

## Original Research Article

# Nutrition education and counselling by frontline health and nutrition care workers is associated with improved iron adherence among pregnant women: evidence from the National Family Health Surveys, 2015-21

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## ABSTRACT

**Background:** Anaemia is a global public health problem affecting developing and developed countries with major consequences for human health and social and economic development.

**Methods:** This paper attempted to understand the determinants of iron adherence among women of reproductive age during their last pregnancy in India and states/union territories, the iron deficiency being associated with anaemia, using multiple logistic regression analyses of data from the fourth (2015-16) and fifth (2019-21) rounds of the India National Family Health Survey. The individual unit-level data were analysed using Stata 17 software.

**Results:** After adjusting for standard covariates, it was found that those who reported receiving counselling by a frontline health worker and/or antenatal care visits were much more likely to consume at least 90 days of iron-containing supplements. Results shows that for NFHS-4 women who had received counselling from a frontline health and nutrition care worker were 1.489 times (95% CI: 1.429-1.553) to adhere to at least 90 days of iron tablets or syrup after adjusting for potential confounders and for NFHS-5 women who had received counselling from a frontline worker were 1.162 times (95% CI :1.124-1.200) more likely to adhere to IFA supplements or syrup for at least 90 days.

**Conclusions:** Based on insights from these analyses, it appears that counselling seems to be effective in making women aware of the benefits of IFA, thus increasing the likelihood of intake of iron-containing supplements. Counselling seems to be an important predictor of adherence to iron intake in India.

**Keywords:** Anaemia, Antenatal care, Counselling, Health worker, Iron and folic acid tablets/syrup supplementation, NFHS

## INTRODUCTION

Anaemia, defined as a reduced haemoglobin concentration, is associated with increased perinatal mortality, increased child morbidity and mortality, impaired mental development, impaired immune

competence, increased susceptibility to lead poisoning, and decreased performance at work. Iron deficiency is the most prevalent nutritional disorder worldwide. It occurs when iron absorption cannot compensate for iron requirements and losses. Requirements are especially high in pregnant women, infants, young children and

adolescents who are more likely to be iron-deficient and thus are more susceptible to developing iron deficiency anaemia. Causes of anaemia are multiple and complex, but iron deficiency (ID) is considered to be the major cause of anaemia, especially among women of reproductive age due to limited intake of iron-rich foods along with poor bioavailability and increased requirement associated with menstruation.

In 2019, global anaemia prevalence was 29.9% (95% uncertainty interval (UI) 27.0%, 32.8%) in women of reproductive age, equivalent to over half a billion women aged 15-49 years. Since 2000, the global prevalence of anaemia in women of reproductive age has been stagnant. Research shows this could be partially due to methods of assessing hemoglobin, but we sought to look at other potential contributors to anaemia. Hence, anaemia is a global public health problem. In India, according to NFHS-5, 2019-21, 57% (95% CL: 56.8%, 57.3%) of women aged 15 to 49 years of age are anaemic.

Maternal iron deficiency can lead to adverse pregnancy and new-born outcomes, including stillbirth, low birth weight and infant mortality and anaemia in pregnancy has been suggested as a potential marker of increased risk of major hemorrhage and a risk factor for maternal death. It has a known association among children with increased perinatal mortality, impaired mental development, impaired immune competence, increased susceptibility to lead poisoning and increased morbidity and mortality. Among adolescents, anaemia has been linked to affecting physical disorders, growth, and mental retardation, and also increases reproductive morbidities girls during their womanhood. Besides, when anaemic adolescent girls become pregnant, they are exposed not only to the risk of maternal morbidity and mortality but also the incidence of premature delivery, low birth weight, and perinatal mortality, and also infants born to anaemic mothers have a greater risk of anaemia in the first six months of life.

Key anaemia control interventions include promoting a diversified diet, iron-folic acid (IFA) supplementation during pregnancy, iron fortification of staple foods, prevention and treatment of malaria, use of insecticide-treated bed nets, helminth prevention and control, delayed cord clamping, and increased birth spacing. In addition, optimizing maternal nutrition before and during pregnancy, prevention of low birth weight and prematurity, control of parasites, and improvements in access to health care, nutrition education, and counselling are many such programs that contribute to the prevention and control of anaemia.

