

Research Article

Adherence of Weekly Iron Folic-acid Supplementation and Determinant Factors Among Adolescent School Girls in Hadiya Zone, Ethiopia, 2023: Institutional Based Mixed Method

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Abstract

Globally, 1.62 billion individuals are affected by anemia, and iron deficiency is thought to be half of all cases. From this, 15% are adolescents. According to a WHO report, 50% of anemia cases are attributed to iron deficiency. The prevalence of anemia in sub-Saharan Africa surpasses 39%. Hence, iron and folic acid supplementation is a World Health Organization-recommended adolescent nutrition intervention to prevent the high burden of anemia. This study investigated adherence to weekly iron and folic acid supplementation and determinant factors among adolescent schoolgirls aged 10-19 years in the Hadiya Zone, Central Ethiopia region, Ethiopia, in 2023. An institution-based mixed method was deployed. Data were collected through a self-administered questionnaire for the cross-sectional one and an open-ended questionnaire for key informants in the study period of March to April 2023. Logistic regression used for quantitative analysis, and thematic analysis was used for qualitative part. From a sample size of 569, the adherence was 74%, and of that, 60.8% always consumed at school on-spot provision and 13.2% consumed by the home take approach. The odds of adolescent school girls who were accessed social and behavioral change communication tools were 14.22 times more likely to adhere to the supplementation; AoR 14.22 (4.56-13.02). Those who were exposed to in-school nutrition education were 16 times more likely to adhere; AoR 16 (15.43-240). Those who had discussed weekly iron folic acid supplementation with their family were 7.47 times more likely to adhere to WIFAS than those who had not discussed about it; AoR 7.47 (1.38-40.14). Those who heard about anemia and knew about anemia were 9.25 times more likely to adhere to WIFAS AoR 9.25 (1.43-59.72). One of the key informants, an adolescent girl, said, *"The great positive experience was that we adolescent girls were aware that the program was a targeted, nutrition-specific supplementary program to prevent anemia, and that was why we accepted and adhered to the weekly provision."* However, significant numbers (26%) of adolescent schoolgirls were interrupting weekly iron and folic acid supplementation consumption. Hence, it should be primarily led and owned by the government, engage all stakeholders, and provide enough locally adapted and adolescent-friendly social and behavioral change communication tools.

Keywords

Ethiopia, Hadiya Zone, Adolescent Girls, Iron and Folic Acid Supplementation, Adherence

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1. Introduction

Around 1.62 billion individuals are affected globally with nutritional and non-nutritional anemia, from this, 15% are adolescents. Iron deficiency is thought to be the cause of around half of all cases [1]. According to WHO, 50% of anemia cases are attributed to iron deficiency. Moreover; the prevalence of anemia in sub-Saharan Africa surpasses 39% [2]. In Ethiopia, according to 2022 a systematic review and meta-analysis study, pooled prevalence of anemia among adolescent girls was 19.1% [1]. Anemia now affects 243 million adolescents worldwide of which Africa and Asia are the most severely affected, necessitating intensified efforts to address the issue [3]. However anemia affects all reproductive age, according to global nutrition report 2020, and nutrition has major impact on health of adolescents aged 10-19 years in current health status or in the future [4].

According to world health organization 2018 report, sustainable balanced diet and healthy eating patterns during adolescence have the ability to prevent any nutritional shortfalls and linear-growth faltering occurred during the first decade of life, and may limit detrimental behaviors contributing to the epidemic of non-communicable diseases in adulthood [5]. Having investment in adolescent health brings triple changes: better health for adolescent now, future adult life wellbeing and productivity, and reduced risk for their children [5]. Ensuring optimal nutrition among adolescent is not simple but it requires coordinated actions and integrated multispectral approaches because if only health sector engaged in nutrition activities, it can only prevent 20% of nutrition problems [3].

Biological factors related with menstruation that leads to chronic iron depletion, inadequate iron reach nutrition consumption; non-nutrition related factors like hookworms [6] put adolescent girls at risk of anemia. According to world health organization 2018, [7] Iron deficiency is thought to be responsible for at least half of the cases [8]. In order to had supported their efforts to achieve the Millennium Development Goals, member States had requested guidance from the World Health Organization (WHO) on the effects and safety of intermittent iron and folic acid supplementation in menstruating women as a public health measure to prevent anemia [9].

By 2025, it is predicted that there will be 265 million more cases of anemia in women worldwide, including adolescent girls. There will also have an additional 800,000 child fatalities and 7,000-14,000 maternal deaths related with anemia [10]. To prevent this, it is planned to decrease anemia prevalence by 50% and from set strategies, WIFAS for adolescents is one of the strategies [11].

In a studies conducted in sub Saharan Africa and Asia, prevalence of anemia found to be 20% or more, and severe public health problem as defined as greater than 40% anemic in five African countries for child aged 7-11 and for children aged 12-14 years in the same four countries [12]. When ado-

lescent became pregnant, pregnancies become high risk of complications and higher maternal, infants and child mortality or poor health outcomes when compared with adult women pregnancies. Hence, improving adolescent nutrition by providing WIFAS and biannual deworming is mandatory strategies [13].

In Ethiopia, iron deficiency is one of the leading causes of anemia, which has major effects for women and children [14]. More than half of children aged 6 to 59 months (57%) and 24% of women aged 15 to 49 are anemic [15]. According to the Ethiopia Micronutrient Guideline, ministry of health (MoH) 2016, and adolescent nutrition 2023 guideline, adolescent girls (10-19 years) should take a weekly dose of iron and folic acid tablet containing 60 mg of elemental iron and 2.8 mg of folic acid to prevent anemia.

WIFAS prevents and reduce risk of anemia in adolescent population and improves iron status by improving concentration of hemoglobin and ferritin. According to world health organization, 2011, improvement in hemoglobin and possible reduction in anemia could lead to improvement in brain function and subsequent school performance. There is lost potential from anemia in adolescent girls and women. This can include decreased school performance, loss of productivity, and in the event of adolescent pregnancy, anemia has negative health outcomes for the adolescent mother and her infant [16].

Another great importance of WIFAS using the WHO recommended dose of recommended dose of 2.8 mg of folic acid can reduce the risk of neural tube defects NTDs like spinal bifida [17]. The efficacy trial conducted in India found that non pregnant women who received WIFAS formulated with 2.8 mg had a 271 nmol/L greater mean RBC (red blood cell) folate than those receiving the 0.4 mg dose [18]. Additionally, WIFAS formulated with 2.8 mg folic acid were seven times more effective in increasing red blood cell (RBC) folate to levels associated with reduced risk of Neural tube defect (NTD) affected pregnancy than 0.4 mg dose [5]. (NTD) prevention through WIFAS is important for adolescent girls as each year approximately 10 million unplanned pregnancies occur among girls aged 15-19 years in low and middle-income countries [13].

