Research Article

A Mixed-Methods Evaluation of an Iron Supplementation Program for Adolescent Girls in Magelang City

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Abstract

Objective: To evaluate the implementation of the iron supplementation program for adolescent girls in Magelang City and identify supporting and inhibiting factors.

Methods: This study used a mixed-methods triangulation design with purposive sampling. Quantitative data from the Magelang City Health Office were analyzed descriptively, while qualitative data from interviews and FGDs explored implementation barriers.

Results: The program achieved 72.2% coverage, meeting the national target. Supporting factors included regulatory planning, digital reporting via e-PPGBM, cross-sectoral collaboration, and the Aksi Bergizi initiative. However, barriers such as lack of budget, SOPs, human resources, and low adherence were identified.

Discussion: Quantitative findings provided an overview of program success, while qualitative insights revealed operational challenges. Low adherence was influenced by limited awareness, unclear benefits, and perceived barriers like nausea and lack of parental support. Reporting delays and system closures also hindered performance.

Conclusion: Despite meeting coverage targets, the program faces significant implementation challenges. Strengthening budgeting, SOPs, and human resources, along with improving adolescent awareness, is essential for future success.

Keywords: Adolescent girls, iron supplementation, mixed-methods study, program evaluation.

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INTRODUCTION

The Indonesian government is trying to reduce stunting rates with the Accelerated Stunting Reduction Programme with specific and sensitive nutrition interventions, one of which is the iron supplementation tablet programme for adolescent girls [1]. The government's programme is in line with the World Health Organization's (WHO) Sustainable Development Goals (SDGs) with the aim of ending all malnutrition conditions in the world, including reducing stunting rates by providing adequate nutrition to adolescent girls[2]. The prevalence of anemia in pregnant women and adolescent girls in the South East Asia region is around 40% and a report from the Indian Council Medical Research (ICMR) states that anemia in adolescent girls is around 90% with severe anemia conditions around 7% [3]. The 2018 -Riset Kesehatan dasar (Riskesdas)- Basic Health Research survey reported the prevalence of anemia in the young age group to be 48.9% [4]. Iron deficiency anaemia is a condition where the body lacks iron in red blood cells below value 12 g/dL [5]. Adolescent girls are a group that requires high iron intake for physical growth, and

sexual needs such as menstruation [4,6]. Anemia in adolescent girls continues into pregnancy will experience maternal anemia. The main causes of maternal anemia in developing countries are iron deficiency, inadequate intake and infection [5].The adverse effects of anemia in pregnancy will cause complications in the mother and baby, namely post partum hemorrhage, prematurity, low birth weight babies and stunted growth [6,7,8]. Growth restriction in the prenatal child and short babies are major predictors of stunting at birth [9,10]. The incidence of stunting at birth which if not immediately corrected will continue to have a negative impact on long-term physical and intellectual growth in children [11].

WHO has advised all countries to reduce anaemia rates by 50% in adolescent girls or women of childbearing age by recommending iron supplementation where anaemia rates are more than 20%, including Indonesia [2,12]. Earlier investigations have identified several personal barriers to adherence, including fear of side effects, limited awareness of the benefits of iron tablets, misconceptions that iron tablets serve as contraceptives, and insufficient knowledge about their proper use [13]. Randomised trials have shown that intermittent iron supplementation given orally either daily or weekly has smilar effectiveness with fewer side effects and good compliance [12].

Despite iron deficiency is a recognized contributor to stunting, many interventions predominantly target younger children or pregnant women. Efforts to mitigate iron deficiency anemia have predominantly focused on supplementation-based interventions [14]. Interventions to address iron deficiency anemia include the administration of iron tablets, combined iron and folic acid (IFA) supplements, iron in combination with other micronutrients, as well as culturally tailored approaches such as the use of iron-fortified lentils. [13,15,16,17]. Non-supplementation interventions may be implemented through education and training programs [18,19]. Additionally, a combined approach involving supplementation and health promotion interventions may be implemented [20].

