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Original Article

Public Health Section

Bottleneck Analysis of Iron and Folic Acid Supplementation among Children Aged 6 Months to 5 Years using the Modified Tanahashi Model: A Community-based Cross-sectional Study

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ABSTRACT

Introduction: Even though there is a public health intervention to provide a biweekly Iron and Folic ACID (IFA) supplementation to children of six months to five years, the prevalence of anaemia in this age group of children in India remains high.

Aim: To identify potential bottlenecks in the implementation of IFA supplementation, and suggest measures to address them in children aged six months to five years using the modified Tanahashi model.

Materials and Methods: The present cross-sectional study was done from August to September 2022 in randomly selected Anganwadi Centres (AWC) in Koraput district, Odisha, India. A total of 10 AWC and the front-line health service providers-Auxiliary Nurse and Midwife (ANM), Accredited Social Health Activist (ASHA) and Anganwadi Worker (AWW) were taken for facility survey. Around 100 mothers /caregivers of children in the age group six months - five years were taken for a community survey. Content analysis was done for the qualitative data.

Results: As reported by about three out of 10 (30%) of the AWWs and about four out of 18 (22.22%) of ASHAs, mothers resisted to feed IFA syrup to their children due to misconceptions. About 41 out of 100 (41%) of mothers did not know the recommended schedule for IFA supplementation. None of the mothers orally administered IFA syrup to the children as per the guidelines. The ANMs reported that no screening of children for anaemia was done at the Urban Health and Nutrition Day (UHND).

Conclusion: Trained health workers, maintenance of buffer stocks and easy accessibility in terms of distance were the factors increasing the coverage of IFA supplementation. However, irregular administration, less frequent household visits by the healthcare provider, low compliance in service delivery, poor adherence to guidelines, lack of screening at UHNDs, poor awareness among mothers may have resulted in sub-optimal supplementation.

Keywords: Anaemia, Anganwadi centres, Bioavailability, Global health problem, Iron deficiency

INTRODUCTION

Anaemia is a serious global health problem in children which not only affects human health but also has consequences on the social and economic developments of a nation [1]. It is a cause of morbidity and mortality among children in developed and developing nations. An estimated 42% of children less than five years of age are anaemic worldwide [2]. About 67.1 % of children in the age group six months to five years are anaemic in India according to The National Family Health Survey (NFHS) 5. In Odisha, about 64.2% children aged 6-59 months are anaemic (<11.0 g/dL) [3].

The common causes of anaemia in developing countries, especially in vulnerable age groups that is in infants and preschool children are nutritional deficiencies, worm infestations and infections like malaria [4]. The two-leading causes of anaemia are inadequate nutrient intake and infectious diseases and both have impacts on the economic growth of the country [5]. Deficiency of iron is the most frequent micronutrient deficiency and 90% of all types of anaemia in the world are due to iron deficiency [6]. Iron deficiency anaemia remains a major health problem in India affecting children aged six month-five years [7].

In young children, iron deficiency is due to increased iron requirement during periods of rapid growth. In addition, infant and toddler diets are often poor in bio- available iron, particularly post weaning. Hence, the age six months to five years is a vulnerable age for iron deficiency anaemia [8,9].

NHFS 5 suggests that anaemia prevalence in 675 districts is more than 40% in children aged six months-five years. According to NHFS 4 data, anaemia prevalence in children in Odisha in the age group six months to five years was 58% which has increased to 64.2%, as per NHFS 5 data, in Odisha. Achieving the Sustainable Developmental Goals (SDG) 2.2 target of ending all forms of malnutrition by 2030 may not be possible if this is not taken care of [10,11].

IFA supplementation program can be improved by identifying the barriers in the program and this can be done using the modified Tanahashi model. Developed in 1978, the Tanahashi model was later modified to form a more efficient model that can be used to identify gaps and barriers [12]. Tanahashi fully intended his model to be used in a practical way to guide systematic evaluation of bottlenecks in service delivery and the constraining factors responsible for these bottlenecks, and in the selection of effective measures to improve services [11]. The modified Tanahashi model is used to assess the constraints and bottlenecks in the coverage of an intervention for any program with a focus on the quality and effectiveness of actions.

Anaemia Mukt Bharat targets to bring down the prevalence of anaemia by 3% per year and to bring down the prevalence to 40% by

2022. Still, the high prevalence of anaemia shows low effectiveness in the implementation of the program [13]. The Tanahashi model helped to identify barriers on the supply and demand side of healthcare service delivery.