However, the effectiveness and cost effectiveness of WIFAS as a strategy to prevent NTDs depends on reaching adolescent girls and women in the preconception period and in the first month of pregnancy, before the neural tube closes [19]. In-school WIFAS programs are at varying stages of implementation, globally. India may be one of the only countries with a nationwide program implemented across states with both school and community-based platforms [20]. Many other countries are in the early implementation or scale up phases, with most reach through school-based delivery. Many of these programs may not be reaching many of the adolescent girls who may become pregnant; however, ado-

lescents in school who become pregnant may benefit [12]. Consideration should be given to the target population, folate deficiency, rate of NTD-affected pregnancies and access to other folic acid supplementation programs (e.g., food fortification) [12]. The significance of this study could add value in provision of full insight as backup's quantitative cross-sectional study with qualitative findings triangulation, and contextualization. Specific to study area, the previous study overlooked backing up quantitative findings with qualitative findings. Revealed findings in this study significantly introduced how to enhance implementation theory and practice of WIFAS implementation, policy, and future research. Ultimately, this research advances understanding of practical implications.

2. Methodology

2.1 Study Settings

Hadiya zone is one of central Ethiopia region, and Hosanna is the capital city of the zone, and central Ethiopia region with the distance of 190 km from Hawassa and 230 from the Addis Ababa. In Hadiya zone, there were 20 woredas (districts), and in these 20 woredas, there were 547 primary school (governmental and non-governmental) and 82 secondary level schools (governmental and non-governmental). Weekly iron folic acid supplementation program was implemented in the selected primary and secondary schools in 8 woredas (districts), namely Soro, East badawacho, Gibe, Gombora, Anlemo, Duna, Shashogo, and Lemo woredas which was 40% from total woredas of hadiya zone.

WIFAS had been implemented in 152 (one hundred fifty two) primary & secondary schools where supported majorly by Nutrition international (122 schools) and 30 schools by UNICEF. So, WIFAS coverage at school level was 24% from the total schools of the zone. From the eight woredas, at least 33% of schools or 15 schools in six woredas and 16 schools from each of two woredas were enrolled in this weekly iron folic acid supplementation program. Totally there were 40,560 adolescent girls enrolled in 152 schools. So, the study was conducted at randomly selected schools among adolescent school girls. All eight woredas was included in the study and from each woreda, two WIFAS implementing schools were selected randomly, and then from each school study unit (adolescent girls) were included in the study by simple random sampling from WIFAS registration books. The study was conducted from March 2023-April 2023.

2.2. Study Design

Mixed method (quantitative and qualitative) methods were used. Institutional (school) based analytic cross sectional study was deployed and it was supported by qualitative study design (key informant interview and document review. Qual-

itative findings were used to inform, and validate quantitative findings. These thematically analyzed qualitative findings helped to triangulate, and contextualize the quantitative data, particularly adherence against document reviewed, and key informant interview. The study was conducted among adolescent's schools girls aged 10-19 in WIFAS implementing schools, and key informants interviewee (woreda and school level WIFAS focals, zonal program coordinators and adolescent school girls) So, the study was conducted at randomly selected schools among adolescents

2.3. Sample Size Determination and Sampling Procedure

Single population proportion formula was used. At 95% confidence level with 50% of population proportion at 66% adolescent adhere for iron-folic acid consumption including 10% non-response rate

$$n = z\alpha/2 * p (1-p) / d^2$$

Where: - α = confidence interval=95%, d= margin of error or maximum acceptable difference=5%

$Z\alpha/2$ =value of confidence level=1.96

p = Taking 66% of Adolescent girls consumed four tablets in the first month of supplementation in India. d = margin of error (5%)

$$n = (1.96)^2 * 0.66(0.34) / (0.05)^2 = 344.8$$

By considering design effect, it was multiplied by $1.5 * 344.8 = 517$. Since study population was greater than 10,000 populations (40560), and so that no correction formula was applied but 10% non-respondent rate that was 52 added and final samples sized for quantitative method were 569. For qualitative part, document review and key informant interviews were conducted from 16 participants from consumer level and enabling level.

All eight WIFAS implementing woredas were part of the study but actually two schools per woreda were involved in the study by Simple random sampling method. Number of adolescent student girls distribution in the woredas/districts/ were proportional and sample size distribution for each of eight WIFAS implementing woredas namely Soro, East badawacho, Gibe, Gombora, Anlemo, Duna, Shashogo, and Lemo were to be 71 adolescents' girls.

From each woreda randomly selected schools, 36 adolescent school girls were selected from WIFAS service registration book by simple random sampling lottery methods. Already existing school WIFAS registration book was used as sampling frame for qualitative key informant interview study, 16 purposely participant's interview was recorded and note taken. Document review at was conducted in randomly selected sixteen schools.

As defined in operational definition section, adherence

meant those who were consumed WIFA for consecutive three months out of five months implementation periods (October 2022 -February 2023) either in school on spot provision or take home strategy during weekly supplementation of 30 mg-60 mg elemental iron with WHO recommended 2.8 mg folic acid or if no 2.8 mg formulation, 0.4 mg folic acid as optional. To avoid confusion, WIFAS implementation periods were (October 2022 -February 2023) but study was conducted March-April 2023.

2.4. Data Collection

2.4.1. Quantitative Data

To avoid non response rate, and to make the questionnaire very clear, and avoid confusion, data were collected through interviewer supported, locally translated but with no interruption on their decision, structured self-administered questionnaire with adolescent school girls aged 10-19 years. Regarding the appropriateness about self-administered questionnaire, it is about the program they have been very familiar and they understood what it to mean. This was verified with the same questionnaire in different schools before actual data collection. Variables were adapted from similar previous studies in Ethiopia, Africa and other countries.

Socio demographic characteristics: Basic sociodemographic data such as adolescent school girls (ASGs), marital status, grade attending, family occupation, ASGs religion, residence, parents/guardian highest level of education data were collected at school from ASG.

Knowledge of adolescent girls on weekly iron-folic acid supplementation (WIFAS) & Anemia: Data collected were importance of taking iron-folic acid (IFA), Amount to be taken in a given month and in school calendar, minimum supplement to be consumed, appropriate age to start supplement, appropriate time to consume, beverages that decreases iron absorption, knowledge on anemia (how to recognize sign & symptoms, causes, prevention mechanisms, consequences if not prevented, previous experience and exposure of anemia), source of iron rich foods.

Source of information & nutrition education on WIFAS: Data collected were source of information, source that used more to know about WIFAS, presence or absence of in school nutrition education, frequency of nutrition education, who provides nutrition education, access to WIFAS related SBCC, if no nutrition education possible reasons, nutrition education support for WIFAS uptake.

WIFAS consumption practice and adherence: Data collected in this variable were WIFA consumption practice up to interview date, what they did after taking IFA, How long had been taking, time interrupted to consume WIFA, reasons for interruption.