Magelang City is one of the cities located in Central Java Province of Indonesia with the second smallest area in Indonesia. Data from 2021 to 2022 indicate an upward trend in the stunting rate, increasing by 0.6% from 13.3% to 13.9%. Additionally, the prevalence of anemia among adolescent girls in Magelang City reached 43% in 2023, a figure approaching the national average. Despite a good Human Development Index (HDI), adequate access to health services and transportation, and the implementation of an iron supplementation program targeting adolescent girls, a thorough evaluation of the program's implementation in accelerating stunting reduction has yet to be conducted [1,21,22,23].

The substantial gap in anemia prevalence among adolescent girls necessitates a comprehensive evaluation. This study employs a mixed-methods approach focusing on program implementers to assess program outcomes and implementation by identifying facilitating and inhibiting factors, thereby informing alternative solutions. It can uncover sociocultural factors, logistical challenges, and individual perceptions influencing adherence—insights that quantitative studies alone cannot provide. Understanding these aspects is critical to evaluating the implementation of supplementation programs among adolescent girls [24,25].

METHODS

Ethical statement

This study received ethical approval from the Ethics and Research Commission of FK-KMK UGM on March 22th, 2024, under approval number KE/FK/0454/EC/2024. Prior to data collection, permission was obtained from the Magelang City Government through letter number 070/ IV.194/330/2024. Participants were fully informed about the research procedures, and their participation was voluntary, with the option to withdraw at any time without any consequences. Confidentiality was strictly maintained, ensuring that participants' employment status and residential locations were not disclosed or affected. After completing the interviews, the researchers thanked the participants and offered tokens of appreciation, including transportation allowances and gifts.

Study design

This study employed a mixed-methods design with a concurrent triangulation approach to achieve a comprehensive understanding and formulate alternative solutions. The quantitative component assessed the role of program implementers in achieving iron supplementation

coverage among adolescent girls, based on secondary data from the Magelang City Health Office, analyzed descriptively. The data did not include individual characteristics or clinical outcomes. The qualitative component was obtained through in-depth interviews and focus group discussions, focusing on the experiences of program implementers. Beneficiaries were involved only to validate program implementation. The study did not directly assess stunting prevention, which is considered a long-term outcome of iron supplementation and was discussed only in the introduction.

The qualitative assessment was guided by the Donabedian framework, which includes three key aspects: input, process, and output. The input aspects evaluated comprised regulations, budget allocation, human resources, facilities, and planning. The process aspects included the implementation of standard operating procedures (SOPs), reporting mechanisms, and monitoring activities. The output aspect focused on identifying supporting and inhibiting factors affecting program implementation. Data were collected through recorded in-depth interviews, transcribed verbatim using Microsoft Excel, and thematically categorized based on the input-process-output structure of the Donabedian model [26]. Qualitative data were interpreted to identify root causes and propose alternative solutions. Data collection and analysis were conducted by a team of four researchers, including the principal investigator—an experienced specialist in Obstetrics and Gynecology—supported by one trained research assistant who had received prior instruction on assisting with the study.

Participant

Participants in the quantitative component of this study were drawn from the 2024 registry data of the Magelang City Health Office, which recorded a total of 13,574 adolescent girls, of whom 9,801 had received iron supplementation. The data focused on junior high school students in grade 7 and senior high school students in grade 12, as reported by five main primary health care in Magelang City: South Magelang, Jurang Ombo, Central Magelang, Kerkopan, and North Magelang. However, the data were limited to the distribution of iron supplement tablets and did not include classifications by age, educational level, menstrual history, hemoglobin levels, or other relevant characteristics.

The qualitative component involved purposive sampling, consisting of eight program implementers who participated in in-depth interviews. Additionally, 17 participants took part in three focus group discussions (FGDs). FGDs 1 and 2 were conducted with five coordinating midwives and five primary health care volunteers (cadres) from the main primary health care, while FGD 3 involved one representative beneficiary from the Central Magelang sub-district.

