



Compliance of Iron Supplementation and Determinants among Adolescent Girls: A Systematic Review

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Abstract

Background: Iron deficiency anemia in children or women in pregnancy, is a public health problem in some countries. The World Health Organization (WHO) has called on all countries to achieve a 5% reduction in anemia in women of childbearing age, including adolescent girls, by 2025. One of the programs is iron supplementation. The success depends on the adherence of adolescent girls to consume iron tablets. This systematic review aimed to find the level of compliance to iron supplementation consumption among adolescent girls and explore barriers and facilitator factors to such adherence.

Methods: This article was a systematic review and conducted a multi-database search. The articles passed the PRISMA flow diagram process. The inclusion and exclusion rules decided the qualification of studies included. Of 1066 articles, we obtained 20 studies for the systematic review.

Result: The lowest compliance found were 26.2% and 26.3%, and was high (>80%) in intervention studies involving supervision and monitoring and peer educator. All articles' barrier and facilitator factors were classified into four categories; personal, social, environmental, and regimen.

Conclusion: Efforts to improve adolescent compliance to take iron tablets should consider all of these factors.

Keywords: Adolescent; Woman; Iron-deficiency anemia; Compliance

Introduction

The burden of anemia in adolescents will continue to be carried until the next generation if the problem is not solved. WHO has called on all countries to achieve a 50% reduction in anemia rates in women of childbearing age, including adolescent girls, by 2025 (1). The WHO has distributed guidelines that help arrangements for the

anticipation and control of anemia among vulnerable groups, one of which is to provide recommendations for intermittent iron supplementation for all adolescents, in countries where anemia is more or equal to 20% (2).

Oral iron supplementation or iron tablet, is one strategy to prevent iron deficiency (3). Iron ad-



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ministration is suggested for adolescent girls who have menstruated in order to enhance hemoglobin concentration and iron status, as well as to prevent the risk of anemia (4). Daily oral iron supplements were found to effectively reduce the prevalence of anemia and iron deficiency, increase hemoglobin and iron reserves, improve performance and reduce the symptoms of fatigue that are often symptoms of anemia. On the other hand, this benefit is also accompanied by side effects of gastrointestinal symptoms (5). Intermittent iron supplementation also reduces anemia and increases iron reserves(6). Randomized controlled trials demonstrated that weekly oral iron and folic acid supplementation was as effective as daily supplementation in iron deficiency anemia patients, with fewer side effects and better compliance (6,7). The administration of iron tablets in adolescence is also beneficial to improve the status of anemia and increase iron stores in the early stages of pregnancy (8).

Oral iron supplementation is also considered a cost-effective program in achieving its goal of reducing the incidence of anemia (9). Supplementation for adolescents was given once a week of 60 mg elemental iron and 2,8 mg folic acid for three consecutive months, followed by three empty months and repeated the following month. WHO also added that supplementation could be given throughout the learning year (10). Therefore, the success of supplementation using iron tablets depends on the compliance of adolescent girls to consume them according to the recommended time frame and method.

The goal of the systematic review was to find the level of adherence to iron supplementation consumption among adolescent girls and to find facilitator and barrier factors to such compliance.

Methods

Search Strategy

The search strategy and article selection are summarized in Fig. 1. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and checklist were used in

this study(11). The question of the study is 1) what is the level of compliance of adolescent girls to iron supplementation? 2) what are the supporting factors and barriers to such compliance behavior?

A searching strategy was being used in seven databases (ProQuest, EBSCO Host, Science Direct, PubMed, SAGE, Emerald Insight), using keywords "compliance," "iron supplementation," and "adolescent girls." The results were further screened using filters: the last ten years, full text, research article, English language. The database results were then imported into Microsoft Excel to remove duplicates. Then the results were screened for the title and abstract. Eligibility was determined based on inclusion and exclusion criteria. The final results obtained were then used for systematic review.

Inclusion and Exclusion Criteria

The article included in this study was an article that could answer research questions. The inclusion criteria for this systematic review were as follows: 1) Research about compliance and factors that contributed to compliance in taking iron supplementation. We included researches examining determinant factors but did not address the level of compliance. This was because the determinant factors of compliance were explored from qualitative research that was often difficult to determine the average level of compliance of a population. 2) Target population was adolescent girls. Studies on adolescent boys and girls could be accepted. 3) Peer-reviewed articles. 4) We included mix-method and intervention studies. The design of research could be surveyed, observational analytic, or intervention. Interventions could be school-based or community-based; Randomized Controlled Trials (RCT) and non-RCT. The exclusion criteria were: 1) Research meta-analysis and literature or systematic review. 2) Study on women over 18 yr of age. 3) Study on pregnant women even though they were adolescence.