WIFAS direct beneficiaries or adolescent school girls (ASGs) involvement status in the program. Data collected were ASGs discussion with their parents or guardians, to

whom they discussed among parents or guardians, parents or guardians response, supporting groups or individuals other than parents or guardians, any form of trouble encountered, measures taken, what ASGs guess the reasons if their friends are not consuming or discontinuing WIFAS, being motivator girls and why they motivated to be, roles as motivator girl.

Sectoral coordination: Data collected were on multisectoral engagement, number of sectors engaged, and WIFAS incorporation on multisectoral nutrition coordination plan, time interval multisectoral meeting and monitoring, any relevant, any transparent and effective decisions on WIFAS, what has been done for program continuity and sustainability.

2.4.2. Qualitative Data

Key informant interview: Data were collected through open ended adapted questionnaire from purposely selected 16 participants who were involved and well know about the program, (4 KII at zonal level, 4 KII at woreda level, 4 KII at school level focal teachers and 4 KII at school level adolescent girls). Sample size was determined based on Dworkin 2012 principle for KII. Data were collected on describing experience in WIFAS, stakeholders of WIFAS, how stakeholders selected, eligible for WIFAS, purpose of WIFAS implementation, supplementation approach, most effective & least effective supplementation approach, adolescent girl's engagement & participation, barriers to engaging important stakeholders, all relevant stakeholder engagement and additional stakeholder need to be engaged, WIFAS implementation success, what helped to be successful, measurement of success, strengths, facilitating factors, limitations, barriers or challenges of WIFAS implementation, and how this impacted, actions to mitigate barriers, recommendation for better iron folic acid (IFA) uptake and adherence.

Document review & observation: institutional IFA supply stock & storage nomination letter to focals, adolescent motivator girls establishment, involvement of adolescent school girls, completion of orientation training, IEC/nutrition education activity were observed. Documentation reviewed in sixteen schools in total of sixty four registration books (four from each school) and sixteen reporting pads for completeness, consistency, timeliness and accuracy. Document review was crosschecked with response where needed.

2.5. Data Management and Analysis

Quantitative data was coded, checked and entered in to Epi data 4.6 versions and then transferred to SPSS 20 software version for analysis. Adherence was calculated as those who continuously consumed WIFAS with no interruption in five months school calendar (October 2022 to February 2023). Descriptive statistics were used to characterize study population. Normal distribution of data was checked by Kolmogorov-Smirnov test. Bivariate logistic regression analysis with crude odds ratio at 95% CI was used to assess the

association between dependent and independent variables. Multivariate logistic regression analysis with the adjusted odds ratio at 95% CI conducted to determine predictors of WIFAS adherence and association were declared significant at p value ≤ 0.05 . Multicollinearity among independent variables was checked. Model fitness status was checked by Hosmer-Lemeshow goodness of fit test. Statistical control, (regression models) were employed to control confounding factors for variables like Socio-economic status, parental education, and access to nutrition services when analyzing adherence rates.

For qualitative data, descriptive open coding deployed by identifying meaningful chunks to change data in to ideas. Then merged the open codes in to several categories, and also merged the categories in to themes. Finally identified themes were arranged into coherent groupings; and narrative report was prepared and triangulated with quantitative findings.

2.6. Ethical Clearance

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the IRB [institute of review board] committee; a specific ethics number IRB/129/14. Verbal informed consent was obtained from all subjects: Verbal consent was witnessed and formally recorded from school principals and school parents, teachers, and students association chairman because most of adoles-

cent school girl were less than 18 years old. In school platform where under eighteen years old students could be participated in any study, parent teachers association head, and school principal guarantee the permission on behalf of study participant parents. Principal investigator was communicated on the purpose and procedure of data collection and confidentiality and privacy issues were assured through data collection, entry and analysis.

3. Results

3.1. Sociodemographic Characteristics

Among 569 adolescent school girls with 100% respondent rate, because the study was institutional (in school based) where many eligible adolescent students were presented could be involved based on preset participant selection. The majority (67%) was 15-19 years old and the remaining 33% were early adolescents (10-14). Almost all of the respondents (98.6%) were single. About 41.7% were grade 6-8 students and 35.7% were grade 3-5 students, but the remaining were 9-12 grade students. The majority of respondents (80.8%) were protestant religion followers, and 82.8 respondents residences were in rural areas. Concerning parents and guardians, the majority of their occupation (69.2%) was farming, 39.9% completed at least secondary level education, and 13.5 were at least diploma holders (Table 1).

Table 1. Sociodemographic characteristics of participant adolescent school girls (N 569) in hadiya zone, Central Ethiopia Region, Ethiopia, 2023.

character/variable	category	frequency	percent
age	10-14	188	33
	15-19	381	67
	single	561	98.6
Marital status	married	5	0.9
	divorced	3	0.5
	3-5	203	35.7
Grade	6-8	237	41.7
	9-10	74	13
	11-12	55	9.7
Parents/guardians occupation	farmers	394	69.2
	government employee	65	11.4
	private	53	9.3
	daily laborer	19	3.3

character/variable	category	frequency	percent
Religion	merchant	35	6.2
	other	3	.5
	protestant	460	80.8
	orthodox	43	7.6
	Muslim	39	6.9
	others	27	4.7
Residence	urban	98	17.2
	rural	471	82.8
	illiterate (cannot read and write)	69	12.1
Parents/guardians educational status	elementary	88	15.5
	primary level	108	19.0
	secondary level	227	39.9
	diploma and above	77	13.5

3.2. Adolescent Schoolgirls' Knowledge on WIFAS and Anemia

Among 569 respondents (100% respondent rate), 66.3% believe that it is for protection against anemia, 28.6% for good school performance, and 3.3% do not know the importance of consuming WIFAS, but they consume it because their friends consume. Many adolescent schoolgirls (88.6%) know for how long the supplement should be consumed within a month, and 80.9% know that the appropriate age for IFA supplementation is 10 years, but 19.1% responded that 15 years and above is the appropriate age. Only 45.7% of participants responded to consume WIFAS without delay after meal and the remaining 54.3% did not know the right

time to consume WIFAS. Also 60.6% know beverages that could interfere with iron absorption. Concerning consequences of anemia if not prevented, 28.5% responded as increased risk of death, 26.7% said may become ill, 18.3% responded as it could result poor school performance, and 6.2% responded lack of concentration. Regarding causes of anemia, 49% responded inadequate dietary iron intake, followed by 22.5% responded blood loss. Less than half (45.9%) believe that meat is the primary iron-rich food source, followed by 33.4% green leafy vegetables (Table 2).

Awareness about adolescent nutrition: Among participant's (N 569), 78.6% were aware that adolescence is a critical period for nutrition, but 21.4% did not consider it a critical period (Figure 1).

