CI: 1.08-1.12). This improvement was associated with a large effect size ( $d = 1.30$ ), indicating a clinically meaningful change.

Similarly, a paired-samples t-test showed a significant increase in haemoglobin levels from  $11.60 \pm 1.06$  g/dL to  $12.47 \pm 0.95$  g/dL, with a mean difference of 0.87 g/dL (95% CI: 0.83-0.91) and a moderate-to-large effect size ( $d = 0.86$ ) (Table 8).

However, between-group comparison revealed no statistically significant difference between the

intervention and control groups at baseline ( $p = 0.168$ ) or after the intervention ( $p = 0.630$ ), suggesting comparable haemoglobin levels in both groups before and after treatment (Table 8).

## DISCUSSION

### 1. The Effect of TikTok Video Education on the Knowledge of Adolescent Girls

The TikTok platform is a short-form video creation application that offers distinctive and engaging visual effects, extensive music integration, and diverse creative features. These characteristics enable users to express themselves in various styles and stimulate creativity, encouraging them to become content creators [12]. Knowledge is the outcome of the process of knowing, arising when individuals perceive information through their senses, including sight, hearing, smell, taste, and touch. Cognitive knowledge plays a crucial role in shaping an individual's observable behavior [13].

The study findings revealed that respondents' baseline knowledge regarding anaemia was generally low prior to the intervention, regardless of group allocation. Specifically, 96.9% of participants in the intervention group and all participants (100%) in the control group demonstrated low levels of knowledge. Pre-inter-

vention questionnaire results indicated no meaningful difference in knowledge levels between the two groups. This condition may be attributed to limited access to relevant information, which can substantially influence adolescents' understanding of health-related issues.

Following the implementation of TikTok-based educational videos in the intervention group, while the control group received no educational exposure, a marked improvement in knowledge was observed. All respondents in the intervention group (100%) achieved a high knowledge category after the intervention. The mean knowledge score increased from  $4.38 \pm 1.45$  at baseline to  $8.69 \pm 0.78$  post-intervention, with a mean difference of 4.31. Statistical analysis using the Wilcoxon test yielded a p-value of 0.000 ( $p < 0.05$ ), indicating a significant improvement in knowledge after the intervention.

Conversely, the control group showed no significant change in knowledge levels, with the majority of respondents (96.9%) remaining in the low category. The mean score slightly declined from  $4.62 \pm 1.04$  to  $4.34 \pm 1.65$ , with a minimal mean difference of 0.28. The Wilcoxon test ( $p = 0.457$ ;  $p > 0.05$ ) indicated no statistically significant change in the control group.

Further analysis using the Mann-Whitney test demonstrated a significant difference in post-test knowledge scores between the intervention and control groups ( $p = 0.000$ ), while no significant difference was observed at baseline ( $p = 0.607$ ). These findings suggest that both groups had comparable initial knowledge levels; however, the TikTok video-based educational intervention effectively enhanced anaemia-related knowledge among adolescent girls in the intervention group.

Overall, the results underscore the critical role of education in improving adolescents' knowledge. TikTok-based video education enables adolescent girls to better understand the material, facilitating greater uptake and understanding of health information [14]. These findings are consistent with a study by Pasaribu (2023), which reported insufficient knowledge of anaemia among adolescent girls, including limited understanding of its definition, consequences, preventive measures, and balanced nutrition. However, after receiving nutrition education via TikTok, participants demonstrated improved knowledge and attitudes and were better able to respond to questions related to anaemia and balanced dietary practices [15].

Additionally, Pamilasari *et al.* (2022) noted that video-based educational media are increasingly utilized due to their effectiveness in enhancing learning and message delivery. This aligns with the features and characteristics of the TikTok platform. Educational content delivered through TikTok videos can increase adolescents' motivation to engage, accept, and retain information, as audio-visual media provide a more engaging, less monotonous learning experience through the integration of motion, imagery, and sound. Consequently, viewers are more likely to absorb the information and apply the conveyed messages in their daily behaviors [8].

## 2. The Effect of *Moringa oleifera* Capsules Enriched with Royal Jelly on Haemoglobin Levels in Adolescent Girls

Anaemia is defined as a condition in which haemoglobin (Hb) concentration, haematocrit levels, and red blood cell counts fall below normal reference values. Low haemoglobin levels represent a common health problem among women, including adolescent girls [16]. Adolescent females are more susceptible to anaemia than their male counterparts due to regular menstrual blood loss. Furthermore, concerns related to body image often lead adolescent girls to adopt unhealthy dietary practices, which further increases their risk of developing anaemia [17].

*Moringa oleifera* capsules enriched with royal jelly contain essential micronutrients such as iron, vitamin C, and antioxidants that are beneficial to the body. The mechanism by which iron and vitamin C contribute to increased haemoglobin levels involves several biochemical processes. Dietary iron exists in two primary forms: heme iron derived from animal sources and non-heme iron obtained from plant-based foods. Heme iron is readily absorbed, whereas non-heme iron requires enhancers to improve its bioavailability. Vitamin C (ascorbic acid) plays a crucial role as a reducing agent by converting ferric iron ( $Fe^{3+}$ ), which is poorly absorbed, into ferrous iron ( $Fe^{2+}$ ), a form that is more easily absorbed by the intestinal mucosa. After absorption, ferrous iron binds to transferrin in the bloodstream and is transported to the bone marrow, where it participates in haemoglobin synthesis by binding to globin chains to form haem. In addition, vitamin C inhibits iron oxidation within the gastrointestinal tract, thereby increasing iron availability for erythropoiesis. Through these mechanisms, vitamin C enhances iron absorption and utilization, ultimately supporting haemoglobin production and efficient oxygen transport throughout the body [18].