The aim of the present study was:

- To identify bottlenecks in the implementation of IFA supplementation to children in the age group six months -five years;
- To analyse the causes of the bottlenecks;
- To suggest evidence-based measures to address the bottlenecks.

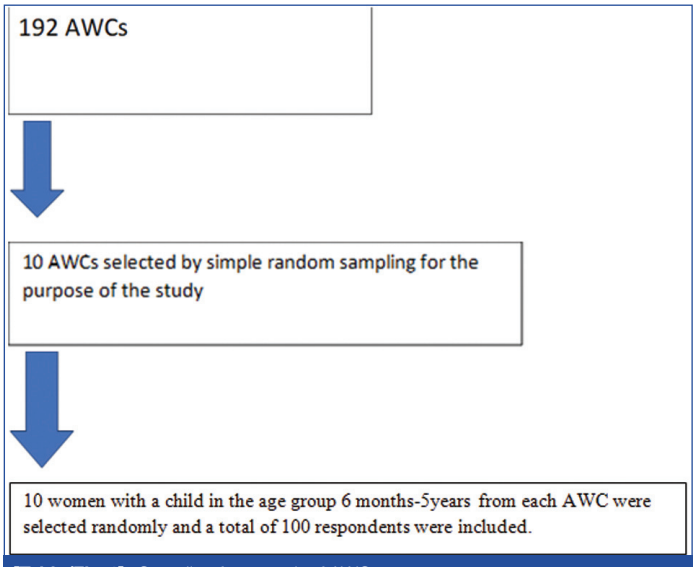
MATERIALS AND METHODS

The present cross-sectional study was done from August to September 2022 in randomly selected AWCs in Koraput district, Odisha, India. Ethical approval was taken from the Institutional Ethics Committee at MKCG Medical College, Berhampur, bearing IEC No. 1157. Informed consent was taken from all the stakeholders involved in the study.

Inclusion and Exclusion criteria: Mothers/caregivers of children in the age group six months-five year were taken for community survey. Those willing to participate in the study were included while those with sick children were excluded. Ten AWCs and the front-line health service providers -ANM, ASHA and AWW were taken for facility survey.

Sample size calculation: Mothers/caregivers of children in the age group six months-five years: Sample size is calculated using the formula $4pq/l^2$, where p is 64.2% (64.2% is the prevalence of anaemia in under 5 years children as per NHFS 5) [10] alpha error as 0.05 and l as 10% (Allowable error) and the sample size was 92. Taking a non-response rate of about 10%, the final sample size was calculated to be 100.

Sampling framework of AWCs. There is a total of 192 AWCs. A 5% of AWCS was selected and visited [Table/Fig-1].



[Table/Fig-1]: Sampling framework of AWCs.

Bottlenecks in the IFA supplementation to children in the age group six months to five years was identified using the modified Tanahashi model using quantitative and qualitative method [12]. There are six determinants of coverage of an intervention or service that help to find the bottlenecks in service delivery as per the modified Tanahashi model:

1. Availability of essential health commodities: It is the availability of essential logistics like drugs for the target population. The information was obtained from a review of stock registers during facility visit.
2. Availability of human resources: It is the availability of trained staff providing quality and effective interventions or services.
3. Geographical accessibility: It is the physical access to health services by the clients or beneficiaries such as distance, travel time, the ease with which a client can access a facility along with the waiting time to use the health service. 4. Initial utilisation: It assesses the first contact with the health service which is influenced by financial accessibility and knowledge about the health service.
4. Continuous utilisation: It measures continuity and compliance of multiple visits for the care.
5. Effective coverage: This indicates the proportion of people receiving satisfactory service that is quality care. It is the proportion of people who received all adequate components of service in a timely and complete manner.

Study Procedure

Approval was taken from the District Social Welfare Officer and data was collected in a semi structured pretested schedule. Part 1 of the schedule was for obtaining information from mothers/caregivers which was in local language; Part 2 was for data from the registers of the AWCs, Part 3 was for interviewing the ANM, ASHA and AWW and part 4 was for assessing available infrastructure and manpower in AWCs. For the qualitative part, In-Depth Interview (IDI) was conducted with the ANM, ASHA and AWW.