Table 2. Knowledge of adolescent girls towards WIFAS and anemia in hadiya zone, Central Ethiopia Region,, Ethiopia 2023 (N=569).

character/variable	category	frequency	percent
Importance of taking IFA	good school performance	163	28.6
	protection against anemia	377	66.3
	I do not know	19	3.3
	other	10	1.8
For how long IFA should be taken in a month	for one week or one supplement per month	39	6.9
	for two week or two supplements per month	10	1.8
	for three week or three supplement per month	16	2.8
	for four week or four supplements per month	504	88.6

character/variable	category	frequency	percent
For how long IFA supplement should be taken within first semester of school calendar year	One month	24	4.2
	Two months	24	4.2
	Three months and above	475	83.5
	I do not know	40	7.0
	other	6	1.1
For how long IFA should be taken in one school calendar year	12	11	1.9
	24	369	64.9
	36	171	30.1
	no limit	15	2.6
	other	3	.5
Appropriate age to start IFA supplement consumption	10 year	460	80.9
	15 year	91	16
	18 year	15	2.6
	other	3	.5
	after 1st or 2nd learning period	260	45.7
Appropriate time to consume WIFAS	after 4th learning period	76	13.4
	after 4 hour of food consumption	208	36.6
	I do not know	25	4.4
	coffee	213	37.4
Beverages that may interfere or decrease iron absorption	tea	132	23.2
	other	42	7.4
	I do not know	165	29.0
	both coffee and tea	17	3.0
If not prevented what do you think are the consequences of anemia	Increase risk of dying	162	28.5
	Adolescents may become seriously ill	152	26.7
	Can result in poor school performance	104	18.3
	Can result in lack of concentration	35	6.2
	I don't know	3	.5
	chose increase risk of dying and seriously ill	61	10.7
	chose risk of illness, dying, and other more	52	9.1
	Inadequate dietary iron intake	279	49.0
	Not taking prenatal iron supplementation	46	8.1
	Blood lose	128	22.5
what do you think could be the causes of anemia	Parasitic infection	16	2.8
	I don't know	5	.9
	Other; specify(hereditary	2	.4
	inadequate iron intake and blood lose	93	16.3
	Iron reach food sources	190	33.4

character/variable	category	frequency	percent
	legumes	72	12.7
	nuts	17	3.0
	meat	261	45.9
	don't know	5	.9
	answered meat and green leafy vegetables	24	4.2

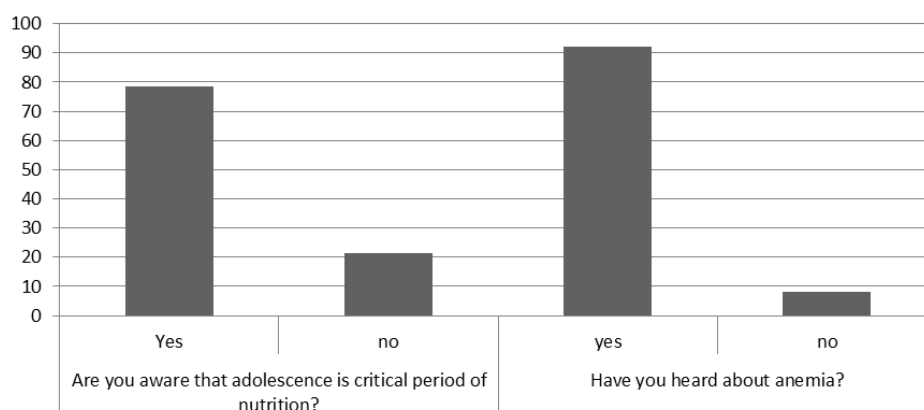


Figure 1. Awareness of weekly iron and folic acid supplementation among adolescent school girls in hadiya zone, Central Ethiopia Region, Ethiopia 2023 (N=569).

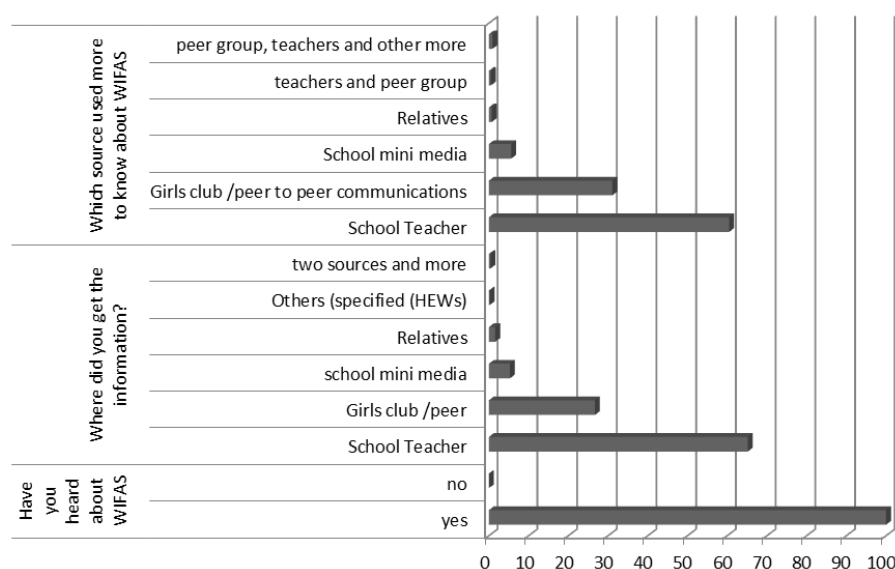


Figure 2. Source of information about WIFAS for in school adolescent girls in hadiya zone, Central Ethiopia Region, Ethiopia 2023 (N=569).

Source of information: Of the 569 participants in the study, all study participants (100%) heard about WIFAS and of those, 65.2% had got the information from school teachers and 26.7% from peer-to-peer communication or school clubs. Adolescents referred different sources for getting in-

formation accordingly, 60.1% adolescents used school teachers as a major source of information to know about WIFAS, followed by 31.1% peer-to-peer communication or girls health and nutrition club communication among each other (Figure 2).

Nutrition education and SBCC: Among 569 participant's, 519 (91.2%) respondents witnessed that there was nutrition education in the schools. However, 340 (60.7%) responded frequency of nutrition education was every week, followed by 86 (15.11%) respondents who said that there was no fixed schedule of nutrition education. The study showed that 53.6% were getting nutrition education by WIFAS-trained teachers and 26.3% by any homeroom teachers. Regarding WIFAS-related SBCC materials, 404 (71%) accessed WIFAS posters at some times. However, for either interruption or absence of nutrition education in the school, 193 (33.9%) responded that there were not enough locally adapted and durable types of SBCC materials, 18.5% said no free nutrition education time; and 14.8% also responded shortage and turnover of trained manpower. Despite the aforementioned factors of nutrition education, 559 (98.2%) accept that nutrition education was supported for WIFAS uptake, followed by 1.4% who were not sure (Table 3).

