Original Article

Understanding barriers in implementation and scaling up WIFS from providers perspective: A mixed-method study, Rishikesh, India

Meenakshi Khapre[1], Hemant D. Shewade[2,3,4], Surekha Kishore[1], Gomathi Ramaswamy[5], Amol R. Dongre[6]

[1]All India Institute of Medical Sciences (AIIMS), Rishikesh, [2]Centre for Operational Research, International Union Against Tuberculosis and Lung Disease (The Union), Paris, France, [3]Operational Research, The Union South-East Asia Office, New Delhi, [4]Community Health and Operational Research, Karuna Trust, Bengaluru, Karnataka, [5]All India Institute of Medical Sciences (AIIMS), New Delhi, [6]Sri ManakulaVinayagar Medical College, Puducherry, India

Abstract

Context: Since the implementation of Weekly Iron and Folic acid Supplementation (WIFS) program in India in 2013, little effort has been made to comprehensively evaluate the program. **Aims:** This study was carried out to assess the coverage of WIFS among adolescent girls, explore implementation barriers, and suggest solutions to improve WIFS through public schools in Rishikesh, India (2018–19). **Methods and Materials:** This was a sequential explanatory mixed-methods study. Quantitative component was a community-based cross-sectional survey to determine the prevalence of anemia and coverage of WIFS. Qualitative component added an explanation to understand WIFS implementation through document review and nonparticipant observation of WIFS session. We invited stakeholders for nominal group discussion on barriers and solutions. **Statistical Analysis Used:** Variables were described as proportion and mean. Group discussion transcript was analyzed using content analysis. **Results:** Of 400 adolescent girls, 16% (95% CI: 12.4, 19.6) received weekly and 45% ever received iron tablets over the last 3 months and 79% were anemic. From ten schools, one school never implemented WIFS. There was iron-folic acid (IFA) stock out for 10 months last year. Major barriers identified were nonavailability of IFA, and irregularity in submitting IFA consumption report. Suggested solutions were ensuring IFA stock, strengthening supervision, ownership, training, and regular meetings of stakeholders. **Conclusions:** To conclude, in a setting with high anemia prevalence, WIFS was poorly implemented. Ownership and strengthening supervision is essential for the success of the program.

Keywords: Adolescent, mixed-method approach, schools, weekly folic acid supplementation

Introduction

Globally, India has the largest adolescent population amounting to 253 million that corresponds to 20% of the total adolescent population.[1] Adolescence is a transition phase; characterized by growth spurt with the increased requirement of nutrient dietary allowances making them more vulnerable to iron deficiency anemia (IDA), as this extra amount is usually not met by diet.[2] Although anemia is prevalent globally, India is one of the most severely affected.[3] Among adolescents, 51% girls and 20% boys are anemic.[4] Various studies from India found the varied prevalence of anemia among adolescent girls ranging from 40–80%.[2,5-10]

In 2013, to combat anemia in adolescents, Government of India implemented 'Weekly Iron and Folic acid

Address for correspondence: Dr. Meenakshi Khapre, Department of Community and Family Medicine, All India Institute of Medicine Sciences, Rishikesh - 249 203, Uttarakhand, India.
E-mail: drmeenaxi15@ymail.com

Received: 16-11-2019 **Revised:** 03-02-2020
Accepted: 14-02-2020 **Published:** 26-03-2020

Access this article online
Quick Response Code:
Website: www.jfmpc.com
DOI: 10.4103/jfmpc.jfmpc_1014_19

How to cite this article: Khapre M, Shewade HD, Kishore S, Ramaswamy G, Dongre AR. Understanding barriers in implementation and scaling up WIFS from providers perspective: A mixed-method study, Rishikesh, India. J Family Med Prim Care 2020;9:1497-509.

Supplementation (WIFS)'. Adolescents (girls and boys) in class VI to XII, enrolled in government/municipal schools were covered. School dropouts were covered through *Anganwadi* centers (AWC) across all states in India.[11]

Studies have already proven the efficacy of weekly WIFS over daily iron supplementation in preventing anemia.[12-14] During 2000–2005, UNICEF had pilot tested the WIFS before its nationwide scaling up.[15] The WIFS program has been rarely evaluated since its universalization in India. We could find only two evaluation studies related to coverage of WIFS in Puducherry, a union territory across the eastern coast in south India.[16,17] The consumption of iron tablets among adolescents in these studies varied from 47% to 85%. We did not find evaluation studies of WIFS in other parts of India after 2012. To comprehensively review WIFS, we need a mix of quantitative and qualitative research methods. Since anemia is a major problem among adolescent girls with implications on maternal and child health,[18] we focused on the implementation of WIFS among adolescent girls. Moreover, the findings of the present study will help to identify gaps and recommend further strategies for effective implementation.