Indicators used for the determinants of the modified Tanahashi model [Table/Fig-2]. For this, data was collected from:

- Mothers/caregivers
- Documents (Registers) from AWCs
- Front line health service providers (ASHA, AWW and ANM) at AWCs

Determinants of modified Tanahashi Model	Decided criteria
Availability of essential health commodities	Proportion of AWCs with stockouts of the drug in the past 3 months
Availability of human Resources	Proportion of AWCs with trained front-line workers
Accessibility of service delivery points	Proportion of beneficiaries residing within 5km of the facility
Initial utilisation	Proportion of mothers who gave IFA syrup to children as per required dose for at least 30 days
Continuous utilisation	Proportion of mothers who gave the IFA syrup to children as many times as needed in last 3 months.
Effective coverage	a. Proportion of mothers who gave IFA syrup as per age and as per schedule b. Proportion of beneficiaries who said they received good quality service

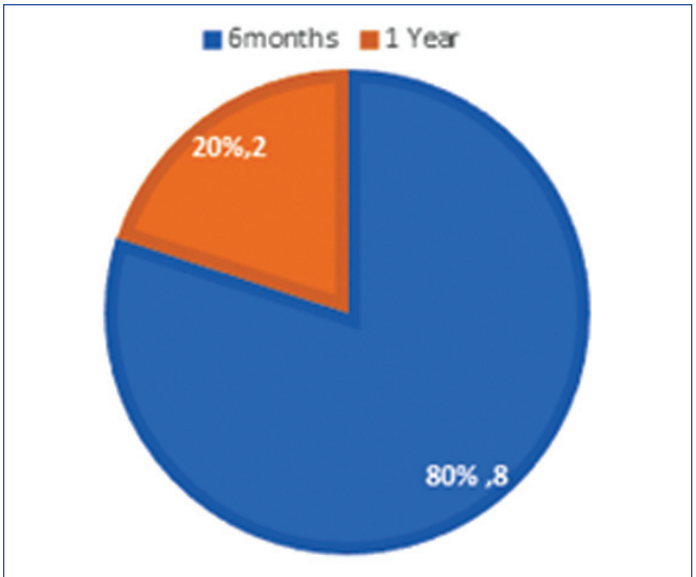
[Table/Fig-2]: Determinants of modified Tanahashi Model in the study.

STATISTICAL ANALYSIS

The quantitative data collected was entered in MS Excel and analysed in Statistical Package for Social Sciences (SPSS) (version 17). Content analysis was done for the qualitative data. Fischer-exact test used to determine the Association between distance from the nearest AWC, and Chi-square test was used to determine awareness about anaemia with IFA supplementation to the beneficiaries.

RESULTS

AWW: The mean number of children aged six month to five years receiving IFA in all the 10 AWCs was 51.84±18.552. All the AWWs had received training relating to Iron and folic acid supplementation. The AWWs administered Iron and folic acid syrup to the school going children at AWCs twice a week after meal, i.e., on Tuesdays and Fridays. The majority of the AWWs start giving IFA syrup to children from six months of age [Table/Fig-3].



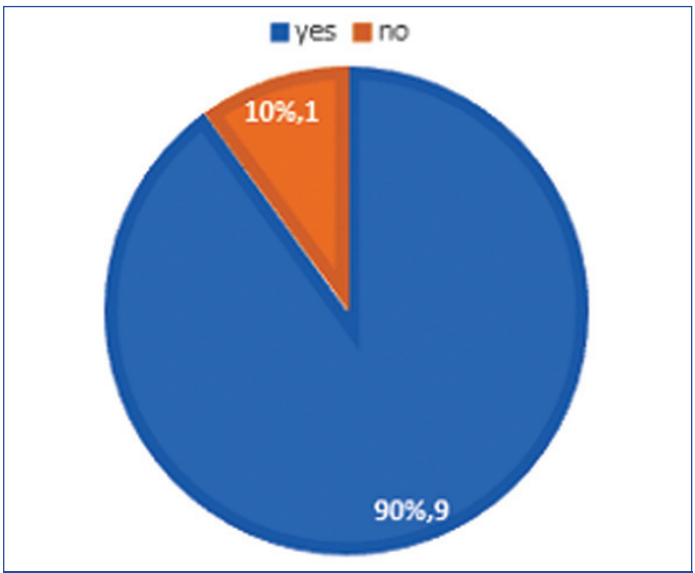
[Table/Fig-3]: The ages at which IFA is offered for the first time by the AWWs (N=10).

One of the AWWs said "We tell the mothers that this syrup will help in blood formation in the child".