IFA consumption and adherence: Until the date of data collection, 550 (96.7%) adolescent school girls were receiving WIFAS irrespective of their weekly consumption adher-

ence status, but the remaining 3.3% were taking but had not continued until the date of the interview. From those taking WIFAS, consumption adherence was 74% (60.8% always consume at school on spot provision, and 13.2% consume by home take approach). The remaining 22.7% receive IFA but do not consume it regularly every week between October 2022 to February 2023. Fear of minor side effects accounts for the majority of reasons for interruption. 60 (10.5%), followed by more than one reason for interruption. 32 (5.6%), and 29 (5.1%) absenteeism, with the least one (1.4%) were temporary on-spot supply shortages at the time of provision (Figure 3). Although adherence was measured by response from consumers it was stated as limitation of the study, however supported by proxy indicators by document observation for Proper storage & enough of IFA stock was observed in 12 (75%) schools, and completeness of the reporting pad was observed in 13 (81%) schools. Health and nutrition education is also provided weekly in 13 schools (81%) and 13 (81%) schools provide orientation to the PSTA (parents, students, and teachers association).

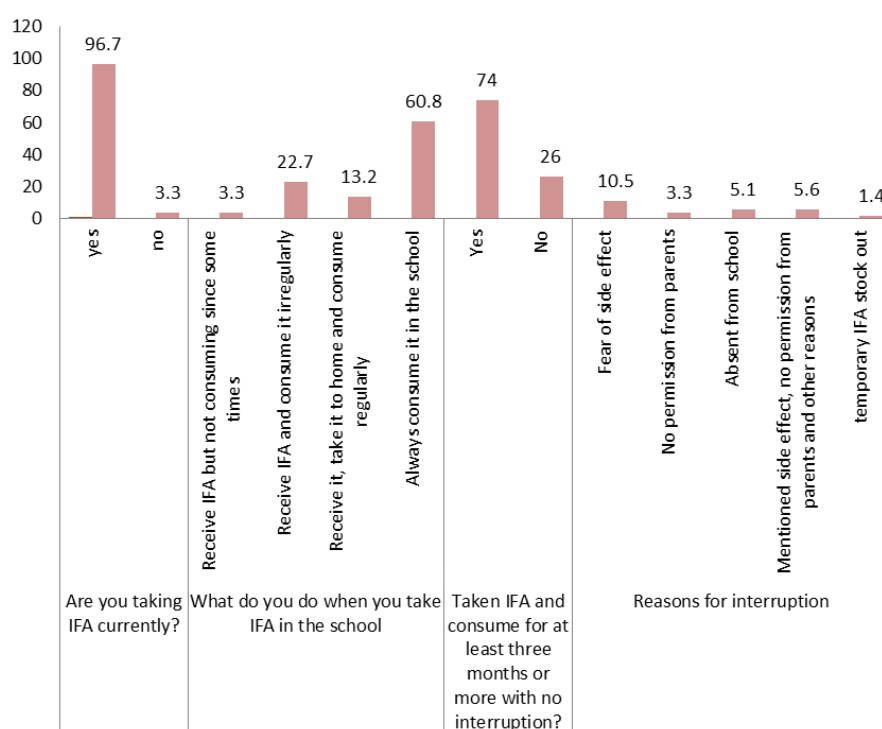


Figure 3. Status of WIFAS adherence among adolescent girls by number in hadiya zone, Central Ethiopia Region, Ethiopia, 2023 (n=569).

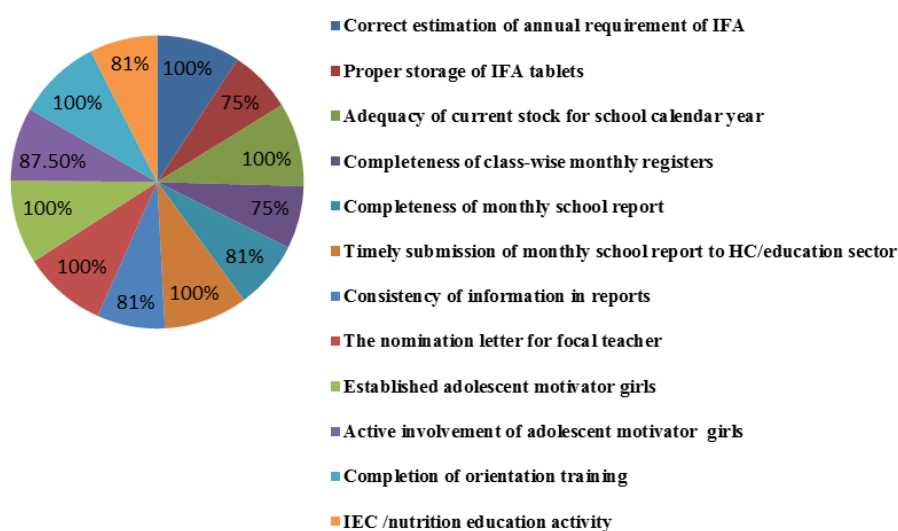


Figure 4. WIFAS documentation review findings towards status of WIFAS adherence among adolescent girls by number in hadiya zone, Central Ethiopia Region, Ethiopia, 2023 (n=569).

Table 3. In school nutrition education and SBCC access in hadiya zone, Central Ethiopia Region, Ethiopia, 2023 (N=569).

character/variable	category	frequency	percent
Is there nutrition education in the school?	yes	519	91.2
	no	50	8.8
If yes, frequency of nutrition education session	Weekly	340	60.7
	Bimonthly	34	6.0
	Monthly	59	10.5
	Not fixed and it is flexible	86	15.11
	Any home room teachers in the school	147	26.3
Who usually provides nutrition education in the school?	Trained teachers	300	53.6
	Health extension workers	52	9.3
	Health professionals	32	5.7
	Trained peer members	9	1.6
	mentioned two education providers	6	1.1
	mentioned more two nutrition education providers	14	2.5
Have you accessed any type of SBCC materials related with WIFAS?	yes	509	89.4
	no	60	10.6
	posters	404	71
Which type of SBCC materials exist in the school?	videos	0	0
	fact sheet and brochures	36	6.3
	a guide for group discussion	127	22.3
	accessed both poster and fact sheet	2	.4
	Poor commitment	69	12.1
If no nutrition education in the school or not provided continuously in every week, what do you think are possible reasons?	no enough supporting SBCC materials	193	33.9
	No free time for nutrition education the school	105	18.5

character/variable	category	frequency	percent
Do you agree that nutrition education helped you for WIFAS uptake?	no trained teacher on nutrition education	84	14.8
	I don't know	48	8.4
	other specify	4	.7
	mentioned poor commitment and shortage of SBCC materials	35	6.2
	mentioned poor commitment, lack of SBCC materials, and others	15	2.6
	No nutrition education interruption in our school	16	2.8
	agree	559	98.2
	disagree	2	.4
	not sure	8	1.4

Table 4. Facilitators and barriers of WIFAS of WIFAS program in hadiya zone, Central Ethiopia Region, Ethiopia, 2023.