Quality Assessment of Studies

The quality assessment of the study is carried out with several tools according to the research design. For mix-method research, the study was assessed quantitatively using the Newcastle-Ottawa Scale. This assessment was adapted for cross-sectional research by looking at three large parts (selection, comparability, and outcome) (12). There were 12 studies assessed with this tool. Four studies obtained eight stars, three studies with seven stars and five studies with six stars. For non-RCT intervention studies, quality assessment of the study used ROBINS-I (13). This assessment was to look at the risk of bias from the research included in this systematic review. There were six studies assessed with this tool. Most of the studies did not provide the information about confounding factors. For intervention research assessment with RCT was using the

Cochrane Collaboration tool (14). There were two studies that were assessed using this tool with the result mostly low risk of bias.

Results

The result of the article search is shown in Fig. 1. Of the 1003 articles reviewed by the title and abstract, 35 reports met the inclusion and exclusion criteria. After studying the full-text article, we got 20 articles for the research purpose. The general characteristic data of the reports can be seen in Table 1. India is the country where the most research is conducted. The most reviewed articles came from 2016 and 2020, with four articles. The most widely used study designs in this systematic review were mix-method.

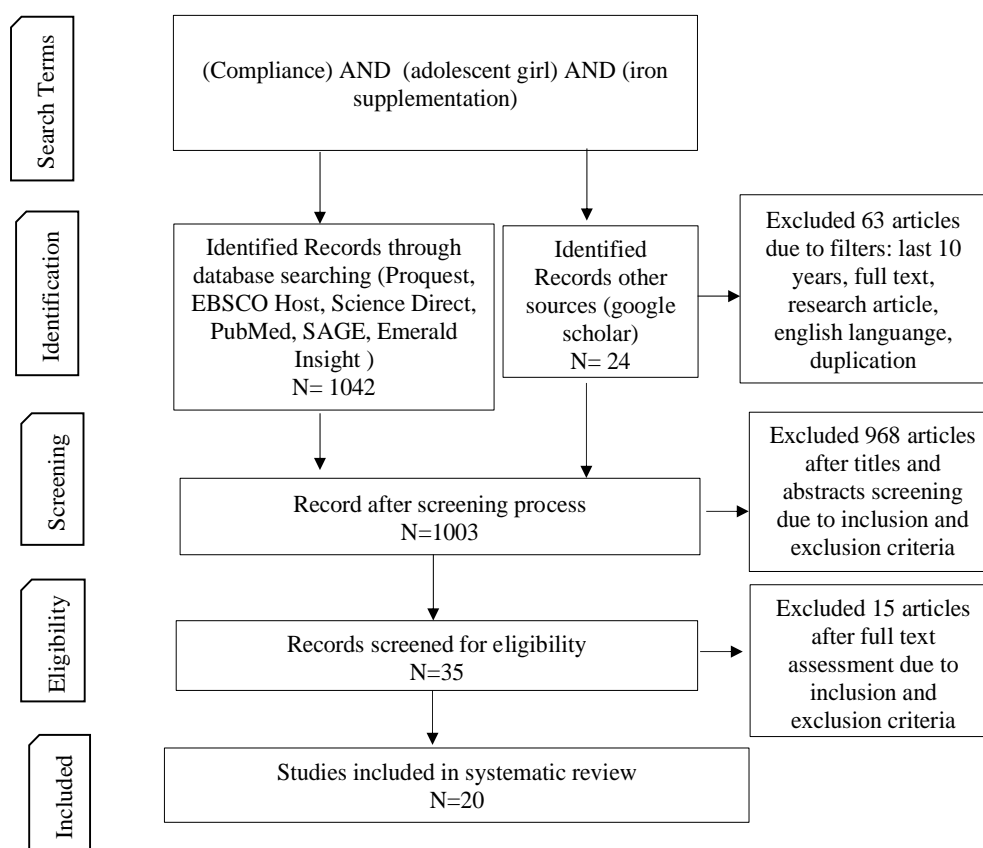


Fig. 1: PRISMA flowchart of study selection

Table 1: General Characteristics of Studies (N=20)