Data collection

This study was conducted in Magelang City, Central Java Province, Indonesia, beginning in April 2024. Quantitative data collection commenced after obtaining informed consent from eight key stakeholders responsible for the iron supplementation program targeting adolescent girls. These participants included the Head of *Dinas Kesehatan Kota (DKK)* – City Health Office, representatives from *Dinas Pemberdayaan Masyarakat dan Perlindungan Perempuan dan Anak, Pengendalian Penduduk, dan Keluarga Berencana (DPMP4KB)* – Office of Women's Empowerment, Child Protection, Population Control and Family Planning, – *Badan Perencanaan dan Penelitian Daerah (BAPERIDA)* – Regional Research and Planning Office, – *Badan Kependudukan dan Keluarga Berencana Nasional (BKKBN) Jawa Tengah* – National Population and Family Planning Office, Central Java staff, – *Usaha Kesehatan Sekolah (UKS)* – School Health, the Head of – *Kesehatan Keluarga (Kesga)* – Family Health team, and program implementers at the health office.

Data collection involved both primary and secondary sources. Secondary data for the quantitative component were obtained from the registry of the Magelang City Health Office. Primary data for the qualitative component were collected through in-depth interviews, followed by three sessions of Focus Group Discussions (FGDs) to enrich and validate the findings.

Sampling method

In this study, participants for the qualitative component were selected using purposive sampling, based on specific criteria established by the researchers. Eligible participants included individuals responsible for or directly involved in implementing the iron supplementation

program, actively engaged in the stunting reduction acceleration team, and working within the Magelang City area. A representative of the program beneficiaries was also included, selected from the Central Magelang region, which serves as the designated stunting locus.

Reflexivity

To reduce bias in data collection, reflexivity was upheld by the principal investigator—an experienced Obstetrics and Gynecology specialist unaffiliated with stakeholder agencies. Participants were assured of confidentiality and professional neutrality, with informed consent obtained prior to interviews. The investigator, professionally engaged in Social Obstetrics, was supervised by senior specialists from Gadjah Mada, Diponegoro, and Sebelas Maret Universities, and assisted by a trained nutritionist with field experience

RESULTS

Quantitatif Study

The quantitative results are presented descriptively, including demographic characteristics, data from in-depth interviews and Focus Group Discussions (FGDs 1, 2, and 3), and the achievement of national targets, as shown in Tables 1, 2, and 3.

Table 1. Characteristics of informants in the in-depth interviews of dinas level implementers

Variable	Characteristics	n	%
Gender	Male	3	37
	Female	5	63
	Total	8	100
Age (Years)	<50	5	63
	>50	3	37
	Total	8	100
Education	College of Health	4	50
	Non-Health Colleges	4	50
	Total	8	100
Occupation	<5	1	13
	>5	7	87
	Total	8	100

Regarding **Table 1** the demographic characteristics of the in-depth interview informants, the majority were female, approximately 50 years old, and held a university degree.

Table 2. Characteristics of FGD 1, 2, and 3 informants

Variable	1st FGD N (%)	2nd FGD N (%)	3th FGD N (%)
Age			
- <50	4 (80)	2 (40)	7 (100)
- >50	1 (20)	3 (60)	
Education			
- Secondary Primary School		4(80)	7(100)
- Non-Health Colleges		1(20)	
- College of Health	5(100)		
Occuppation			
- Not working			6(86)
- <10 tahun		2(40)	1(14)
- >10 tahun	5(100)	3(60)	

As shown in this table, most informants are less than 50 years old, while FGD 1 informants all have a tertiary education in the health sector. FGDs 2 and 3 mostly have secondary education. The length of employment in FGDs 1 and 2 is above 5 years, while FGD 3 is mostly unemployed **(Table 2)**.