character/variable	category	frequency	percent
Have you discussed with your family on your status of taking IFA?	yes	499	87.6
	no	70	12.4
To whom you discussed with?	My father	115	20.2
	mother	398	69.9
	relatives	19	3.3
	for at least two members of the family	11	1.9
	other	6	1
What was their response?	encouraging	421	74.0
	discouraging	127	22.3
	no response	21	3.7
If discouraging, what was their reason	believes adolescence is not the right time for nutrition action or WIFAS consumption	65	11.4
	not clear about WIFAS program	62	10.9
	other	0	0
	Teachers	358	62.9
Is there anyone other than your family supporting you?	Girls club or peer members	185	32.5
	Boys in the school	14	2.5
	Others	4	.7
	no body	4	.7
Have you ever encountered any form of trouble other than minor side effect after you have taken your IFA tablet?	mentioned at least two	4	.7
	yes	10	1.8
What kind of trouble encountered other than minor side effect?	no	559	98.2
	epigastric burning sensation	10	1.8
	Increase in menstruation flow	0	0.0

character/variable	category	frequency	percent
What measure have you taken to solve the problem?	Increasing Weight	0	0.0
	Went to health facility for advice	3	0.5
	Temporarily discontinued	5	0.9
	timely consumed just after eating food	1	0.2
	Delayed to take tea & coffee	1	0.2
	awareness or understanding level among parents or guardians & students about WIFAS	231	40.6
What do you think are the possible reasons for Adolescent girls if not taking or discontinuing WIFA?	Family decision	140	24.6
	Fear of adverse effect	194	34.1
	Other	4	0.7

Table 5. Factors associated with adherence of WIFAS in hadiya zone, Central Ethiopia Region, Ethiopia, 2023.

Variables	Category	Frequency	P value	CoR (95% CI)	P value	AoR (95% CI)
Accessed any SBCC	Yes	509	0.002	8.11(6.83-16.4)	0.00	7.7.22(4.56-13.02)
	No	60				
Exposed for nutrition education	yes	519	0.03	20.46(4.53-23.86)	0.02	16(15.43-240)
	No	50				
Family discussion	Yes	499	0.04	14.54(3.65-52.65)	0.01	7.47(1.38-40.14)
	no	70				
Heard about anemia	Yes	524	0.04	11.16(8.45-68.23)	0.01	9.25(1.43-59.72)
	No	45				
Aware about adolescence is critical period of nutrition	Yes	509	0.04	7.43(5.25-98.65)	0.08	12.16(9.25-125)
	No	60				

Facilitators and barriers of WIFAS program: From the total respondents (N 569) with a 100% respondent rate, 499 (87.6%) were discussed with their family on their status of taking IFA, and of those discussants, the majority (398, or 69.9%) was discussed with their mothers, and 115 (20.2%) were discussed with their fathers. Of all discussants, 74% of parents or guardians were encouraging, and 22.3% of parents or guardians were discouraging WIFAS consumption. For discouraging, 62 (10.9%) reasoned that they don't know about the program, and the remaining 65 (11.4%) perceived that the adolescent period is not the right time for nutrition action or WIFAS consumption. Other than students' parents or guardians, teachers and girls peer members were encouraging as responded by 62.9% and 32.5% study participants respectively. Other than minor side effects, 10 (1.8%) encountered any form of trouble, and all reported (1.8%) epigastric burning after consumption, which could be related to taking in an empty stomach. They said action taken was tem-

porarily discontinuing IFA, visiting health facilities, consuming just immediately after food intake, and delaying or minimizing coffee and tea. From those who interrupted, they responded that possible reasons for adolescents interrupting or not consuming WIFAS were 40.6% said awareness or understanding level difference, 24.6% family decision or influence, and 34.1% fear of side effects (table 4).

Factors associated with WIFAS adherence: Variables were analyzed by bivariate logistic regression for crude odd ratio, and then analyzed by multivariate logistic regression. The odds of Adolescent school girls accessed any type of SBCC were 7.7 times more likely correlated to adhere to WIFAS. The AoR 7.7 (4.56-13.02). Also, those who were exposed to in-school nutrition education were 16 times more likely to adhere to WIFAS; AoR 16 (2.49-19.82). Those who had discussed WIFAS with their family were 7.47 more likely correlated towards adherence to WIFAS than those who had not discussed WIFAS; AoR 7.47 (1.38-40.14). in the same man-

ner, those who heard about anemia and knew about anemia were 9.25 times more likely correlated to adhere to WIFAS AoR 9.25 (1.43-59.72), and also those who heard adolescence period is critical period for nutrition were 12 times more likely correlated to adhere AoR 12.16(9.25-125) (Table 5).

Sectoral coordination and adolescent schoolgirls' involvement in the program's implementation (n = 569). From the total respondents, 206 (36.2%) were motivator girls and 363 (63.8%) were non-motivator girls. From those motivators, 19.7% became motivators because knew benefits, 11.6% were requested by teachers, and 4% were encouraged by their family be motivator girl. As per the motivator girl's response, 9.8% were doing promotion activities, 7.2% supported WIFAS focal teachers, 6.5% identified targets and provided WIFAS, etc. Adolescents were majorly engaged in the program during implementation (83.3%), and the majority of adolescents (70.5%) knew that only the health and education sectors collaborated in the program's implementation, but 12.8% responded that health, education, and women's and children affairs collaborated for the program's effectiveness. 349 (61.3%) responded that there was a WIFAS plan at least at the school level, but 203 (35.7%) did not know the existence of a WIFAS plan in their school. Regarding program sustainability at least at the school level, 154 (27.1%) said program awareness creation had been done, and 96 (16.9%) responded that the program had been institutionalized at implementing schools, followed by 51 (9%) who believed school or institutional capacity building had been done (Table 6).

3.3. Qualitative Result

3.3.1. WIFAS Documentation Review

Proper storage of IFA stock was observed in 12 (75%) schools, and completeness of the reporting pad was observed in 13 (81%) schools. Health and nutrition education was also provided weekly in 13 schools (81%) and 13 (81%) schools provide orientation to the PSTA (parents, students, and teachers association). This document review supported how much the adherence findings reported by adolescent girls were consistent with the consumption documentation in the WIFAS registration books and observed compliance with guidelines during implementation period:

3.3.2. Key Informant Interview Results

Totally, 16 key informants were interviewed, of whom 4 were zonal nutrition officers and focals, 4 were at woreda level from WIFAS focals, 4 were at school level from WIFAS focals, and 4 were WIFAS user adolescent school

girls at school level. They were purposely selected and expressed their WIFAS experience, stakeholders of WIFAS, eligibility for WIFAS, purpose of WIFAS, supplementation approach used in each school and effectiveness, user engagement, success and failure, strengths, facilitating factors and barriers, limitations for adherence and impacts on adherence, and recommendations. Result is organized theme by theme and summarized in the table.