Among all the probable strategies, anaemia prevention programs through iron-folic acid (IFA) supplementation have been implemented across many countries, but in resource-poor and infection-prone countries, it may be difficult to achieve the targets of anaemia prevention and control through a single-pronged approach of iron-folic acid supplementation. It becomes pertinent to look into

other determining/factors that may affect the receipt and adherence to IFA.

### ***History of anaemia control programs in India***

In India, the anaemia control programme was launched in 1970 and after 15 years, an evaluation of the programme was carried out by ICMR. Evaluation showed that the programme failed to make any noticeable impact in reducing the incidence of anemia. Later on, the anemia prophylaxis programme was reviewed and renamed as “National Nutritional Anaemia Control Programme” in 1990. Later on in 1997, this programme was made an integral part of nationwide “Reproductive and Child Health” (RCH) programme. A national nutrition policy was adopted in 1993, with the objective of operationalizing multi-sectoral strategies to address the problem of under-nutrition/malnutrition. Based on this, the national plan of action on nutrition 1995 laid out the sectoral plan of action for 14 ministries and departments of the government of India. A national nutrition mission has been set up to address nutrition issues through a mission mode approach under the oversight of the Ministry of Women and Child Development (MWCD). The Guidelines for Control of Iron Deficiency Anaemia was published in 2013 under the National Iron+ Initiative (NIPI). In April 2018, the Intensified National Iron Plus Initiative (I-NIPI) was launched. In 2018, Anaemia Mukh Bharat strategy was launched to reduce anaemia prevalence in the country in a life cycle approach. It aims to strengthen the existing mechanisms and foster newer strategies for tackling anaemia in six target beneficiary groups through six interventions and six institutional mechanisms and reduce anaemia prevalence both due to nutritional and non-nutritional causes. Currently, the following interventions are being undertaken by the government of India to address the high levels of anaemia in the country: prophylactic iron and folic acid supplementation including adolescent girls (10-19 years); intensified year-round behaviour change communication (BCC) campaign, including ensuring delayed cord clamping; testing of anaemia using digital methods and point of care treatment; addressing non-nutritional causes of anaemia in endemic pockets with a special focus on malaria, hemoglobinopathies and fluorosis; management of severe anaemia in pregnant women undertaken by the administration of i.v. iron sucrose/blood transfusion; providing incentives to the ANM for the identification and follow-up of pregnant women with severe anaemia in high-priority districts (HPDs); training and orientation of medical officers and front line-workers on newer maternal health and Anaemia Mukh Bharat guidelines; field-level awareness by ASHAs through community mobilization, IEC and BCC activities focused on anaemia in pregnant women.

Thus, this paper attempted to understand the determinants underlying iron intake in India using multiple logistic regression analyses of two rounds of demographic and

health surveys, titled as National Family Health Surveys (2015-21) in India.

### **Study objectives**

The objectives of this paper were to examine the association between reported nutrition counselling by a health worker and adherence to iron tablets or syrup adherence by adjusting for different socio-demographic characteristics in India. The research question considered here is “does reported nutrition education and counselling play a role in improving adherence to 90+ IFA among pregnant women in India nationally and sub-nationally in the constituent states and union territories?”.

### **METHODS**

This paper used data from two rounds of India’s Demographic and Health Survey (DHS), titled the National Family Health Surveys (NFHS), conducted between 2015 (NFHS-4, 2015-16 and NFHS-5, 2019-21) and 2021. These are large scale cross-sectional surveys.