The distribution of iron supplementation among adolescent girls in the five main primary health care in Magelang City. In 2023, approximately 72.2% of 13,574 adolescent girls received iron supplementation through a regional health program. However, the distribution across the working areas was uneven, with the North and Central areas showing higher coverage. Several other areas-including one sub-district with no recipients-indicate gaps in program implementation that require targeted improvements. Overall, the iron supplementation program for adolescent girls in Magelang City has exceeded the national target, achieving a coverage rate of 72.2% compared to the national standard of 58%.[27].

Qualitative Study

Table 3. Qualitative Results Findings

Framework Donabedian	Supporting factors	Inhibiting factors
Input	The existing regulation and planning available (I6 Stakeholder) Sufficient facilities (I5 Stakeholder)	None of Special budget and Standard Operating Procedure (I6 Stakeholder) Lack of human resources (I5 Stakeholder)
Process	EPPGBM application report (Stakeholder I6).	Inadequate monitoring (I20 Beneficiaries)
output	Innovative program "Aksi Bergizi" (I3 Stakeholder), (I9 Stakeholder)	Medication adherence and bored (I8 Stakeholder) Dislike eating vegetables (I7 Stakeholder) Feel nauseous and dispose tablets (Cadres I15)

The table presents interview excerpts from stakeholders, health cadres, and beneficiaries, highlighting key enablers and barriers to program implementation based on the Donabedian framework. Supporting factors include regulatory planning, digital reporting through *Elektronik-Pencatatan dan Pelaporan Gizi Berbasis Masyarakat* (EPPGBM), a Community-Based Nutrition Reporting Application, and the Aksi Bergizi initiative. Barriers include the absence of a dedicated budget, lack of standard operating procedures (SOPs), insufficient monitoring, and individual challenges such as poor adherence, nausea, and aversion to vegetables (Table 3).

Table 4. The theme of barriers to the implementation of iron supplementation program for adolescent girls in Magelang 2023

Theme	Stakeholder	Caders	Beneficiaries
Budget	Special budget none (I7), (I8)		
Human Resources	insufficient number and capacity of human resources (I1), (I3), (I5), (I6), (I8)		
SOP	No SOPs (I1), (I3), (I4), (I6) Difference in the amount of tablet given (I6), (I8)	Difference in the amount of tablet given (I14), (I15), (I16), (I17), (118)	Difference in the amount of tablet given (I20)
Monitoring	lack of supervision and monitoring (I1), (I3), (I7), (I8)	lack of supervision and monitoring (I5), (I16), (I17), (I18)	lack of supervision and monitoring (I27)
Side Effects and Adherence	Medication non-adherence (I6)	medication non-adherence and nausea (I15), (I17) throw the tablets away (I15)	medication non-adherence (I20),(I27)

The following table presents the barriers to the implementation of the iron supplementation program for adolescent girls in Magelang in 2023. The interview quotes are grouped based on the information provided by stakeholders, caders, and beneficiaries regarding barriers to program implementation. The grouping aims to increase the trustworthiness of the data **(Table 4)**.

Table 5. Joint Display Table

Evaluation Aspect	Quantitative Results	Qualitative Results	Interpretation	Solution
Program Achievement (Output)	72.2% of adolescent girls received iron tablets (above the national target of 58%)	"Aksi Bergizi" implemented every Friday at schools; tablets are distributed by teachers	The program is administratively implemented, but actual consumption and adherence cannot be guaranteed.	Provide SOPs
SOP and Technical Guidelines (Process)	No data available	No formal SOP available; implementation only refers to the terms of reference (I6)	The absence of a clear SOP results in inconsistent implementation and weak quality control.	Provide SOPs
Monitoring and Evaluation (Process)	No post-program Hb data available	Hb is only screened initially; no follow-up Hb checks (I20)	Lack of biological outcome evaluation makes it difficult to measure program effectiveness.	improved monitoring system and data usage
Side Effects and Adherence (Output)	No data available	Students report boredom, nausea; some throw the tablets away (I15, I8)	Side effects are a major barrier to adherence; tablet distribution does not ensure actual intake.	Quality of iron supplement Provide SOPs
Cross-Sector Support and Coordination (Input)	No data available	Special circular letter from mayor and annual government planning exist (I6, I8)	Policy support exists but lacks corresponding funding and capacity-building for implementers.	capacity-building and budgeting
Role of Teachers and Parents (Process & Output)	No data available	Teachers see themselves as mere distributors; parents are not involved (I8)	Monitoring is weak due to limited involvement of key actors such as teachers and parents.	Coordination stakeholder, school and parent.