Therefore, in this study, we aimed to assess the coverage of WIFS over last 3 months among adolescent girls in a city of north India. We also wanted to understand how the WIFS program is being implemented in public schools and explore providers' perspectives into barriers and suggested solutions to improve WIFS implementation.

Materials and Methods

Study design

We conducted a sequential explanatory mixed-methods study involving a quantitative phase followed by a descriptive qualitative phase.[19] Quantitative phase was a community-based cross-sectional survey to determine coverage of WIFS in last 3 months. Qualitative component included a document review and non-participant observation of WIFS sessions in public schools to understand WIFS implementation. To explain the results of cross-sectional survey, we followed it up by exploring the barriers and suggested solutions to improve WIFS from providers' perspective using nominal group technique (NGT).[20]

Setting

Study site

We conducted the study in Rishikesh, Dehradun, Uttarakhand (India), with an estimated adolescent population of 14,099 (22%) of which adolescent girls population was 7135.[21] A number of public schools providing secondary and higher secondary educations were ten (2018). The medical superintendent at district level worked in coordination with schools and ensures screening of adolescents with the help of medical officer, *Rashtriya Kishore Swasthya Karyakram* (RKSK - national adolescent health program) counsellor, and auxiliary nurse-midwife.

Specific setting

WIFS program was launched in Rishikesh in 2012. According to operational framework, IFA tablets should be given weekly to all students from class VI to XII under supervision of class teachers. Principal nominates one nodal teacher from a science background who will procure, dispense, monitor, and supervise the program. Cluster resource coordinator (CRC) had been given the responsibility to distribute tablets as per demand. WIFS session should also be accompanied by behavior change communication sessions and screening for anemia. Class teacher has to fill up individual compliance card, class register format and forward to nodal teacher. The nodal teacher will further compile reports in monthly school format and forward it to principal further to block (sub district administrative unit) education officer and chief medical officer.

Study population and sampling

In a cross-sectional survey (July-November 2018), adolescent girls (10–19 years) residing in wards of Rishikesh irrespective of their enrolment in schools or type of schools were included. Considering 30% coverage of WIFS among adolescent girls, with 90% confidence interval, desired precision of 5%, correction of finite population (total number of adolescent girls 7135 approx.), adjusting for design effect of cluster sampling (1.5), and nonresponse rate of 10%, we determined a minimum sample size of 365.[22]

We used cluster sampling considering population under coverage of each AWC as a cluster ($n = 62$). We selected twenty clusters using population proportional to size sampling. We selected 20 adolescent girls per cluster, totalling 400. If a particular household did not have an adolescent girl, we selected the next consecutive household on the list. In a household with more than one adolescent girl, we selected one randomly. We did not make revisits if an adolescent girl was absent at the time of the survey.

For the qualitative phase involving document review and observation of WIFS session (from Dec 2018 to Feb 2019), we included all ten public schools. For the qualitative phase involving NGT, we considered all stakeholders involved in the implementation of WIFS in schools in Rishikesh. We finalized a list of participants ($n = 6$) after brainstorming among investigators (purposive sampling) and it included block education officer, chief medical officer, CRC of the district, and child development project officer of the block, RKSK counsellor, and medical superintendent.

Data collection and sources of data

For the cross-sectional survey, we administered a structured questionnaire (Appendix 1) using a mobile data capture application called EpiCollect5 (Imperial College London). We assessed hemoglobin level using capillary blood drawn by finger prick and tested using digital hemoglobinometer, Hemocue 301, which is a point of care test.

For the qualitative phase involving document review and nonparticipant observation of WIFS session, we noted down observations in a semi-structured observation guide (Appendix 2).

The broad domains under which observations noted were i) logistics management ii) reporting, monitoring, and supervision and iii) process of dispensing of iron-folic acid (IFA) during sessions. Before the final observation, free observation for two to three visits was done to take care of the Hawthorne effect.[20]

For qualitative phase involving NGT, all stakeholders (n = 6) attended discussion. At the start, moderator welcomed all group members, shared results of a cross-sectional survey, document review and nonparticipant observation of WIFS sessions, stated importance of discussion, and how the output will help to improve WIFS. Moderator also motivated group members to participate actively (see Appendix 3 for step by step procedure of NGT). We audio-recorded discussion and took field notes.

Qualitative research methods were applied by MK who is trained and experienced in qualitative research.

Data analysis

For cross-sectional survey**,** we exported the data in Microsoft Excel (Microsoft, Redmond, WA, USA) format and analyzed using EpiData analysis (version 2.2.2.183 EpiData Association, Odense, Denmark). We summarized the coverage of WIFS and prevalence of anemia (hemoglobin <11.5 g% for age group up to 11 years and <12 g% for 12–19 years) and severe anemia (hemoglobin <8 g%)[23] using proportion and 95% confidence interval (CI).