All the 10 AWWs (100%) did home visits. The visits were not regular and all of them visited the beneficiaries' homes less than twice a week. The visits were scheduled when an online mobile application showed reminder for immunisation of children and thus these visits were not primarily for the IFA syrup administration. About four out of 10 (40%) of the AWWs did household visits twice a month and about six out of 10 (60%) of them visited once a month.

Another participant said, "Whenever someone's name comes up on the mobile application, we visit them to inform the mothers for immunisation of the child, to take the nutritional supplements as provided by Integrated Child Developmental Services (ICDS) and whenever we visit for these purposes, we give the child IFA supplementation as per requirement".

About nine out of 10 (90%) of the AWWs kept records of the women migrating and the areas where they were going to move to [Table/Fig-4]. One of the participants said, "If they mention where they're migrating, we contact the other AWC and cut their name off the register at this AWC". Another said "Every year in April a new survey book is formed, and all the entries are transferred to the new book. If we find discontinued syrup intake record, we strike the name off the register". The AWWs received a particular number of IFA syrup bottles according to the number of beneficiaries in their target population. All the 10 AWWs (100%) requested for supply of IFA syrup from their respective medical authorities. Most {7 out of 10 (70%)} of them informed the ANM and ASHAs over the phone, some {2 out of 10 (20%)} of them wrote to the pharmacist of the district store while a few {1 out of 10(10%)} of them informed the Medical Officer.



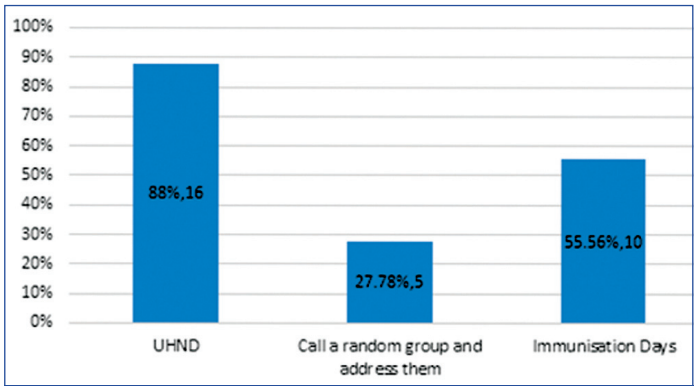
[Table/Fig-4]: Percentage of AWWs who kept records of women who were going to migrate (N=10).

One of the AWWs said, "We write an indent to the pharmacist in which we mention the number of deliveries". Another AWW said, "We contact the ANM supervisor over phone and the health supervisor writes to the pharmacist". If the AWW did not request for IFA requirement for the beneficiaries, the health supervisor and Child Development Project Officer (CDPO) decided the amount of IFA required for the target population of an AWC. All the AWWs who received IFA from ANM and ASHA reported sporadic delivery of IFA. All of them said that there was no demand for IFA among the beneficiaries and they stored the IFA syrup at the AWC. All of them kept records of the IFA supplementation. About three out of 10 (30%) of the AWWs said that the mothers have misconceptions, resistance to communication and other challenges relating to the uptake of iron and folic acid supplementation within the community. To quote one of the AWWs, "Some of the caregivers say that they already are giving a lot of medicines to their respective children, so, IFA syrup might not be necessary".

ASHA: There were a total of 18 ASHAs in the 10 AWCs. All ASHAs were trained in IFA supplementation. Only about 15 out of 18 ASHAs screened the children aged six months-five years for anaemia. All the ASHAs did household visits and all the 18 ASHAs (100%) of them administered iron and folic acid syrup to children during these visits. The frequency of such visits was less than twice a week for all of them. About 16 out of 18 (88.89%) of the ASHAs covered hard to reach groups. According to 13 out of 18 (72.22%) of the ASHAs, the target population was not aware of iron deficiency anaemia.

All (100%) the ASHAs educated the community on IFA supplementation and nutritional needs in their catchment area. About five out of 18 ASHAs said they educate the target population once a week, 11 of them did that once a month and the rest educated the population twice or thrice in a month.