One of the school-level key informant adolescent school girls who consumed WIFAS for one year said, *"Involvement of adolescent girls as motivators and peer-to-peer communication leaders helped the program to be adolescent friendly and effective in terms of information dissemination and transparent discussion"*. Moreover, she said that *"community (parents and guardians) involvement in the program was weak and impacted some parents or guardians by inhibiting their daughters from consuming WIFAS"*. So, she suggested that *"school-level community day should be organized at least twice per year, and awareness-creation social and behavioral change communication sessions should have been organized so far, but not even during school celebration days like card day."*

Another woreda-level health sector nutrition officer and WIFAS focal point pointed out that *"the adolescent nutrition program had not gotten attention as another nutrition program as it was a newly emerged nutrition program in Ethiopia. Due to that, it was not well planned and monitored like other health programs, and it was also not included in the data-sharing health system (DSHS). Hence, PHCU's support to the school was inadequate, and that was why out-of-school adolescents were not addressed by the health extension program as it was not included in the content of the nutrition package at the health post and health center level"*. *"Due to that, no accountability for the program reaches out to out-of-school girls, and even no platform has been set yet. Another issue raised was that the program reviewing mechanism was not inclusive in schools except for training provision like school focals and lead adolescent girls, but only woreda level focals were involved at woreda or zonal level review, which made the program review and learning approach miss inclusive."*

Woreda Education Sector WIFAS focal said that *"due to the low number of trained focals at school level, focals considered it an extra burden besides teaching duties"*. The problem was worse when female focal teachers gave birth and left school due to birth leave. So others, not trained teachers, were in charge of leading the program, but they were not volunteers, and they reasoned they were not well known about the program due to limited training. So, he suggested that cluster-based homeroom teacher training can fill the gap and reduce burden on WIFAS focal only (Table 7).

Table 6. Sectoral coordination and adolescent involvement in the program implementation level in hadiya zone, Central Ethiopia Region, Ethiopia, 2023.

character/variable	category	frequency	percent
If you are WIFAS motivator girl, what motivated you most to be WIFAS motivator girls?	I know benefits of taking WIFAS	112	19.7
	Teachers told me to be involved	66	11.6
	Family encouraged me to participate	23	4.0
	Other	5	.9
	not motivator girl	363	63.8
What do you do as motivator girl?	Promote WIFAS in school club	56	9.8
	Identify ASGs & provide WIFAS	37	6.5
	Support focal teacher	41	7.2
	Provide nutrition education	12	2.1
	supporting focals, and WIFAS promotion	27	4.7
	supporting focals, WIFAS promotion and others role	33	5.8
	Yes during start up	24	4.2
	Yes during implementation	474	83.3
	Do adolescent school girls engaged or involved in WIFAS program management		
	Yes during start up, implementation, & review meeting	4	.7
Which sectors do you think support WIFAS program at school level?	Not in any steps	12	2.1
	I am not sure	55	9.7
	Health & education	401	70.5
	health, education and women affair	73	12.8
	only education	92	16.2
Is there WIFAS implementation plan at your school?	I don't know	3	0.5
	yes	349	61.3
	no	17	3
	I do not know	203	35.7
What do you think has been done for program sustainability?	Maintenance of awareness of its health benefits	154	27.1
	Institutionalization the programs	96	16.9
	Capacity building of the institution	51	9.0
	Noting done so far	123	21.6

Table 7. KII findings summary and illustrative quotes from interviews with 4 zonal-level and 4 woreda-level nutrition and WIFAS officers, school-level WIFAS focals, and 4 adolescent school girls, hadiya zone, Central Ethiopia Region, Ethiopia, 2023.

Themes	Findings	Implications	Potential solutions
WIFAS experience	Positive experiences are: adolescent girl's acceptance of the program; engagement of female teachers; continuous availability of IFA; and support of the program by the majority of	Positive: Ownership by users and gender-responsive nutrition-specific interventions initiatives should be expanded for all target	Addressing the issues by providing training for homeroom teachers. Increasing number of stake

Themes	Findings	Implications	Potential solutions
	communities. Negative experience: Teachers perceive it as extra responsibility and a need for incentive by some teachers to cascade the program, and they face side effects in a few adolescents. <i>"The great positive experience is that we adolescent girls are aware that the program is a targeted nutrition-specific supplementary program to prevent anemia, and that is why we accepted and adhered to the weekly provision."</i>	groups in all areas. Negative: Teachers lack motivation for sustainability and nutrition education.	holders
Stakeholders	Only the health (HWs, HEWs, woreda health office, and zonal health department) and education sectors (ASGs, teachers, principals, woreda education office, and zonal education department) are actively involved in WIFAS, and to some extent, women and child affairs office involved, which indicates inadequate stakeholder engagement. <i>"I see that multisectoral coordination is focused on emergency nutrition and the Seqota declaration, in which 12 sectors are involved, but adolescent preventive nutrition like WIFAS is led only by the health and education sectors, and at each level due attention is not given, but it is mandatory to halt the intergenerational cycle of malnutrition as adolescence is the second window of opportunity for nutrition intervention next to infant age."</i>	Adolescent nutrition has not gotten due attention and has not matured yet in terms of stakeholder engagement, government ownership, and community participation that implies multisectoral nutrition. Intervention package is incomplete, and newly emerged adolescent nutrition intervention programs like WIFAS scale up and sustainability might be endangered.	Sectoral involvement and inclusiveness of WIFAS at each level of the multisectoral nutrition agenda are mandatory to ensure the sustainability of the program.
Supply chain	Availing supplies for adolescent girls are partner-dependent and not owned by the government. Also, the consistency of supply chain flow at the root level between the health post and the school is not consistent. <i>"Beneficiaries of WIFAS are highly encouraged, but we fear that supply (IFA) distribution is partner (NGO) dependent, and if phased out, the program might be interrupted."</i>	Program sustainability could not be ensured unless the government owned the program.	Government ownership of adolescent nutrition program supply is mandatory to ensure sustainability.
Supplementation	There are WIFAS focal teachers in each school who agree on a fixed WIFAS day and provide school-based distribution. Three approaches to provision In school supplementation, before WIFAS day, students have been oriented to bring water (if there is no water in school) and not miss breakfast on WIFAS day. Girl-to-girl supplementation if absent take-home approach that was applicable when students came to school by missing their meal (breakfast). The first approach is the most effective approach, and the second and third approaches are backup or alternative approaches. <i>"We have been empowering and enabling adolescents, especially girls, to run WIFAS program awareness creation, provision, and documentation by themselves. Hence, program ownership and sustainability could be ensured"</i>	Both nutrition education and supplementation for WIFAS are focal-dependent. When WIFAS focal was absent on WIFAS day, fail to distribute unless capable motivator girls are enabled. It is also meal consumption dependent to prevent unexpected side effects if consumed on an empty stomach. If not consumed in school, there is no way to ensure consumption at home and a girls-to-girls approach.	Captivating adolescents to run the program by themselves is the best strategy and option for institutionalizing the program and its continuity without interruption, in addition to training more women. WIFAS focal
Strength and	having enough IFA stock, availability of SBCC	proxy indicator for program sus-	integrated management to