For the qualitative phase involving document review and nonparticipant observation of WIFS session**,** we summarized close-ended entries using frequency and proportions. For qualitative phase involving nominal group technique, after listing (of all problems and suggested solutions) and voting, we took a snapshot of tally sheet. Two independent trained researchers did a content analysis of nonparticipant observations' and NGT discussion transcripts (transcribed and translated from Hindi to English same day) and resolved discrepancies by discussion.[24]

Ethics

Institutional Ethics Committee, AIIMS Rishikesh, India (No. AIIMS/IEC/19/523) and Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease (The Union), Paris, France (No. 90/18) approved the study. We took relevant administrative approvals from state and school authorities prior to data collection. We took written informed consent (assent from adolescents and consent from parents in a cross-sectional survey and NGT participants) as applicable.

Results

Cross-sectional survey: Coverage of WIFS and prevalence of anemia

Of 400 adolescent girls, 70% (n = 281) were studying in public schools. Around 20% (n = 78) in private schools and 10% (n = 41) were school dropouts. Their mean age was 14.7 (2.5) years. Of 359 school-going adolescents, 29% (n = 117) were in primary class, 19% (n = 76) in secondary, 38% (n = 151) were in higher secondary, and 3% (n = 13) were pursuing graduation. Data of two participants were missing.

Of 400, 16% (n = 63, 12.4%-19.6%) received WIFS on weekly basis over the last 3 months. Around 45% (n = 180) ever received iron tablets over the last 3 months. All of those who received WIFS belonged to public schools. Of 63 who received WIFS, 93% (n = 59) consumed IFA tablets and of 180 whoever received iron tablets, 79% (n = 142) consumed them.

Of 400, mean hemoglobin was 10.1 g% (SD: 1.6). Seventy nine percent (n = 317) were anemic and 8.5% (n = 34) were severely anemic. Five participants did not consent for hemoglobin estimation.

Document review and nonparticipant observation of WIFS session

Among 10 public schools, one school never implemented WIFS to date. Tables 1 and 2 depict implementation status of WIFS assessed through document review and nonparticipant observation of WIFS sessions.

Logistics management

In two schools, nodal teachers were aware of estimating demand for IFA tablet. Stockout was present in all schools with a mean period of 10 months. Annual frequency of receipt of IFA from block-level varied from 0–2. No demand was initiated from school. Two schools threw 2–3 months' stock due to the expiry of tablets. There was discordance between school sessions (April to March) and IFA receipt (January to December). The nodal teacher demanded drug only until the end of the current school session i.e. till the end of April.

Reporting, monitoring, and supervision

Five schools sent a "nil" report in the monthly format while rest send annually. Five of ten nodal teachers had received training for implementation of WIFS. No records of behaviour change communication sessions were made available. Two schools had screened children for anemia in last session. There was no record of a visit by ANM, medical officers or RKSK counselor in the last session.

Dispensing of IFA during weekly WIFS sessions

In schools with large strength, nodal teacher distributed tablets on first week of month and informed class teachers to give it on Mondays. In schools with small strength, students assembled in-ground and were given a tablet (weekly). Time taken for distribution and supervision of IFA tablets was 30 min to 1 h. Most of the students readily took tablets as instructed by the teacher. Some of them who refused were given a tablet to take at home.

Table 1: Assessment of implementation of WIFS through document review in public schools of Rishikesh, India (2018-19)

IFA inventory	Number of schools	(%)
Total number of schools	10	(100)
WIFS implemented	9	(90)
Procurement and storage		
Correct estimation of annual requirement of IFA	2	(20)
Correct estimation of annual requirement of albendazole	10	(100)
Proper storage of IFA tablets	6	(60)
Stock register		
Updated till date	6	(60)
Date of expiry mentioned	6	(60)
Stockout in last year	9	(90)
Frequency of reception of IFA stock last year (April 2017- March 2018)		
0	1	(10)
1	7	(70)
2	1	(10)
Stockout in last year (April 2017- March 2018) in months - mean (SD)	9.9	(2.8)
Adequacy of current stock for 12 months	4	(40)
Adequacy of current stock in months - mean (SD)	8.6	(4.3)
Record review		
Completeness of Individual compliance card	1	(10)
Completeness of class-wise monthly registers	3	(30)
Completeness of monthly school report	6	(60)
Timely submission of monthly school report to BEO	5	(50)
Consistency of information in reports	3	(30)
The nomination letter for nodal teacher	9	(90)
Completion of orientation training	5	(50)
IEC activity	1	(10)
Adolescent girls screened for anaemia	2	(20)

WIFS - weekly iron-folic acid supplementation; IFA - iron-folic acid; BEO - block education officer; IEC - information education communication

Tablet was given on fixed day in seven schools after lunch. In eight schools, absent students were noted and the tablet was given to them on the next working day. No students were screened for anemia during sessions.

Only two schools (22%) gave tablets to students during the vacation period and maintained a record. In other schools, the nodal teacher either was unaware of giving tablet on vacation or had concern over safety. We observed a positive attitude of teachers towards program though few felt it increased their reporting work. Very few students denied taking tablets due to gastrointestinal upset or not being allowed by parents. One school had an emergency contact number of a nearby public hospital.