The ASHAs use various methods for educating the target population. Some use multiple methods to generate awareness. Most of the awareness is promoted at the UHNDs, 16 out of 18 (88%) ASHAs promoted this at the UHNDs. Awareness generation during random group talk was done by 5 out of the 18 (27.78%) ASHAs and 10 out of 18 (55.56%) ASHAs said they also do this at immunisation sessions [Table/Fig-5]. To quote one of the ASHAs who promoted suplementation at the UHNDs, "A group of mothers come to the UHND once a month and we inform them the importance of IFA supplementation by saying it helps in blood formation". Another ASHA said, "We measure the weights of children on the immunisation days and if the child is weak, we recommend IFA and other supplements".



[Table/Fig-5]: Approaches adopted by the ASHA to educate the community.

According to 14 out of 18 (77.78%) of the ASHAs, the mothers in the target population of their area had misconceptions. One of the ASHAs said, "Some mothers say it is not required as too many medicines is harmful at such an age. Few mothers also hesitate giving IFA to their child as the child gets irritated and does not cooperate".

Most of the ASHAs claimed to have never had a stockout in the past three months. Out of them 2 (11.11%) reported a stockout a few months ago. On being asked if they had a backup plan in case of stock out, most of them 12 out of 18 (66.67 %) were found to not have any [Table/Fig-6]. One of the ASHAs said, "Once, IFA syrup was discontinued for a month. We contacted the ANM supervisor and the pharmacist at the district store. They asked us to wait. We were asked to come and get when the new stock arrived". Another ASHA said, "We have stock all the time so stockout never happened, so we never needed a backup plan". One of them also said, "New stock is available at just one call. Either ANM gets it, or we go ourselves and get that during sector meeting on Saturdays".

Stockout	N (%)
Yes	2 (11.11)
No	16 (88.89)
Backup plan	
Yes	6 (33.33)
No	12 (66.67)

[Table/Fig-6]: Percentage of ASHA reporting a stockout (N=18).

ANM: All the 10 ANMs were trained in IFA supplementation. The ANMs received the IFA from the UPHCs. They then distributed that to other frontline workers like the ASHA and the AWW. The ASHA and AWW take it to the AWC, where it is stored. One of the ANMs said, "it is stored at the AWCs since it has space and easy to access".

They do not give IFA syrup to the mothers directly unless in certain conditions such as if they live far from the AWC or during lockdowns. To quote one of the ANMs, "We get the IFA units from the UPHC and then distribute them to the ASHA according to the target population of their respective areas. ASHA takes them to the AWCs where there is storage space".

Another ANM said, "The ASHA gives IFA syrup to the mothers of children aged six months to three years if they live very far from the AWC. The ASHA instructs them how to feed. Older children in the age group 4-5 years, get IFA at school. The AWW feeds them on the Tuesdays and Fridays".

Regarding receiving of IFA, the ANMs request for IFA by writing an indent to the pharmacist of the district store. They received IFA from the district store by themselves in their personal vehicle. However, some of them get the IFA units along with the vaccine's shipment directly at the AWC. One of the ANMs said, "We write an official letter to the pharmacist requesting for IFA units. Then get them from the UPHC on our own vehicles or by renting out a vehicle on our own expense".

Most of the ANMs i.e., about eight out of 10 (80%) of them had no clue what to do in case of a delayed shipment, since it has never happened for them. However, only about two out of 10 (20%) of them said that they manage stocks by distributing them in a calculated manner.

To quote one of the participants, "We go and get the boxes ourselves. If we have a delay in shipment, we give half of the asked units in stock to each ASHA and then when rest of the shipment comes, we ask ASHA to come and receive".

IFA delivery is not regular, but it's often delivered once in every three months {for three out of 10 (30%) of the ANMs} or twice a year (for seven out of 10 (70%) of the ANMs).

The previous delivery for IFA syrup for most {nine out of 10 (90%)} of the ANMs was two months ago. A mean of 1278±1209.876 units of IFA were received by the ANMs.

About three out of 10 (30%) ANMs reported to receive IFA syrup bottles once in every three months. About seven out of 10 (70%) ANMs got received once in every six months.