This report integrates findings from the quantitative and qualitative research, presenting key themes identified in the program implementation evaluation along with potential alternative solutions. These themes include Program Achievements, Standard Operating Procedures (SOPs) and Technical Guidelines, Monitoring and Evaluation, Side Effects and Compliance, Cross-Sector Support and Coordination, and the Role of Teachers and Parents.

DISCUSSION

This study employed a mixed-methods approach, using quantitative data to assess program coverage and qualitative data to explore implementation barriers from the implementers' perspective. The iron supplementation program for adolescent girls in Magelang City achieved a coverage rate of 72.2%, which could have been higher without reporting delays. Magelang Selatan Primary Health Care was unable to enter data into the community-based nutrition reporting application (EPGBM) due to system closure.

This study, using a mixed-methods approach, found that while quantitative data showed general program coverage, qualitative findings revealed deeper implementation challenges. Despite supportive elements like regulations, digital reporting (EPPGBM), cross-sectoral collaboration, and the *Aksi Bergizi* initiative, barriers persist. These include lack of dedicated budget, insufficient human resources, absence of SOPs, inconsistent supplementation standards, weak monitoring, and low knowledge and adherence among adolescent girls. Reporting delays further underscore the need for targeted improvements in future program implementation.

These challenges can be resolved by allocating a dedicated budget and strengthening human resources. Given the program's role in preventing anemia among adolescent girls, specific funding and adequate personnel are essential for effective implementation. Availability should be evaluated in terms of both quantity, ensuring

sufficient personnel, and quality, assessed based on skills, educational background (minimum a health-related degree), experience, certification, and dedication [28].

Standard Operating Procedures (SOPs) are essential to prevent miscommunication and misinterpretation in the field (Table 6). SOPs provide detailed guidelines outlining the steps required to carry out activities or programs consistently, efficiently, and in accordance with established standards, thereby minimizing errors [29]. Discrepancies between the quantity of iron supplements distributed and those received by beneficiaries can be addressed by implementing SOPs for receiving, storing, and administering iron supplements, which specify dosage and scheduling.

Issues related to inadequate monitoring at primary health care and schools can be mitigated through the development of monitoring and evaluation SOPs, alongside SOPs for examination and screening of adolescent girls. To address challenges concerning side effects and adherence among adolescent girls, SOPs for education and counseling of adolescents and parents, management of side effects, and reporting and documentation have been established. Additionally, improving the quality of iron supplements, such as providing sugar-coated tablets, may enhance adherence and reduce side effects[29].

Low adherence to iron supplementation among adolescent girls in Magelang, as explained by the Health Belief Model (HBM), stems from limited awareness of anemia risks and unclear understanding of its severity and benefits. Barriers such as nausea, boredom, skipped meals, and lack of parental support further discourage compliance. Although external cues to action, such as the weekly school-based "Aksi Bergizi" program, are in place, these interventions alone are insufficient without fostering internal motivation[30]. Furthermore, low self-efficacy among both adolescents and teachers who often feel responsible only for distribution, not follow-through hampers consistent consumption. Addressing these issues requires strengthening health education, reducing barriers (e.g., managing side effects and food availability), involving parents more actively, and enhancing motivation and confidence through tailored communication and supportive systems [18].