Nominal group technique

Barriers and suggested solutions to improve WIFS are depicted in Tables 3 and 4.

Table 2: Non-participant observation of WIFS session in public schools of Rishikesh, India (2018-19)

Observation findings on WIFS session	Number of schools	(%)
Total number of schools	10	(100)
WIFS implemented	9	(90)
Planned on a fixed day	7	(70)
Distributed in the presence of a class teacher	9	(90)
IFA given after lunch	9	(90)
Supervised by nodal teacher	7	(70)
Consumption of iron tablets by the nodal teacher during the session	4	(40)
Accompanied by Nutrition and Health Education sessions	1	(10)
Teachers screen a student for anaemia	0	(0)
Teacher recording on compliance card	5	(50)
The attempt made to make the noncompliant or absent student take tablets	8	(80)
Mechanism of distribution during vacation	2	(20)
Availability of emergency health department number	1	(10)

WIFS - weekly iron-folic acid supplementation; IFA - iron-folic acid

On discussion with stakeholders, the main problem identified was nonavailability of IFA tablets, irregularity in IFA consumption report from school, lack of information to the teacher, the trained teacher being transferred out, and CRC not being a regular staff. Solutions suggested for this problem were adequate availability of IFA, strengthen monitoring and supervision, ownership of the education department, training of support staff of teachers, and regular block-level meetings. The detailed content analysis of discussion is presented below.

The main barrier in the implementation of WIFS was the nonavailability of IFA tablet. The problem of nonavailability of IFA was mainly due to little knowledge of the procurement process at the district level.

Participant #3 said, *"There is no definite time of procurement. We distribute as and when received from the state"*. In addition, communication between the health and education departments was very limited. No monitoring or supervision of the program was done so the teacher fails to submit monthly consumption reports.

Participant #4 said *"Training of nodal teacher though was done in 2014, later on, no refresher training was done. No teaching material was provided to train other teachers. Trained teachers got transferred, and CRC did not receive any training."* It was also suggested that the principal should be involved in training.

Block officers in health department too were not well oriented.

Participant #1: "*When the tablet was given at block level, then they sent it to primary health centers and then to auxiliary nurse-midwife. It did not reach up to adolescents."*

All participants agreed that capacity building was needed at all levels from teacher to block education officer and RKSK

Table 3: Ranking of barriers to improve coverage of WIFS identified by stakeholders, Rishikesh, India (2018-19)

Ideas (after clarification phase)	Priorities (scores from each participant)						Sum of scores (for each idea)	Relative importance (%)*	Frequency of voting (for each idea)	Ranked priority (via scores and frequency)
	1	2	3	4	5	6				
Non availability of tablet	5	5	5	5	5	5	30	33.33	6	#1
Irregularity in IFA consumption report from school	4	4	4	3	4	4	23	25.56	6	#2
Lack of information to teacher	2	2	2	1	3	3	13	14.44	6	#3
Trained teacher being transferred out	1	3	3	2	0	0	9	10.00	4	#4
CRC not permanent	3	1	1	3	0	0	8	8.89	4	#5
No workshop for principal and teachers	0	0	0	4	0	0	4	4.44	2	
Hesitancy of student to take tablet	0	0	0	0	2	2	4	4.44	2	

*Relative importance = [(score for item) ÷ (maximum points for group i.e., participant number×15 points) × 100]. WIFS - weekly iron-folic acid supplementation; IFA - iron-folic acid; CRC – cluster resource coordinator

Table 4: Ranking of suggested solutions to improve coverage of WIFS identified by stakeholders, Rishikesh, India (2018-19)

Ideas (after clarification phase)	Priorities (scores from each participant)						Sum of scores (for each idea)	Relative importance (%)*	Frequency of voting (for each idea)	Ranked priority (via scores and frequency)
	1	2	3	4	5	6				
Adequate Availability of IFA	5	4	4	5	5	5	28	31.11	6	#1
Strengthen monitoring and supervision	4	3	3	2	4	4	20	22.22	6	#2
Ownership of education department	3	5	5	0	3	3	19	21.11	5	#3
Training of support staff of teachers	2	2	2	4	2	2	14	15.56	6	#4
Regular block level meeting	1	1	1	3	1	1	8	8.89	6	#5
Effective Orientation training	0	0	0	1	0	0	1	1.11	2	

*Relative importance = [(score for item) ÷ (maximum points for group i.e., participant number x 15 points) x 100]. WIFS - weekly iron-folic acid supplementation; IFA - iron-folic acid

counselor to the medical officer and state drug store in the health department. No department was taking ownership of the program. Participant #4 suggested health officials should visit schools biannually. This will increase the morale of teachers and students too will develop confidence in the program.