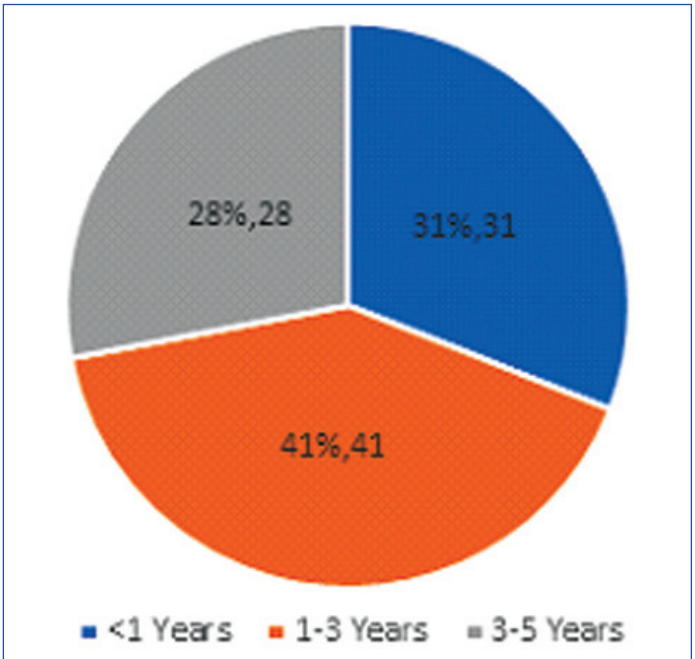
One of the ANMs reported a stockout in the past three months. However, the stock out was not for a long duration and a new stock was replenished within one week. To quote the participant, "I contacted the health supervisor and got a call within 3-4 days to go and receive once new stock arrived".

All the ANMs were trained on keeping the records. Most {nine out of Ten 9 (90%)} of the ANM kept the records [Table/Fig-7]. The health supervisor checked the records of the most of the ANMs on Saturdays during sector meeting at the UPHCs.

Stockout (in the past 3 months)	Frequency (N=10)	Percentage (%)
Yes	1	10
No	9	90
Backup plan		
Yes	5	50
no	5	50

[Table/Fig-7]: Stockouts reported by the ANMs and if they had any back up plans (N=10)

Mothers and caregivers: All 100 of the mothers had Mother and Child Protection (MCP) cards. Mean age of the beneficiaries was 21.9±12.4328 months [Table/Fig-8].



[Table/Fig-8]: Age of the beneficiaries (N=100).

The mean income of the population was found to be Rs.15660±15943.854 per month [Table/Fig-9]. About 59 (59%) out of 100 of the beneficiaries received IFA syrup from ASHA/AWW/ mothers. Due to lack of awareness about IFA supplementation

Educational qualification of the mother	Percentage
Professional degree	1
Graduate	25
Intermediate	15
High school	14
Middle school	2
Primary school	8
Illiterate	35

Occupation of the head of the family	
Professional	21
Clerical	23
Skilled	27
Unskilled	29
Income in rupees	
<5000	31
6000-10000	24
11000-20000	13
21000-30000	1
31000-40000	11
>41000	20
Socioeconomic class (with scores)	**Number of participants (N=100)**
Upper class (26-29)	7
Upper middle (16-25)	25
Lower middle (11-15)	17
Upper lower (5-10)	51
Lower (<5)	0

[Table/Fig-9]: Socioeconomic status of the study population using the Modified Kuppuswamy scale (N= 100).

and the schedule of IFA supplementation, about 41 (41%) out of 100 of mothers did not know when to give or whom to contact for IFA syrup or when they were supposed to receive the first service [Table/Fig-10]. To quote one of the mothers "I don't know anything about that (IFA), but we feed him vitamins. Healthcare workers give us vitamins to be fed to the child". One of the participants said, "I don't know what you are talking about. Never heard of anything like that". The children who received IFA supplementation were either provided by the mother or the health care providers i.e., ASHA/AWW or both. About 21 out of 100 (21%) of the mothers administered IFA to their children themselves. The mothers who fed IFA syrup to their children got the bottles from the AWC. Some of them received IFA syrup bottles from the ASHAs during their home visits. No caregiver complained of or had any concern related to any side effects of IFA syrup.

Knowledge related to IFA and anaemia asked in the local language	Yes	No
Ever heard of "anaemia"	41	59
Are they aware of IFA supplementation	38	62
Have they seen the IFA syrup bottle	46	54

[Table/Fig-10]: Awareness among mothers about anaemia and IFA supplementation (N=100).

About 73 out of 100 (73%) of households were visited by the healthcare workers, as informed by the mothers/caregivers. However, the visits were not regular and were once or twice a month. One of the participants said, "The healthcare workers visit us once in 2-3 months. They used to visit once in every 15 days during pregnancy. Now they don't visit much". Another caregiver said, "ASHA Didi comes when we call her over the phone if the child is not well". About 27 out of 100 (27%) of participants have not been visited by any healthcare worker. As quoted by one of the mothers, "We shifted here about six months ago and been visiting this AWC for five months now, but no healthcare worker visits us at home". While another participant said, "We have never been visited at home by any healthcare worker. We only see them during immunisation sessions".