NFHS surveys are conducted under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India. MoHFW designated the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency and funding for NFHS was provided by the United States Agency for International Development (USAID), the United Kingdom Department for International Development (DFID), the Bill and Melinda Gates Foundation (BMGF), UNICEF, UNFPA, the MacArthur Foundation, and the Government of India. ICF provided technical assistance through The DHS program, which is funded by USAID. To achieve a representative sample of 15% of households, NFHS-4 conducted interviews in every alternate selected household in 30 per cent of the selected clusters. In NFHS-4, 28,586 primary sampling units (PSUs) were selected across the country in NFHS-4, of which fieldwork was completed in 28,522 clusters. NFHS-4 fieldwork for India was conducted from January 20 2015, to December 4 2016, by 14 field agencies and gathered information from 601,509 households, 699,686 women, and 112,122 men. NFHS-5 fieldwork for India was conducted from June 2019 to April 2021, gathered information from 639,699 households, 724,115 women, and 101,839 men. In all, 30,456 primary sampling units (PSUs) were selected across the country in NFHS-5 drawn from 707 districts as on March 31, 2017, of which fieldwork was completed in 30,198 PSUs. We used the data of currently married pregnant women of reproductive age (15-49 years) for our analyses. The sample sizes of the five rounds are as follows:

### **Nutrition counselling**

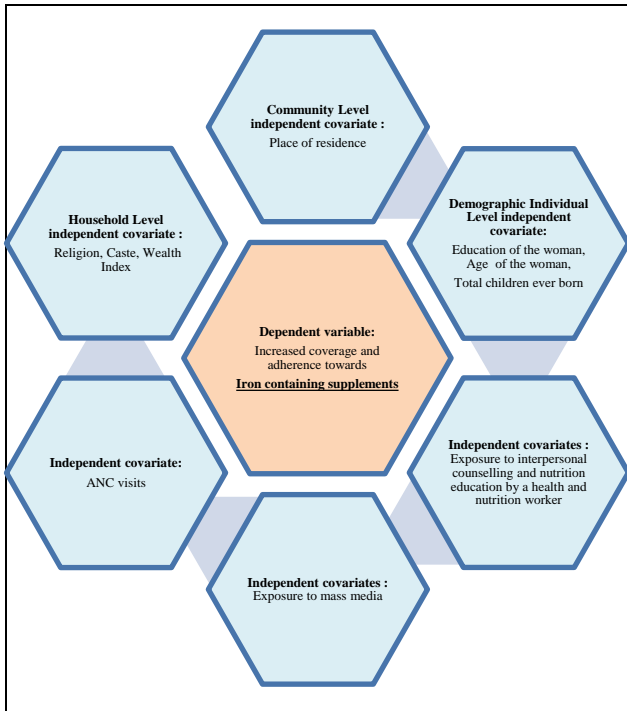
Nutrition counselling is a two-way interaction through which a patient or beneficiary and the member of the health and nutrition team interpret the results of a

nutritional assessment, identify the patient’s nutritional problems, needs and goals, discuss ways to meet these goals, and agree on future steps and the frequency of monitoring. It is a two-way conversation, where the counsellor utilizes active listening, demonstrates empathy and respect, and engages in joint problem-solving. There are two main modes of counselling- individual and group counselling or 1-1 and 1-G communication or interaction.

The individual-level datasets were analysed using Stata 17 software, accounting for the survey design. In addition to bivariate analysis, multiple logistic regression analysis was performed to control for the effects of other factors. The dependent variable considered was consumption of iron tablets or syrup or iron with folic acid tablets or syrup for at least 90 days. It was coded as 1 if the mother consumed iron tablets or syrup for 90 or more days and 0 if she did not consume iron tablets or syrup for 90 or more days. Multiple logistic regression model was adopted to explore associations between the dependent variable and independent variables, adjusting for socio-demographic and economic covariates.

Multiple logistic regression was performed to answer the research questions outlined previously and to explore factors associated with adherence to the 90 days of iron supplementation regimen. The dependent variable for these analyses was self-reported consumption of iron-containing supplements for at least 90 days during pregnancy. Logistic regression can be used to predict a dependent variable on the basis of independent variables and to determine the per cent of the variance in the dependent variable explained by independent variables, to rank the relative importance of independent variables, and to understand the impact of covariates. The logistic regression applies maximum likelihood estimation after transforming the dependent variable into a logit variable (the natural log of the odds of the dependent occurring or not). In this way, logistic regression estimates the probability of a certain event occurring. Its output includes changes in the log odds of the dependent variable, not changes in the dependent variable itself, as ordinary least squares (OLS) regression does.