Discussion

In a setting with high prevalence of anemia among adolescent girls from a city in north India, we report poor uptake of WIFS. This is further validated by document reviews, nonparticipant observation, and nominal group technique that showed gaps in the procurement of IFA tablets due to poor monitoring and supervising mechanism in public schools. Studies done on evaluation of WIFS in India after nationwide scaling were limited to coverage of WIFS. Present study comprehensively evaluated WIFS program using a mixed-methods approach.

There were two limitations. Firstly, the Hawthorne effect during the nonparticipant observation was possible but we tried to limit it through initial free observations. Secondly, we limited our qualitative exploration to public schools only, as barriers to utilization of AWC services were explored in our earlier study.[25]

This study shows poor coverage of WIFS which is consistent with findings of studies by Priya *et al.* and Dikhale *et al.*[16,17] This is especially important considering the high prevalence of anemia in our setting (71%). Many studies done on a smaller scale reported a higher prevalence of anemia among adolescent girls that is consistent with this study.[7,9,26] These children with anemia should have been screened and identified to receive therapy for anemia. Considering the high prevalence of anemia, we recommend that all adolescent girls in public schools be tested for hemoglobin once a year. Those with anemia should be treated for anemia followed by WIFS after treatment completion. Screening and referral for anemia referral were poorly implemented. Following were reasons for poor implementation.

At first, IFA stockout was a key barrier. Lack of training led to a lack of awareness about procedures for procurement of tablets. Each school was expected to make a requisition to CRC; however,

none of the school made any requisitions and relied on whatever supplies it received. Teachers did not immediately address these stockouts, as they perceived their role was limited to distribution. This IFA stockout is despite the allocation of dedicated funds for WIFS program in-state annual plan.[27] Ensuring regular submission of IFA consumption report and requisition from schools is expected to solve the problem of IFA nonavailability. When IFA stocks were available, conduct of WIFS sessions was mostly satisfactory. The nodal teacher was expected to consume tablets in front of students to build faith among student about the program. In our observation, teachers consumed it infrequently.

Secondly, reporting, monitoring, and feedback mechanism were weak though the timeline for each was mentioned in the program.[11] School administration is not answerable to the department of health and there is a felt need for them to own program. Each sector has been working independently of each other, without any formal working mechanism. Lack of coordination resulted in ineffective and inefficient implementation. This could be addressed through regular meetings of stakeholders from both the department. There is a need for memorandum of understanding with clear roles and responsibilities at each level evolving to collaborative relationships.[28]

Thirdly, there was a lack of effective training of teachers and health personnel involved in the program. The training was done during the inception of the program, 2013. One day training is not sufficient to make teacher competent in executing the program. The program should also consider the attrition of teachers. A study from Cameroon reported that poor training of health workers, the presence of unqualified supervisors, and lack of supplies and material were important barriers to implementation of reproductive healthcare.[29] Therefore we suggest that communication should be strengthened by providing targeted training and retraining for school health coordinators and healthcare personnel (CRC).

Lastly, we did not observe any use of information, education, and communication materials, or any social marketing strategy for community acceptance and involvement. A strong communication component was responsible for successful uptake of WIFS amongst adolescent girls in Tanzania and India.[13,30] One Philippine study demonstrated how the social mobilization of local officials and health personnel was integral to the social marketing strategy of a WIFS program.[31] The role of peers should be considered for better acceptance and demand generation.[32]

Supply-chain management system, communication strategy, indicators of effectiveness, and operating costs of program needs to be observed, analyzed, and documented to formulate recommendations for the program in future. We further recommend carrying on comprehensive evaluation studies of WIFS in various other parts of India.

Conclusion

We conclude that there is a high prevalence of anemia among adolescent girls (90% school going) in the community and poor coverage and implementation of school-based WIFS in public schools of Rishikesh, India. We strongly recommend maintaining records of hemoglobin level for all schools-going adolescents followed by appropriate management. Nonavailability of IFA was the main concern for poor implementation of WIFS which was found to be a due delay in receipt of the demand-consumption report and inadequate training of teachers. There is a gap in documentation, reporting, and monitoring with limited communication between stakeholders. There is need for targeted training for school authorities and health personnel. Collaborative efforts and sense of ownership from the health and education department are needed for successful implementation of the program.