The mothers who are aware about anaemia and IFA supplementation said yes on being asked if healthcare workers provide information about importance of IFA. Almost all of the participants were counseled on nutrition at least once at Urban Health and Nutrition Day (UHND). Most {77 (77%) out of 100} of the participants resided within walking distance to the AWC. Few of them used personal vehicle {13 (13%) out of 100} or public transport services {10 (10%) out of 100}. AWCs were located within 5km for 93 (93%) out of 100 of the beneficiaries and for 7 (7%) out of 100 of them, AWC were in >5 km distance. Waiting time at the AWC for most {92 (92%) out of 100} of the participants was less than an hour. About 50 (50%) out of 100 of them were satisfied with the service at their respective AWCs.

AWC: All the 10 AWCs had registers for record keeping. Most of them had their registers updated. The home visit planner was according to reminders from a mobile application for the AWWs. Family and pregnancy details were in a separate register. None of the AWCs had registers for monthly survey of IFA events. One of the AWWs said, "Family and pregnancy details are in the survey book and for the rest we have separate books on which we mark with a red pen on Tuesdays and Fridays, that is, after we feed them IFA syrup". Each UHND session lasted for about two hours and the AWC was visited by the district officer the previous month for a supervision. Another AWW said," The district officer assessed only the logistics. He checked if all the staff are present and if enough stock of drugs is present". There was no significant relationship noted between distance from AWCs and IFA supplementation while there was a statistically significant association between awareness of Anaemia among the mothers of beneficiaries and IFA supplementation [Table/Fig-11].

Parameters		IFA Supplementation		p-value
		Yes	No	
Distance from the AWC	<5 km	55	38	0.44
	>5 km	3	4	
Awareness about anaemia	Yes	43	6	<0.00001
	No	12	39	

[Table/Fig-11]: Association between distance from the nearest AWC (Fischer-exact test) and awareness about anaemia with IFA supplementation to the beneficiaries. (Chi-square test)

Results as per the determinants of the modified Tanahashi model is shown in [Table/Fig-12].

Determinants of the modified Tanahashi model	Definition	Frequency	Percentage(%)
Availability of essential health commodities	Proportion of AWCs with stockouts of the drug in the past 3 months.	9 out of 10	90
Availability of human resources	Proportion of AWCs with trained front- line workers.	10 out of 10	100
Accessibility of service delivery points	Proportion of beneficiaries residing within 5km of the facility.	93 out of 100	93
Initial utilisation	Proportion of mothers who gave IFA syrup to children as many times as needed in last 3 months	40 out of 100	40
Continuous utilisation	Proportion of mothers who gave IFA syrup to children as many times as needed in last 3 months.	20 out of 100	20
Effective coverage	Proportion of mothers who gave IFA syrup as per age and as per schedule Proportion of beneficiaries who said that they received a good quality service.	20 out of 100 50 out of 100	a.20 b.50

[Table/Fig-12]: Determinants of the modified Tanahashi model.

Supply side issues: There was a stockout of IFA syrup in 10% of the AWCs in the last three months. All the AWCs had the required number of healthcare providers, ASHA/AWW for IFA supplementation. There was no gap in the training of the healthcare providers. All had undergone training on IFA supplementation program. The AWC was located within 5 km of the residence of 93% of the beneficiaries. However, 7% of beneficiaries resided more than 5 km.

Demand side issues: The proportion of mothers who gave IFA syrup to children for at least 30 days after the initial dose was only 40%. The proportion of mothers who gave the IFA syrup to children as many times as needed in the last three months was only 20%. The proportion of mothers who gave IFA syrup to children as per age and schedule was 20%. The proportion of mothers who said they received good quality service was 50%.

DISCUSSION

All the healthcare workers, the AWWS, the ASHAs and the ANMs were trained in iron and folic acid supplementation. However, trainings and sensitisation workshops for the state and district level officials were conducted till 2019-20 only in seven states [14].

Mean number of children aged six month to five years, receiving IFA according to AWWs were 51.84±18.552, which is about 88.7% of the total beneficiaries. It is however, higher than as reported by Joe W et al., which was 15% supplementation coverage in this age group [15].