<i>Categories</i>	<i>Number of Re-search Studies</i>
Year of Publication	
2012	1
2013	2
2014	1
2015	1
2016	4
2017	2
2018	1
2019	3
2020	3
2021	2
Location	
India	12
Mathura	1
Ahmedabad	1
Rishikesh	1
Delhi & Haryana	1
West Bengal	1
Karnataka	1
Gujarat	1
Pondicherry/ Puducherry	2
Madhya Pradesh	1
Nagpur	1
Khunti	1
Republic of Ghana	2
Tamale	1
Northern and Volta regions	1
Burkina Faso	1
Nanoro & Yako	1
Iran	3
Zahedan	1
Tabriz	1
Savojbolagh County	1
Ethiopia	1
Tigray (Northern Ethiopia)	1
Indonesia	1
Yogyakarta	1
Study design	
Mix-method	12
Intervention Non-RCT	6
Intervention RCT	2

Compliance

Data on measuring compliance and compliance levels in each article is attached to Table 2. Of the 21 studies, 17 articles discussed compliance levels. Adherence was high (>80%) in intervention studies involving supervision and monitoring (15) and peer educators (16). Compliance was also

high in the first week of iron consumption and decreased in the following weeks (17) due to the experience of experiencing side effects. The lowest compliance was found where the levels of compliance obtained were 26.2% and 26.3%(18,19).

Table 2: Compliance Measurement and Highlight Results of Included Studies (N=17)

No	Author, Year	Sample size	Compliance measurement	Highlight Results
1	Kaur et al, 2020 (20)	312 students (104 boys and 208 girls)	Questionnaires and in-depth interviews. Compliance was categorized into 3, taking an iron tablet once a week, taking an iron tablet irregularly and not taking it at all.	Compliance was 59.6%.
2	Bhatt et al., 2013 (19)	431 adolescent girls	Questionnaires with the question about the frequency of taking iron tablets and the continuity of taking them.	35.9 % use tablets on a weekly basis; 26.3 % use them daily and 26.3% are consuming occasionally, 103 (66%) stopped taking tablets.
3	Dubik et al., 2019 (21)	424 adolescent girls	Questionnaires with the question about the number of tablets consumed in the previous seven weeks. Adolescents who consumed at least five tablets equating to 70% of the expected amount prior to data collection were considered compliant.	Compliance was 26,2%
4	Compaoré et al., 2018 (22)	39 non-pregnant women aged 15–24 yr	Weekly records of field workers who recorded the number of participants who took iron tablets each week. Adherence was broadly classified as "good" (more than 50 weekly supplements consumed), "medium" (25–50), or "poor" (25).	14 respondents had good adherence, 12 medium adherence, 12 poor adherence, one excluded
5	Shah et al., 2016 (16)	117 girls and 127 boys ages of 10 and 19	The Peer Educators collected data on the number of iron tablets consumed on a continuous basis. Compliance is divided into two categories: 41-52 tablets and < 41 tablets.	92,3% of girls comply
6	Gosdin et al., 2020 (23)	1387 adolescent girls	Adherence is defined as the number of tablets consumed each week of the school year following program launch (30–36 weeks depending on the school).	90% had used the tablet at some point, while 56 % had used it 15 times per week.
7	S et al., 2016 (24)	240 school children (120 girls, and 120 boys)	A pre-designed and pre-tested proforma in the local language (Tamil). Qualitative information was collected through 6 FGDs.	47.2% consumed IFA tablets regularly, 52.8% consumed occasionally or rarely.
8	Chakma et al., 2012 (15)	233 girls	Cards and interviews were used to assess compliance. Adolescent girls who consumed more than 80 IFA supplements out of a total of 100 were classified as 'compliers,' while those who consumed less than 80 tablets were classified as 'non-compliers.'	Compliance was 89%