Acknowledgments

This research was conducted through the Structured Operational Research and Training Initiative (SORT IT), a global partnership led by the Special Program for Research and Training in Tropical Diseases at the World Health Organization (WHO/TDR). The model is based on a course developed jointly by the International Union Against Tuberculosis and Lung Disease (The Union) and Medécins sans Frontières (MSF/Doctors Without Borders). The specific SORT IT program which resulted in this publication was jointly developed and implemented by: The Union South-East Asia Office, New Delhi, India; the Centre for Operational Research, The Union, Paris, France; Department of Preventive and Social Medicine, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India; Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh, India; Department of Community Medicine, All India Institute of Medical Sciences, Nagpur, India; Dr. Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi, India; Department of Community Medicine, Pondicherry Institute of Medical Science, Puducherry, India; Department of Community Medicine, Kalpana Chawla Medical College, Karnal, India; National Centre of Excellence and Advance Research on Anemia Control, All India Institute of Medical Sciences, New Delhi, India; Department of Community Medicine, Sri Manakula Vinayagar Medical College and Hospital, Puducherry, India; Department of Community Medicine, Velammal Medical College Hospital and Research Institute, Madurai, India; Department of Community Medicine, Yenepoya Medical College, Mangalore, India; Karuna Trust, Bangalore, India and National Institute for Research in Tuberculosis, Chennai, India.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other

clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

The training program, within which this paper was developed, and the open access publication costs were funded by the Department for International Development (DFID), UK and La Fondation Veuve Emile Metz-Tesch (Luxembourg). The research received an intramural grant from All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India that included costs for the digital hemoglobinometer (Hemocue 301), stationaries and travel. The funders had no role in study design, data collection, and analysis, decision to publish, or preparation of the manuscript.

Conflicts of interest

There are no conflicts of interest.

Disclaimer

The views expressed in this paper are of the authors and do not represent the views of the authors' organizations.

References

1. UNICEF. Progress for Children: A Report Card on Adolescents. UNICEF: New York; 2012.
2. Kaur S, Deshmukh PR, Garg BS. Epidemiological correlates of nutritional anemia in adolescent girls of rural Wardha. Indian J Community Med 2006;31:5.
3. Vitamin and Mineral Nutrition Information System (VMNIS), WHO. WHO Global Database on Anaemia. Available from: https://www.who.int/vmnis/anaemia/data/database/countries/ind_ida.pdf?ua=1. [Last accessed 2019 Jun 12].
4. Ministry of Health and Family Welfare, Govt of India. India Factsheet, National Family Health Survey (NFHS) 4 2015-2016. Mumbai, International Institute of Population Sciences; 2016.
5. Chaudhary SM, Dhage VR. A study of anemia among adolescent females in the urban area of Nagpur. Indian J Community Med 2008;33:243-5. Available from: https://doi.org/10.4103/0970-0218.43230.
6. Shah SP, Shah P, Desai S, Modi D, Desai G, Arora H. Effectiveness and feasibility of weekly iron and folic acid supplementation to adolescent girls and boys through peer educators at community level in the tribal area of Gujarat. Indian J Community Med 2016;41:158-61.
7. Kulkarni MV, Durge PM, Kasturwar NB. Prevalence of anaemia among adolescent girls in urban slum. NJCM 20123:108-11.
8. Kumari R, Bharti RK, Singh K, Sinha A, Kumar S, Saran A, *et al.* Prevalence of iron deficiency and iron deficiency anaemia in adolescent girls in a tertiary care hospital. J Clin Diagn Res JCDR 2017;11:BC04-6.
9. Kotecha PV, Nirupam S, Karkar PD. Adolescent girls' anaemia control programme, Gujarat, India. Indian J Med Res 2009;130(5):584-9.
10. Singh J, Singh JV, Srivastava AK. Health status of adolescent girls in slums of Lucknow. Indian J Community Med 2006;31:2.
11. Operational Framework of Weekly Iron Folic Acid Supplementation Programme for Adolescent. RCH-DC Division Ministry of Health and Family Welfare Government of India; 2012.
12. Schultink W, Gross R, Gliwitzki M, Karyadi D, Matulessi P. Effect of daily vs twice weekly iron supplementation in indonesian preschool children with low iron status. Am J Clin Nutr 1995;61:111-5.
13. Vir SC, Singh N, Nigam AK, Jain R. Weekly iron and folic acid supplementation with counseling reduces anemia in adolescent girls: A large-scale effectiveness study in Uttar Pradesh, India. Food Nutr Bull 2008;29:186-94.
14. Cook JD, Reddy MB. Efficacy of weekly compared with daily iron supplementation. Am J Clin Nutr 199562:117-20.
15. Aguayo VM, Paintal K, Singh G. The adolescent girls' anaemia control programme: A decade of programming experience to break the inter-generational cycle of malnutrition in India. Public Health Nutr 2013;16:1667-76.
16. Dhikale P, Suguna E, Thamizharasi A, Dongre A. Evaluation of weekly iron and folic acid supplementation program for adolescents in rural Pondicherry, India. Int J Med Sci Public Health 2015;4:1360.
17. Priya Sh, Datta S, Bahurupi Y, Narayan K, Nishanthini N, Ramya M. Factors influencing weekly iron folic acid supplementation programme among school children: Where to focus our attention? Saudi J Health Sci 2016;5:28.
18. WHO. Strategies to Prevent Anaemia: Recommendations from an Expert Group Consultation. New Delhi, India: WHO; 2016.
19. Creswell JW, Plano C. Designing and Conducting Mixed Methods Research. 2nd ed. Thousand Oaks, CA: Sage Publications, Inc.; 2007.
20. Witkin BR, Altschuld JW. Planning and Conducting Needs Assessments: A Practical Guide. Thousand Oaks, CA: Sage publication; 1995.
21. Rishikesh City Population Census 2011 – Uttarakhand. Available from: http://www.census2011.co.in/data/town/800313-rishikesh-uttarakhand.html. [Last accessed 2018 Sep 07].
22. Ministry of Health and Family Welfare. Maternal and Adolescent Health; Ministry of Health and Family Welfare, New Delhi, India: Delhi; 2017.
23. WHO. Haemoglobin Concentrations for the Diagnosis of Anaemia and Assessment of Severity. Vitamin and Mineral Nutrition Information System. Geneva, World Health Organization; 2011.
24. Erlingsson C, Brysiewicz P. A Hands-on Guide to Doing Content Analysis. Afr J Emerg Med 2017;7:93-9.
25. Khapre MP, Kishore S, Sharma A. Utilization of ICDS program by adolescent girls and implementation barriers in Urban Rishikesh, India. J Family Med Prim Care 2019;8:3584-90.
26. Dongre AR, Deshmukh PR, Garg BS. Community-led initiative for control of anemia among children 6 to 35 months of age and unmarried adolescent girls in rural Wardha, India. Food Nutr Bull 2011;32:315-23.
27. Dureja S. Weekly Iron and Folic Acid Supplementation Program for Adolescents in India. 2016.
28. Weaver B. Coordination, Cooperation, and Collaboration: Defining the C3 Framework. Honours Program, Senior Capstone project, 2012.