IFA delivery to the AWC is done either by the ASHA or the ANM. About 16.67% of ASHA screened children in the age group six months to five years for anaemia and it was according to the screening guidelines of children in Anaemia Mukt Bharat [13]. However, no screening of children for anaemia was done at the UHND as reported by the ANMs.

All the ASHAs educated the target population regarding IFA supplementation in their community. The counselling provided at UHND was mostly about nutrition and immunisation, with a little or no emphasis on IFA supplementation for infants and children. Some of the mothers who were aware of anaemia had some idea about anaemia and IFA supplementation during pregnancy and not in children aged six months to five years. Only about 38% of caregivers were aware of IFA supplementation, which was lower than the value found in a study by Mishra JP et al., which was 51.5% of mothers [16]. A few of the healthcare workers reported of a stockout in the past three months. However, the stocks were replenished soon within a week. About 66.67% of ASHA and about 50% of ANM had no backup plan in case of stockout. This may be due to the already reserved stock at the AWC. However, in the present study the stockouts reported by ANMS were lower than as reported by a study by Wendt AS et al., which reported that 44% ANM were out of stock [17].

About 40% of the mothers gave the required dose of IFA syrup to their children for at least 30 days. This may be due to lack of awareness about iron deficiency anaemia among the mothers of the beneficiaries. About 20% of the mothers gave IFA syrup to their children as many times as needed in the last three months. About 20% of the mothers gave IFA as per age and schedule. About 50% of the mothers said they received good quality services. A bottleneck analysis on IFA supplementation by United Nations International Children's Emergency Fund (UNICEF) in Pakistan found that barriers in the delivery system hamper progress. A viable supply chain mechanism, supported by community-based delivery, ensures consistent and frequent access to supplements as well as opportunities for follow-ups with supplementation, by building trust and disseminating information to beneficiaries [18]. Few of the bottlenecks identified and their solution is summarised in [Table/Fig-13].

Indicators used	Bottlenecks identified	Proposed strategic option
Proportion of beneficiaries residing within 5km of the facility	1.Long distance from the AWCs resulting in difficulty in transport	a.Mothers can be given the IFA syrup bottles and instructed how to feed the syrup to the child at home.
Proportion of mothers who gave IFA syrup to children as per required dose for at least 30 days	1.Lack of awareness among the mothers. 2.Lack of counselling on IFA 3.Irregular home visits by the healthcare providers especially ASHAs	a.Awareness should be created among mothers and caregivers regarding anaemia in early childhood and its detrimental effects. b.The frequency of meetings and counselling by the healthcare providers should be increased. c.Incentivise the ASHAs.
Proportion of mothers who gave the IFA syrup to children as many times as needed in last 3 months.	1.Irregular supplementation 2.Lack of awareness among mothers 3.Misconceptions (as reported by ASHA) 4.Lack of counselling on IFA supplementation 5.Irregular home visits by the healthcare providers especially ASHAs	a.Mothers should be counselled on the importance of IFA to prevent iron deficiency anaemia. b.Misconceptions should be clarified by the healthcare providers at meetings and contact sessions with mothers and caregivers. c.Incentivise the ASHAs.
Proportion of mothers who gave IFA syrup as per age and as per schedule Proportion of beneficiaries who said they received good quality service	1.Irregular supplementation 2.Lack of knowledge regarding iron deficiency anaemia	a.Healthcare workers should counsel about the required dose and schedule in the meetings. b.IEC and BCC activities should be conducted regularly focusing on creating awareness related to anaemia and its prevention. c.Demand generation should be scaled up.

[Table/Fig-13]: Detailed findings and proposed strategic options of the modified Tanahashi model.

Limitation(s)

The study was conducted only in a few AWCs of southern Odisha, India hence, the findings cannot be generalised to other regions. Some of the participants may not have given the correct response since they are themselves part of the healthcare system. There is a likelihood of recall bias, as participants may have omitted details while relying on memory to report their responses. Since anonymity and confidentiality were not maintained during In-Depth Interview (IDI), there is a possibility of social desirability bias. There is a potential for participant bias, as the practices were self-reported rather than being directly observed by the data collector.

CONCLUSION(S)

The analysis revealed that nutritional literacy of the mothers and caregivers of the children should be enhanced by providing them with appropriate nutrition related education and counselling. This would lead to better IFA compliance. Apart from this, refresher training, supportive supervision and monitoring of activities of the frontline healthcare service providers and incentivising ASHAs based on performance can help to motivate them.

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