9	Khammarnia et al., 2016 (25)	400 female high school students	Questionnaires used to collect data of total iron tablet consumption (students consuming all tablets received in all distributions for 16 wk or four months)	30,8% take iron tablets irregularly, 38.2 % had not taken iron supplements in the previous 16 wk, and 31% take complete iron supplementation.
10	Wangaskar et al., 2021 (26)	499 students (144 boys and 355 girls)	Questionnaire of frequency of distribution and IFA tablet intake for the previous month	378 students reported receiving IFA tablets in the previous month of school, 67.7% being IFA tablet compliant.
11	Kheirouri & Alizadeh, 2014 (27)	658 aged 14-16 yr old adolescent girls.	Questionnaires were used to collect data of compliance (total number of tablets consumed during the 16-week intervention period)	The average level of continuous compliance was 62,3%
12	Joshi & Gumashta, 2013 (7)	The 120 anaemic adolescent girls (10-19 yr)	Field Workers/ Supervisors/ Investigators checked on compliance through home visits and interview methods. In order to assess IFA intake, empty cartons were also collected from them.	The mean of unconsumed IFA tablets was 6.1 ± 10.98 in the 'Daily IFA' group and 1.3 ± 3.15 in the 'Weekly IFA' group ($p=0.0012$).
13	Khapre et al., 2021 (28)	400 adolescent girls	Individual compliance cards and class register format must be completed by the class teacher and forwarded to the nodal teacher. The nodal teacher is in charge of compiling reports in monthly school format and delivering them to the principal, as well as the education officer for the block (sub-district administrative unit) and the chief medical officer.	Over the last three months, 16% received WIFS on a weekly basis. 45% had received iron tablets in the previous three months. 93 % took IFA tablets, and 79 % took iron tablets.
14	Sethi et al., 2019 (17)	4,183 adolescents from grades VI to XII (1,980 boys and 2,203 girls) pd.	Adherence and side effects were measured at wk 1, 2 and 3, respectively	WIFS consumption in weeks one, two, and three was 85%, 63% and 52% respectively.
15	Ansari et al., 2021 (29)	211 adolescent girls aged 12-18 yr	Compliance was measured from the number of IFA tablets consumed/ number of IFA tablets distributed.	62,1% consumed IFA supplements.
16	Sau, 2016 (30)	167 (59%) boys and 118 (41%) girls.	Taking less than four tablets in a month is considered "Non-Compliant."	Of the 285 students tested, 67,7% were comply
17	Angadi & B, 2019 (31)	175 adolescent girls aged 11-15 yr	Interview once every three months using a pre-designed, pre-tested, semi-structured questionnaire. Over the course of a year, data was collected.	Compliance rate was 58.4%.

Determinants of iron supplementation's compliance

Table 3 shows barrier factors and supporting factors for compliance with iron tablet consumption

in adolescent girls. Data from all articles can be grouped into personal, social, environmental, and regimen factors.

Table 3: Barriers and facilitators of iron supplementation's compliance among adolescent girl (N=20)

Factors	Barriers	Facilitators
Personal	- Fear, afraid of side effects (20,24,30,31)	- Status of anemia (20,26)
	- Lack of motivation (19)	- Aware of anemia (21)
	- Unaware of positive effect or benefit of iron tablets (19,22,32)	- Good knowledge of anemia (21)
	- Misperception of iron tablet as contraceptive (22)	- Good understanding of the IFAS program (21)
	- Knowledge of iron deficiency issues (27)	- Capable of making up IFA distributions that were missed (23)
	- Irregularity in submitting IFA consumption reports (28)	- Junior secondary school (23)
	- Forgetfulness (31)	- Experience of the benefit of IFA tablet (24)
		- Age (26)
		- Education of parents (26)
		- Parent's profession (26)
Social	- No contact information in the incident of a limited supply. (20)	- Socioeconomic status (26)
	- Parents pressure (20,25)	- Teacher's support (Kaur et al. 2020; Sethi et al. 2017)
	- Peer pressure (20,25,29)	- Peer educator (16)
	- Was not provided by the teacher's consideration (21)	- Educators participating in program-related training (23,33)
	- Misperception of the iron tablet as contraceptive by the community (22,33)	- Availability of teachers and workers (15)
	- Educators' perceptions that implementation was complex (23)	- Counselling (15,33)
	- Excessive time burden (23)	- Health workers qualification (15)
	- Unavailability of water in the classroom (21,27)	- Family support (29)
	- Fasting during the local festival (15)	
	- Social mobilization (15)	
Environment	- Timely supply of tablets (15)	- A sufficient supply of iron tablets in nearby health care facilities and schools (33)
	- Religious and cultural effects (33)	- Place of residence (35)
	- Uncertainty about the value of iron tablets as a supplement (33)	- Methods of distribution (31)
	- Low community awareness (33)	
	- Nonavailability of IFA (28)	
	- School holiday/leave (31)	
	- Side effects (17,19,24,25)	
	- Quality of tablets (15)	
	- Daily regimen (27)	
	- Bad taste and odour (29)	
Regimen		

Discussion

In this systematic review, the compliance and adherence of the terms are used together. Adolescent girls are aware and agree to follow the iron tablet instruction. Failure in compliance can be due to a lack of attachment to iron tablets. These are shown in this review, such as lack of motivation, unaware of positive effect, perceived low risk of anemia, feeling healthy (19,22,32). Good adherence to iron tablets can be indicated by decreased anemia among adolescent girls. Several studies have shown how taking iron tablets affects decreasing anemia rates among adolescent girls (16,36). To measure compliance of iron tablets among adolescent girls, most researchers used questionnaires, which has an advantage in cost-effectiveness. The limitation of this self-report measurement is the risk of bias because it depends on respondents' memory.