29. Tita AT, Selwyn BJ, Waller DK, Kapadia AS, Dongmo S. Evidence-based reproductive health care in cameroon: Population-based study of awareness, use and barriers. Bull World Health Organ 2005;83:895-903.
30. Muro GS, Gross U, Gross R, Wahyuniar L. Increase in compliance with weekly iron supplementation of adolescent girls by an accompanying communication programme in secondary schools in Dar-Es-Salaam, Tanzania. Food Nutr Bull 1999;20:435-44.
31. Paulino L, Angeles-Agdeppa I, Mari M Etorma U, C Ramos A, Cavalli-Sforza T. Weekly iron-folic acid supplementation to improve iron status and prevent pregnancy anemia in filipino women of reproductive age: The Philippine experience through government and private partnership. Nutr Rev 2005;63:S109-15.
32. Malhotra S, Yadav K, Yadlapalli K, Sinha S, Yadav V, Pandav C. Challenges in scaling up successful public health interventions: Lessons learnt from resistance to a nationwide roll-out of the weekly iron-folic acid supplementation programme for adolescents in India. Natl Med J India 2015;28:81-5.

Additional file 1

Annexure 1:

KAP questionnaire

General information

Name: Age

Education: Address:

Mobile no if any

Type of school : Govt aided /municipal

Private

School dropout

Part 1 : Knowledge

1. Have you heard of iron deficiency anemia

- Yes
- NO
- Don't know/no answer

2. If yes, can you tell how you can recognize someone who has anaemia?
(Don't prompt)

- Less energy/ weakness
- Paleness
- Spoon nail/koilonychias
- More likely to become sick
- Other
- Don't know

3. What are consequences of anemias in adolescent? (don't Prompt)

- Stunted growth
- Reduced immunity/infections
- Menstruation related problem
- Complications in pregnancy
- Poor school performance/ attention span
- Other
- Don't know

4. What are Causes of Iron deficiency anaemia (don't Prompt)

- Lack of iron in diet
- sickness/infection(malaria, hookworm , other infections)
- heavy bleeding during menstruation
- others
- don't know

5. How can anaemia be prevented (don't Prompt)

- Eat iron rich food
- eat vitamin C risch food
- take iron supplement
- treat other causes of anaemia (disease/ infection)
- others
- don't know

6. Can you list some of iron rich food (don't Prompt)

- green leafy vegetable
- jagerry
- legumes
- nuts
- others
- don't know

7. When taken during meal , certain food help the body absorb and use iron. What are those foods (don't Prompt)

- fresh citrus food
- other
- don't know

8. Some beverages decreases iron absorption

- coffee
- tea
- others
- don't know

Part 2: Practice of iron deficiency anemia

1. How frequently had you taken iron rich food in last month

- Almost daily
- Atleast half days in a week
- Once a week
- Not taken

2. How frequently had you taken citrus fruits in last month

- Almost daily
- Sometimes
- Never

3. Do you usually take coffee or tea?

Yes **No**

4. When do you take it?

- Two hours or more before meal
- Right before meal
- During meal
- Right after meal

- Two hours or more after meal

4. Do you get iron tablet from school: yes No

5. How frequently you get iron tablets from school in last 3 month:

- once a week
- once a month
- once in 2-3 months

6. Do you consume it: yes / NO

7. Why not:

- not needed or aware
- side effect
- parents don't allow
- taste not good
- other