The study results indicated that prior to the intervention, most respondents in both groups were classified as having mild anaemia, accounting for 50.0% of participants in the intervention group and 51.7% in the control group. Baseline haemoglobin measurements using the HemoCue device demonstrated that both groups were predominantly affected by mild anaemia before the intervention. This condition may be attributed to poor adherence to Iron Supplement Tablet (IFA) consumption programs provided by Community Health Centers.

Following a 12-week (three-month) intervention involving the administration of Moringa oleifera leaf capsules enriched with royal jelly, which were consumed collectively at school, a significant improvement in haemoglobin levels was observed. In the intervention group, 78.1% of respondents achieved normal haemoglobin levels. The mean haemoglobin concentration increased from  $11.26 \pm 0.82$  g/dL to  $12.36 \pm 0.87$  g/dL, with an average increase of 1.10 g/dL. Paired-samples T-test analysis yielded a p-value of 0.000 ( $p < 0.05$ ), indicating a statistically significant improvement following the intervention.

Similarly, the control group showed an increase in haemoglobin levels, with 79.3% of respondents reaching the normal range. The mean haemoglobin level rose from  $11.60 \pm 1.06$  g/dL to  $12.47 \pm 0.95$  g/dL, corresponding to an average increase of 0.87 g/dL. The Paired Sample T-Test likewise showed a significant difference between pre- and post-intervention values ( $p = 0.000$ ;  $p < 0.05$ ).

Results from the Independent Sample T-Test indicated no significant differences between the intervention and control groups at baseline ( $p = 0.168$ ) or after the intervention ( $p = 0.630$ ;  $p > 0.05$ ). These findings suggest that both groups had comparable initial haemoglobin levels and that haemoglobin concentrations increased similarly following the administration of Moringa oleifera capsules enriched with royal jelly.

The observed improvement in haemoglobin levels can be attributed to the rich nutritional profile of Moringa oleifera, which contains iron, vitamin C, folic acid, and protein-nutrients essential for erythropoiesis in the bone marrow. Vitamin C enhances non-heme iron absorption, while folic acid and vitamin B12 support red blood cell maturation and production. These findings are consistent with a study by Gopalakrishnan *et al.* (2016), which reported a

significant increase in haemoglobin levels among anemic women of reproductive age following the consumption of moringa leaves [19]. Additionally, royal jelly contributes to haemoglobin synthesis due to its content of B-complex vitamins, essential amino acids, and minerals involved in iron metabolism and erythropoiesis [20].

Overall, the study demonstrated a reduction in anaemia prevalence among adolescent girls in both groups. In the intervention group, the proportion of respondents with normal haemoglobin levels increased markedly from 12.5% to 78.1% following the combined intervention of TikTok-based education and supplementation with Moringa oleifera capsules enriched with royal jelly. Concurrently, the prevalence of moderate anaemia declined from 37.5% to 6.3%. These findings indicate that the intervention was highly effective in improving anaemia status among adolescent girls. This result aligns with research by Yulni *et al.* (2020), which found that among three supplementation groups-Moringa oleifera capsules enriched with royal jelly, Moringa oleifera capsules alone, and iron (Fe) capsules-the group receiving Moringa oleifera capsules enriched with royal jelly experienced the greatest increase in haemoglobin levels [7]. This evidence supports the potential of *Moringa oleifera* capsules enriched with royal jelly as an effective strategy for improving haemoglobin levels in adolescent girls.

The present study extends prior research by demonstrating that a combined intervention-linking social media-based education with nutrient-rich local supplementation-addresses key limitations of single-component approaches. Unlike previous studies that report outcomes separately, this integrated strategy provides more comprehensive evidence on both behavioral and biological improvements among adolescent girls. These findings highlight the potential of this approach as a scalable, contextually relevant public health intervention. This integrated model may therefore serve as a practical framework for adolescent anaemia prevention programs in low-resource settings.

## STUDY LIMITATIONS

This study has several important limitations. The quasi-experimental design with non-random allocation may introduce selection bias and limit causal inference, despite attempts to control for baseline differences. The relatively small sample size and recruitment from only two schools in a single district may restrict the generalizability of the findings. In addition, the absence

of blinding and the use of self-reported measures for knowledge and dietary behavior may increase the risk of response and recall bias. The 12-week intervention period may not adequately capture the long-term sustainability of the observed changes. Finally, as both groups received the same nutritional supplementation, the independent effect of TikTok-based education on haemoglobin outcomes cannot be fully isolated.

## CONCLUSION

The conclusions of this study indicate that education through TikTok videos and the administration of *Moringa oleifera* capsules enriched with *Royal Jelly* significantly increased knowledge and haemoglobin levels among adolescent girls aged 12-15 years in Takalar Regency. Digital education was effective in significantly increasing knowledge compared with the control group, while supplementation with *Moringa oleifera* capsules enriched with *Royal Jelly* increased haemoglobin levels in both groups. The combination of education and nutrition interventions based on local foods is an innovative and relevant strategy for preventing anaemia in adolescents. Further research is recommended to evaluate long-term changes and compare with other nutritional interventions.

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