In addition, random forests (RF) analysis was conducted to identify independent variables importance and model accuracy using Python 3.6 software. Random forest is a recently developed machine learning technique that deals with the classification and clustering of data non-parametrically. It is an ensemble method that combines several trees by taking the same number of bootstrap samples from the original data and growing a tree on each bootstrap sample. Tree implementations are very simple and user-friendly and require fewer techniques from the investigator. The individual trees in a random forest are not pruned and used for decisions in classification or clustering. Based on an extensive literature review, the analysis considered the following covariates:



**Figure 1: Conceptual framework of adherence to iron supplementation.**

**RESULTS**

The socio-demographic, economic, health and nutrition profile of India is presented below in Table 1.

**Table 1: Socio-demographic, economic, health and nutrition indicators in India.**

Indicators	India
Projected population, July 1, 2021 (in billion)	1.3
Population density (persons per sq. km.)	382
Overall sex ratio (males/females *100) (country census)	94.3
Total fertility rate (lifetime births per woman), NFHS-5, 2019-21	2.0
Crude birth rate (2019) (no. of live births per thousand mid-year population)	19.7
Children under 5 years who are stunted (height-for-age) (%), NFHS-5, 2019-21	35.5
Children under 5 years who are wasted (weight-for-height) (%), NFHS-5, 2019-21	19.3
Children under 5 years who are underweight (%), NFHS-5, 2019-21	32.1
Children under 5 years who are overweight (%), NFHS-5, 2019-21	3.4
Children (6-59 months) with blood haemoglobin concentration <110 gm/l (%), NFHS-5, 2019-21	67.1
Non-pregnant women (15-49 years) with blood haemoglobin concentration <120 gm/l (%), NFHS-5, 2019-21	57.2
Pregnant women (15-49 years) with blood haemoglobin concentration <110 gm/l (%), NFHS-5, 2019-21	52.2
Infant mortality rate (number of infant deaths per thousand live births), NFHS-5, 2019-21	35.2
Under-five mortality rate (no. of under-five deaths per thousand live births), NFHS-5, 2019-21	41.9
Maternal mortality ratio (no. of maternal deaths per 100,000 live births), SRS 2016-18	113
Status of Human Development, UNDP, 2019 (Rank)	131
Level of Human Development, UNDP (2019)	Medium
GDP per Capita (current US\$), 2020	1927.70
World Bank classification (June 2020)	Lower middle income

**Results of the multiple logistic regression analyses**

Predictors used in the model such as background community level and individual level socio-demographic and economic covariates, which are expected to influence the iron tablets or syrup coverage and adherence behaviour and known to affect the risk of having anaemia, have been entered in the model. The predictors used in the model are the place of residence, age of the woman, children ever born, education of the respondent and current work status of the respondent, possession of household assets used in the construction of wealth quintile and exposure to mass media and receipt of antenatal care.

The sample of women from NFHS-4 round indicates that of 70% of them belonging to rural areas and major proportion (78.9%) of respondents were Hindus and 72.4% of the women in the sample were literate. With regards to the exposure to modes of mass media for behaviour change communication, 71.4% watched television, 34.9% read the newspaper and 13.8% listened to the radio. In all, 65.5% of women of reproductive age received at least three antenatal care visits. Among the women, 78% received or bought iron tablets or syrup and 38.8% consumed it for a period of 90 or more days during their last pregnancy, and 27.6% received nutrition education and counselling from frontline health workers such as auxiliary nursing midwifery (ANM), Anganwadi worker (AWW) and accredited social health activist (ASHA).