A similar program implemented in Vietnam in 2006, which provided weekly iron–folic acid supplementation in combination with anti-helminthic treatment, demonstrated a significant reduction in anemia prevalence—from 37.8% to 14.3% over a six-year period. These findings suggest that sustained weekly iron and folic acid supplementation, when integrated with anti-parasitic interventions, is a practical and effective strategy for reducing anemia among women of reproductive age [31]. Layrea (2023) evaluated the GIFT Program in Accra and found that adherence to protocol supported its success, while low motivation, side effects, and misconceptions such as fears that IFA supplements affect fertility were key barriers. The study recommends improving supplement quality and community awareness to enhance program outcomes [32].

Strengths and limitations

This preliminary study in Magelang City provides useful insights for evaluating small-scale programs in areas with unique geographic and health service contexts, especially within Indonesia's stunting reduction efforts. While it offers a thorough review of program implementation and achievements, limitations such as missing individual data and potential stakeholder bias restrict its ability to assess overall impact. The findings mainly highlight implementation challenges rather than program success.

CONCLUSION

Although the iron supplementation program for adolescent girls has reached the national target, challenges remain in Magelang, including limited budgets, human resources, SOPs, monitoring systems, supplement quality, and cross-sector collaboration. Addressing these requires improvements in capacity building, budgeting, stakeholder coordination, SOP development, data systems, and supplement quality. Future research should explore factors affecting implementation and consider cluster-randomized controlled trials to assess the impact of educational and behavior change interventions. Sustainable reductions in adolescent anemia and stunting will depend on multilevel collaboration, evidence-based planning, and long-term behavior change strategies.

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CONFLICT OF INTEREST

The authors declare no conflict of interest in this research

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Attachment:

Informant Data Table from In-Depth Interviews and Focus Group Discussions

Code	Age	Education	Duration of Work	Origin of agency	Department	Position In Program
I1	46	Economics degree	27 year	BAPERIDA	Governance and Human Development	Stakeholder
I2	54	Master of health management	32 year	DPMP4KB	Head of Department DPMP4KB	Stakeholder
I3	44	Doctor	18 year	DKK	Head of DKK	Stakeholder
I4	25	law degree	3 year	BKKBN Central Java Province	Technical Assitant BKKBN Magelang City	Stakeholder
I5	42	Nutritions degree	15 year	DKK	Programme implemetation	Stakeholder
I6	45	Master of public health	21 year	DKK	Head of the family welfare team	Stakeholder
17	53	Master of health management	31 year	Education and Culture Office	Head of Department	Stakeholder
I8	56	Bachelor's degree in biology	26 year	Junior High School 2 Magelang City	Student health unit teacher	Stakeholder
I9	42	D4 Professional midwife	11 year	North Magelang Primary Health Care (PHC)	Midwife Supervisor	Stakeholder
I10	42	D4 Professional midwife	19 year	Kerkopan PHC	Midwife Supervisor	Stakeholder
I11	32	D3 Midwifery	32 year	Central Magelang PHC	Midwife Supervisor	Stakeholder
I12	41	D3 Midwifery	19 year	South Magelang PHC	Field Midwife	Stakeholder
I13	51	D4 Professional midwife	31 year	Jurangombo PHC	Midwife Coordinator	Stakeholder
I14	55	Senior high school	10 year	North Magelang PHC	North Magelang PHC cadres	Cadres
I15	43	Senior high school	7 year	Kerkopan PHC	Kerkopan PHC cadres	Cadres
I16	51	Senior high school	11 year	Central Magelang PHC	Central Magelang PHC cadres	Cadres
I17	52	Bachelor 1	4 year	Jurang ombo PHC	Central Magelang PHC cadres	Cadres
I18	44	Vocational high school	2,5 year	South Magelang PHC	South Magelang PHC cadres	Cadres
I19	29	Vocational high school		Housewife		Beneficiaries
I20	14	junior high school		Students		Beneficiaries
I21	22	junior high school		Housewife		Beneficiaries
I22	28	Vocational high school		Housewife		Beneficiaries
I23	22	Senior high school		Housewife		Beneficiaries
I24	24	Vocational high school		Shopkeeper		Beneficiaries
125	16	Senior high school		Housewife		Beneficiaries