Part 3: Attitude

1. How likely do you think you are anaemic?

- Not likely
- Not sure
- Likely

2. How serious do you think anemia is?

- Not serious
- Not sure
- Serious

Part 4: Health data

Present c/o if any:

Significant past history and medication

Ht Wt BMI

Hb :

Diagnosis:

Treatment given:

Annexure 2

Semi-structured observation guide during record review

School name :

Total student class 6-12 :

Is WIFS sessions implemented in school : Yes No

If yes move further or else stop

Observation item	Yes	No	Remark
Nomination letter for nodal teacher			
Are they presently available in school			
Is there WIFS committee in school			
Orientation training of teachers done			
Correct estimation of annual requirement of IFA tablet demanded			
Correct estimation of annual requirement of albendazole tablet demanded			
Submit indent of drugs to block education officer			
Frequency in a year of indent			
Timely submission of indent (by march in last 3 years)			
Lead time (time between order and receipt in months)	×	×	
Stock maintenance register update (No of stock received and not updated last 1 year)			
Date of expiry mentioned			
First In first out followed			
Stock out in last year April 2017-march 2018 (no of times, what was done)			
Adequacy of stock (stock sufficient till April next year 2019)			
Optimum (proper) Storage condition of IFA tablet (dark, dry place away from direct sunlight, the packaging in good condition and not tempered)			
Completeness of Individual compliance card (last 3 months atleast 5% of total students selected randomly from each class)			Mention number of cards examined
Completeness of Class- wise monthly registers in last 3 months in aleast 5% of classes			Mention total no classes
Completeness of monthly school report in last 3 months			
Is the information consistent with all the reports			
Timely submission of monthly school report by 5th of following month to BEO in last 3 months:			
Submission of copy of monthly school report to ANM in last 3 month			
Records of IEC/Awareness activities with students and parents in last 3 month (if available, then mention number)			
Records of Number of students screened for anemia by teacher (if available, then mention number))			
Number of students referred for possible presence of anaemia to health facility in last 1 year (if available, then mention number)			
Visit by ANM in last 3 month			
Minutes of meeting regarding WIFS in school last year (mention frequency and note the details for content analysis)			

Any other observation:

Semi-Structured observation guide during non-participant observation of WIFS session

Item	Yes	No	Remark
Is WIFS session planned on fixed day i.e Monday every week			
Who gives a IFA tablet to students	×	×	
At what time the tablet is given (morning. After lunch or some other)	×	×	
Is it supervised by nodal teacher			
Do nodal teachers themselves consume the tablet in front of student			
Is session accompanied by nutrition and health education sessions			
Do teachers screen student for anaemia			
Do teacher keeps record of student taking tablet			
Is the attempt made to make the non-complaint or absent student to take the tablets			
Mechanism to give IFA to children during vacation period in last years			
Is phone number of health dept available for emergency			

Narratives:

- What happened
- How was process

Annexure 3

Detail procedure of Nominal group technique

Following steps were followed in study

1. *Generating ideas*: The moderator presented the results of WIFS coverage survey and observations of WIFS implementation in schools (results related to objective one and two) to the group. Then moderator directed everyone to examine the barriers in brief independently on a sheet of paper. All group members were given a validated topic guide. Each person silently generate ideas and written them down.

2. *Recording ideas*: Group members were then engaged in a round-robin feedback session to concisely record each idea (without debate at this point). The moderator wrote an idea from a group member on a powerpoint slide, and proceeds to ask for another idea from the next group member, and so on. No repetition of ideas; however, if group members believes that an idea provides a different emphasis or variation, then it was included. This continued until all members' ideas have been documented

3. Discussing ideas: Each recorded idea was then discussed to determine clarity and importance. For each idea, the moderator asked, "Are there any questions or comments group members would like to make about the item?" This step provided an opportunity for members to express their understanding of the logic and the relative importance of the idea. Any group member were supposed to clarify the points.

4. *Voting on Ideas*: Individuals voted privately to prioritize the ideas. The votes were tallied to identify the ideas that were rated highest by the group as a whole. The moderator then asked the group members to prioritize the barriers as per experience. To start, each group member selected the five most important items from the group list and writes one idea on each index card. Next, each member ranks the five ideas selected, with the most important received a rank of 5, and the least important received a rank of 1. After members ranked their responses in order of priority, the moderator created a tally sheet on the flip chart with numbers down the left-hand side of the chart, which corresponded to the ideas from the round-robin. The moderator collected all the cards from the participants and asked one group member to read the idea number and number of points allocated to each one, while the moderator records and then adds the scores on the tally sheet. The barrier that is rated top 3 amongst all by the group were considered most important barrier in response to the question posed by the moderator.

The same process was repeated for suggested solutions for these barriers. At the end, the moderator summarize the meeting and thank all the group members for their active participation.