Sample of women from NFHS-5 consisted of 71.8 percent belonging to rural areas, in the sample 79.6 percent of women belonged to Hindu religion followed by Muslims (15.9%), Christians (2.0%) and Sikhs (1.3%). Among the respondents, 80.6% percent were literate and 19.4% were illiterate. In the sample, nearly 70% reported watching TV, 30.5 reported reading newspaper and

12.1% reported listening to radio. Nearly three-fourths (74.2%) of women reported receiving at least three ANC services. In all, 88% of women reported of receiving or buying iron supplements or syrup and nearly 53% (52.6%) reported to adhere to IFA supplements or syrup for at least 90 or more days during their last pregnancy. Nearly 56% (55.7%) reported to receive counselling from a frontline health worker.

**Table 2: Socio-economic, demographic and health variables in India, National Family Health Surveys, 2015-21 (%)**

Predictors used in the model	NFHS-4, 2015-16	NFHS-5, 2019-21
<b>N</b>	187,632	173,996
<b>Background- community level covariate</b>		
Place of residence		
Rural	70.3	71.8
Urban	29.7	28.2
<b>Background- Household level covariate</b>		
<b>Religion</b>		
Hindu	78.9	79.6
Muslim	16.1	15.9
Christian	2.1	2.0
Sikhs	1.3	1.3
Others	1.6	1.0
<b>Socio-economic covariates</b>		
<b>Wealth quintile</b>		
Poorest	23.3	22.7
Poorer	21.1	21.0
Middle	19.9	19.6
Richer	19.0	19.3
Richest	16.7	17.5
<b>Background- individual level covariates</b>		
<b>Education of the respondent</b>		
Non-literate	27.6	19.4
Literate	72.4	80.6
<b>Demographic covariates</b>		
<b>Age group of the woman</b>		
15-19 years	3.4	3.1
20-24 years	31.4	29.3
25-29 years	37.6	38.8
30-34 years	18.3	19.6
35-39 years	6.9	7.2
40-44 years	1.9	1.6
45-49 years	0.5	0.4
<b>Total children ever born</b>		
Have 2 or less than 2 children	68.0	70.6
Have more than 2 children	32.0	29.4
<b>Communication exposure</b>		
<b>Mass media</b>		
<b>Newspaper</b>		
Does not read newspaper	65.1	69.5
Reads newspaper	34.9	30.5
<b>Radio</b>		
Does not listen to radio	86.2	87.9
Listens to radio	13.8	12.1
<b>Television</b>		
Does not watch television	28.6	30.5
Watches television	71.4	69.5

Continued.

Predictors used in the model	NFHS-4, 2015-16	NFHS-5, 2019-21
<b>Receipt of at least 3 ANC's</b>		
Received less than 3 ANC's	35.3	25.8
Received 3+ ANC's	64.7	74.2
<b>Receipt of at least 4 ANC's</b>		
Received less than 4 ANC's	48.8	41.5
Received 4+ ANC's	51.2	58.5
<b>Receipt of at least 8 ANC's</b>		
Received less than 8 ANC's	79.9	80.7
Received 8+ ANC's	20.1	19.3
<b>Iron receipt</b>		
Did not receive or bought any iron supplements or syrup	22.0	12.0
Received or bought iron supplements or syrup	78.0	88.0
<b>Iron adherence (90+ days of iron supplementation or syrup)</b>		
Did not consume iron supplementation for 90 or more days	61.2	47.4
Consumed iron supplementation or syrup for 90 or more days	38.8	52.6
<b>Counselling by a health worker</b>		
No	72.4	44.3
Yes	27.6	55.7
<b>Anaemia among women</b>		
No	45.1	47.8
Yes	54.9	52.2

Source: India National Family Health Survey-4 and 5, 2015-21

**Table 3: Adherence to iron or iron and folic acid tablets or syrup intake for 90 or more days by socio-economic and demographic variables in India National Family Health Surveys 4 and 5, 2015-21 (%).**