Themes	Findings	Implications	Potential solutions
facilitating factors	tools like posters at school, HP and HC, having its own registration book and reporting tools, involvement of adolescent girls in the program, at least two trained personnel in each school (focal & principal), focal person assigned at school, woreda and zonal level, partner strong technical support and follow up are facilitating factors “Almost all of WIFAS focals are female teachers and have transparent communication with adolescents and they consume IFA before giving to girls that developed trust among adolescents”	tainability and adherence	sustain existing strength
Barriers and limitations	Limitations include being partner-dependent and yet not owned by the government, and not being sure of future sustainability. Also, adolescent nutrition got low attention, and it is yet immature at each level, from the federal to the community level. Numbers of trained personnel vs. number of in-school WIFAS targets are not proportional because there is only 2 trained personnel per school. Stakeholder engagement is limited only to the health and education sectors and, to some extent, the women's and child health affairs sectors. A shortage of SBCC materials and poor community engagement are some barriers. <i>“In my opinion, limitation is the program covered not more than 30% of schools and 70% yet not covered that might be resource related and barrier is information, education and communication is not well supported by locally adapted SBCC and not inclusive of parents or guardians”</i>	Government attention for adolescent nutrition inadequate as the coverage is low. Turnover of trained focals influences the program Without adequate SBCC material, nutrition education awareness creation cannot achieved	Needs extra number of trained school focals Government need to take lead in terms of supply and program management Girls empowerment for program ownership is also mandatory Availing different types and enough and locally adapted SBCC
WIFAS success	Schools measure success based on the proportion of adolescent girls in the program, the number of adolescents who attended nutrition education, the number of adolescents who consumed at least one tab in a given month and the number of adolescents who received the recommended dose per month (4 weekly IFA tabs per month). <i>“As a program focal person, for me success is program acceptance by consumer adolescent girls and the school community and then the proportion of adolescents in the program, but the best indicator is the proportion of adolescents who consumed the recommended amount of supplements in a given school calendar.”</i>	To be successful in WIFAS, It needs improved coverage and adherence of recommended dose	It needs increased number of Champion and model girls led peer to peer communication and school community involvement to be successful

4. Discussion

According to the world health organization, the second-fastest period of growth next to infancy is adolescence, and hence it is expected to let adolescents know nutrition intervention at this age. But this study showed that 66.3%, or 377 out of 569, consume WIFAS because they knew the direct

benefits of WIFAS, i.e., they responded for the prevention of anemia. About 163 or 28.6% consume WIFAS by prioritizing indirect benefits of WIFAS, i.e., for good school performance and the remaining 3.3% consume, but they did not know the right purpose, but they consumed because their classmates do that. Even 19.1% believe that the right time to start nutrition intervention was in the late adolescent period (15-19). This implies that nutrition education and SBCC's flow of messages must be standardized and all to be on the

same page to pass the right message at the right time in the right way.

There were significant determinants associated with WIFAS adherence. Those who accessed any type of SBCC material on WIFAS and nutrition were 14.22 times more likely to adhere to the WIFAS than those who did not. This implies that social and behavioral change communication among adolescent students should be supported by social and behavioral change communications tools utilization like posters, videos, brochures, etc. At the same time, those exposed to weekly nutrition education were 16 times more likely to adhere than those not exposed. This indicates that nutrition education made ASGs aware of the objectives of WIFAS, ways of preventing anemia, and adolescent nutrition. However adolescent age is the second critical period for nutrition next to infancy. Most of the adolescents in the school were under the age of 18, and they could not decide many things by themselves, so family guidance plays a role. This study finding supported this, as those discussed with their family and encouraged to consume WIFAS are 7.47 times more likely to consume continuously or with adherence than those not discussed. This implies that engaging the community in WIFAS implementation was mandatory. Moreover, having previously heard about anemia and being aware that the adolescent period was a critical period of nutrition, adolescents were more likely to consume WIFAS 9.25 and 2.16 times, respectively, than not.

MoH's 2016 Ethiopia guideline on micronutrient supplementation recommends adolescent girls consume at least 12 IFA tabs within three months. So what matters in weekly iron and folic acid supplementation was adherence. This study finding supports AAU and NI's 2017 operational research findings in Chifera and Wolayta zones and Damot Gale districts, which were 89.3% and 73.8%, respectively, in the first month of WIFAS however contrasts short period of study. This study's findings (74% adherence) in three months of supplementation significantly gave strong evidence as duration matters towards adherence. *"Involvement of adolescent girls as motivators and peer-to-peer communication leaders helped the program to be adolescent friendly and effective in terms of information dissemination and transparent discussion."*

This study findings revealed increased adherence with same duration (three months of compliance, 66.1%) conducted in 2020 in Debub Achefer Wenda, Amhara Region, Ethiopia. Based on evidence from key informant interview, this difference could probability be related with strong monitoring, technical assistance, review the program, engage beneficiary, and school community, and ensure supply availability. This study finding contradicts another adherence study finding in India in 2016 that was 33% (Kuril BM et al., 2016), 85.8% in rural Pondicherry (Prasad T et al., 215), 47.2% at Bah Our Commencement et al., 2019 in rural Puducherry public, and 26.2% in Jamal metropolis (S. Dajan Dubik et al., 2019). This study had a few limitations. The first was that I used adolescent self-reported quantitative data

to assess WIFAS adherence. So, there might have recall bias and social desirability bias. In addition, I did not assess hemoglobin concentration, so I am unable to link WIFAS adherence with the prevalence of anemia in a study site. Moreover, residual confounding due to unmeasured variables may still influence results despite controlling for known confounders. Future studies would benefit from assessing hemoglobin (HGB) and iron (Fe) biomarkers to assess the prevalence of iron deficiency anemia. The strength of this study is being mixed method (both quantitative and qualitative method). Moreover, future studies could address the need for targeted interventions those consider socioeconomic and educational contexts in public health strategies.

Abbreviations

AAU	Addis Ababa University
ASGs	Adolescent School Girls
DH	Demography and Health
DNA	Deoxyribonucleic Acid
EDHS	Ethiopia Demographic, and Health Survey
FGD	Focus Group Discussion
HC	Health Center
HP	Health Post
IDI	In-depth Interview
IFA	Iron Folic Acid
IFAS	Iron Folic Acid Supplementation
KII	Key Informant Interview
MoH	Ministry of Health
NI	Nutrition International
NTD	Neural Tube Defects
PHCUs	Primary Health Care Units
RBC	Red Blood Cells
RCT	Random Controlled Trial
SNNPR	Southern Nation, Nationalities, and People Region
SPSS	Statistical Software for Social Science Students
WHO	World Health Organization
WIFAS	Weekly Iron Folic Acid Supplementation

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Author Contributions

Kifle Wodebo: Conceptualization, Data curation, Formal Analysis, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing

Wubetu Woyraw: Conceptualization, Supervision, Validation, Writing - review & editing

Disclosure Statement

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Conflicts of Interest

The authors declare no conflicts of interest.

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