Systematic review research assesses compliance with various definitions, particularly measurement time. It is related to the circumstances and choices of each researcher. The WHO recommends that the consumption of iron tablets be carried out throughout the learning year. In this systematic review, compliance measurements were measured within at least three weeks (17) where compliance was measured weekly, and at the latest after 18 months of intervention (22) where compliance was considered good if taking iron tablets > 50 wk. Other compliance periods are within a span of 4 wk (26,30), three months (7,32), and 16 wk (25,27), seven wk (21), 18 months (22), 52 wk (16), 30-36 wk (23), and one year (31).

Determinants of Compliance of Iron Tablet in Adolescent Girls

Personal factor

The level of compliance of adolescent girls to iron supplementation is mostly low. In behavior theory, like the Health Belief Model, compliance behavior results from perceived benefit or severity and cues to action. Behavioral intention is influenced by attitude, subjective norm, and per-

ceived behavioral control, according to the theory of planned behavior (37). Findings in this systematic review show the same thing. One of the most important elements influencing the intention to consume Fe tablets among teenage females in one of schools in Surabaya, Indonesia, is perceived self-efficacy (38). Therefore, intervention to change this individual state needs. Support behavior change even though in iron tablet compliance, there is the long-time challenge. Several interventions that significantly reduce anemia have been carried out, such as health education (39,40). These interventions are mostly centered on increasing an individual's capacity (knowledge, attitude, and ability). It is effective but has limitations in improving compliance, but have not yet affected compliance due to inadequate supervision and motivation from both teachers and parents or other parties.

Social factor

Aside from the individual factor, this systematic review also found that external factors outside adolescents could affect adolescent compliance such as from teachers, parents, family, peers and community (Table 3) such as pressure or misperception vs support and counselling. Adolescents are an age group that, in their psychological development, need support from the surrounding environment to grow and achieve the best achievement. According to social support and social network theory, a person's health is influenced by the social support from his network. Several community-level interventions have shown how deliberate network building and social support in society are associated with increased capacity and community control. It is a strategy for building social capital—investment in social relations to reinforce common social beliefs and reciprocal norms in society. Resources at the individual and community level may have immediate health improvement effects and reduce adverse health effects due to exposure to stressors (37).

In some studies, interventions involving the social environment of adolescent girls showed promising results in adolescent adherence to iron

supplements. Research involving the support of teachers and parents (15) and peer educator showed promising results for improved adolescent adherence (16). Peer educators also demonstrate readiness to provide counseling based on external and internal factors (41). Peer educator activities can improve adolescents' attitudes, normative beliefs, subjective norms, and perceptions of behavioral control when it comes to the prevention of illicit substance abuse (42). The availability of iron tablets is also one factor that determines compliance. It can be government and policymakers' concern to ensure the availability of iron tablets for young women.

Environment factor

Environmental factors can also hinder or support the compliance behavior of young women. Azjen's theory of planned behavior states that behavior is formed by intention, and intention is formed by attitude, subjective norm, and perceived control (37). This explains why the community's presumption of iron tablets as a contraceptive pill and the lack of controls from young women can result in non-compliance. Conditioning to controllable environmental factors can be a practical input to schools' iron tablet supplementation program. Related to community and culture, a community-based approach has shown significant results to compliance, although it takes a relatively long time (15,16,22).

Regimen Factor

Another factor of non-compliance is regarding the regimen factor of iron tablets. Bad taste and smell as well as side effects that can appear in some people (17,19,25,30). There is no supporting factor in terms of regimen for iron tablets. But from some studies, these inhibitors can be overcome with social support and positive reinforcement from teachers, parents, and peers (17).

Conclusion

In most studies in this systematic review, adherence to iron tablets is still relatively low. Barrier

and supporting factors can be divided into personal, social, environmental and regimental factors. The compliance of young women in weaving iron tablets can be improved by utilizing the social capital that exists in young women. Support from parents, families and teachers showed promising adherence to taking iron tablets ultimately expected to lower anemia among adolescent girls. Further research is needed to explore the existing social capital in adolescent girls to improve behavior adherence to iron supplementation.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that they have no conflict of interest.

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