Predictors used in the model	NFHS-4, 2015-16			NFHS-5, 2019-21		
	Non-adherers	Adherers	Significance	Non-adherers	Adherers	Significance
<b>Background- community level covariate</b>						
Place of residence						
Rural	66.0	34.0		51.2	48.8	
Urban	49.9	50.1	***	37.9	62.1	***
<b>Background- household level covariate</b>						
<b>Religion</b>						
Hindu	60.7	39.3		47.5	52.5	
Muslim	67.3	32.8		49.9	50.1	
Christian	44.8	55.2		34.5	65.5	
Sikhs	45.4	54.6		36.0	64.0	
<b>Ethnicity</b>						
Scheduled Caste	61.0	39.0		48.2	51.8	
Scheduled Tribe	64.8	35.2		44.9	55.1	
No caste or tribe	59.8	40.2		38.9	61.0	
<b>Socio-economic covariates</b>						
<b>Wealth Quintile</b>						
Poorest	79.6	20.4		60.9	39.1	
Poorer	68.6	31.4		53.3	46.7	
Middle	58.3	41.7		45.7	54.3	
Richer	50.6	49.4		39.7	60.3	
Richest	41.9	58.1	***	33.5	66.5	***
<b>Background- individual level covariates</b>						
Education of the Respondent						
Non-Literate	78.5	21.5		65.2	34.8	
Literate	54.7	45.3	***	43.2	56.8	***
<b>Demographic covariates</b>						
<b>Age group of the woman</b>						
15-19 years	64.1	35.9		48.4	51.6	
20-24 years	61.2	38.8		48.3	51.7	

Continued.

Predictors used in the model	NFHS-4, 2015-16		NFHS-5, 2019-21			
25-29 years	59.5	40.6	47.1	52.9		
30-34 years	60.9	39.2	45.7	54.3		
35-39 years	65.4	34.6	48.3	51.7		
40-44 years	73.9	26.1	52.3	47.7		
45-49 years	81.0	19.0	***	61.4	38.6	***
<b>Total children ever born</b>						
Have 2 or less than 2 children	55.6	44.4		42.7	57.3	
Have more than 2 children	73.2	26.8	***	58.7	41.3	***
<b>Communication exposure</b>						
<b>Mass media</b>						
<b>Newspaper</b>						
Does not read newspaper	68.1	31.9		51.3	48.7	
Reads newspaper	48.5	51.5	***	38.6	61.4	***
<b>Radio</b>						
Does not listen to radio	61.7	38.3		47.8	52.2	
Listens to radio	58.4	41.6	***	44.7	55.3	***
<b>Television</b>						
Does not watch television	78.8	21.2		60.8	39.2	
Watches Television	54.2	45.8	***	41.6	58.4	***
<b>Receipt of at least 3 ANC's</b>						
Received less than 3 ANC's	80.7	19.3		67.2	32.8	
Received 3+ ANC's	50.6	49.4	***	40.6	59.4	***
<b>Receipt of at least 4 ANC's</b>						
Received less than 4 ANC's	76.9	23.1		63.0	37.0	
Received 4+ ANC's	46.3	53.7	***	36.4	63.6	***
<b>Receipt of at least 8 ANC's</b>						
Received less than 8 ANC's	67.3	32.7		52.6	47.4	
Received 8+ ANC's	37.2	62.8	***	25.7	74.3	***
<b>Counselling by a health worker</b>						
No	64.8	35.3		48.8	51.2	
Yes	52.0	48.0	***	46.4	53.6	***

Note: \*: p<0.05: statistically significant at 5% level \*\*: p<0.01: statistically significant at 1% level, \*\*\*: p<0.001: statistically significant at 0.1% level, n.s.: not significant.

Looking at the exposure to different mediums of communication, it was found that in both the rounds (NFHS-4, NFHS-5) a significant proportion of women who read newspaper, listen to radio, watched television adhered to IFA for at least 90 or more days as compared to those women who did not read newspaper, did not listen to radio or did not watch television. A significant proportion of women who received at least 3 ANC's adhered to iron supplements or syrup for at least 90 days as compared to the women who did not receive at least three ANC in both the rounds. It can be said that the difference in proportion of women adhering to IFA for at least 90 or more days was found to be increasing with increase in receipt of number of ANC's. i.e. more the number of ANC received by the women. Higher was the difference in proportion adhering to at least 90 IFA supplements as compared to their counterparts (Table 3).

Looking at the odds of adhering to IFA supplements or syrup for at least 90 or more days, results from NFHS-4 shows that women residing in urban areas were 1.150 times (95% CI: 1.082-1.221) more likely to adhere to IFA

supplements or syrup for 90 or more days as compared to women residing in rural areas, similarly for NFHS-5 round the women residing in urban areas were 1.192 times (95% CI:1.129-1.258) more likely to adhere to IFA for 90 or more days as compared to women residing in rural areas. Results shows that for NFHS-4 women who had received counselling from a frontline health and nutrition care worker were 1.489 times (95% CI: 1.429-1.553) to adhere to at least 90 days of iron tablets of syrup after adjusting for potential confounders and for NFHS-5 women who had received counselling from a frontline worker were 1.162 times (95% CI: 1.124-1.200) more likely to adhere to IFA supplements or syrup for at least 90 days. For NFHS-4, women those who had received at least three antenatal care visits were 2.695 times (95% CI: 2.576-2.819) were more likely to adhere to at least 90 days of iron supplements or syrup supplementation after adjusting for the potential confounders. Similarly, for NFHS-5, women who had received at least three ANC services were 1.162 times (95% CI: 1.124-1.200) more likely to adhere to iron supplements or syrup for at least 90 days as compared to those women who did not receive at least three ANC check ups (Table 4).

**Table 4: Adjusted odds ratio (AOR) with 95% confidence intervals from the multiple logistic regression (MLR) of adherence to iron tablets or syrup or iron and folic acid tablets or syrup for at least 90 days in India, National Family Health Surveys 4 and 5, 2015-21.**

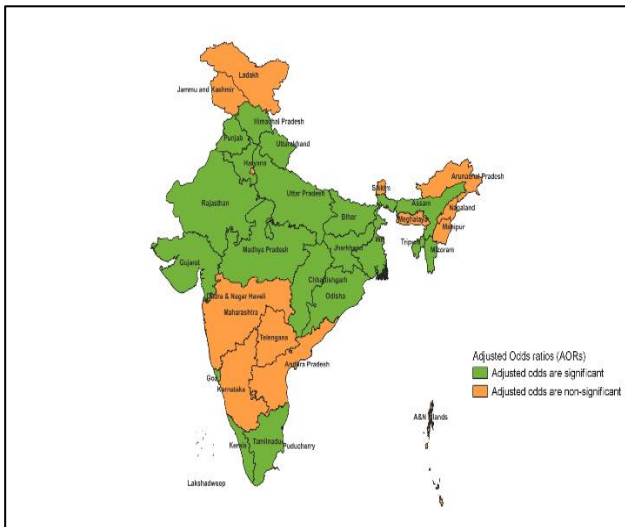
Predictors used in the model	NFHS-4, 2015-16			NFHS-5, 2019-21		
	%	Adjusted odds ratio (95% CI)	Significance	%	Adjusted odds ratio (95% CI)	Significance
<b>N</b>		187,632			173,966	
<b>Community level covariate</b>						
Place of residence						
Rural <sup>Ref</sup>	70.3			71.8		
Urban	29.7	1.150 (1.082-1.221)	***	28.2	1.192 (1.129-1.258)	***
<b>Household level covariate</b>						
Religion						
Hindu <sup>Ref</sup>	78.9			79.6		
Muslim	16.1	0.809 (0.760-0.860)	***	15.9	0.930 (0.879-0.984)	**
Christian	2.1	1.561 (1.386-1.758)	***	2.0	1.471 (1.325-1.633)	***
Sikhs	1.3	1.070 (0.956-1.196)	n.s.	1.3	1.246 (1.116-1.392)	***
Ethnicity						
Scheduled Caste <sup>Ref</sup>	88.2			88.1	1.343 (1.258-1.433)	***
Scheduled Tribe	7.3	1.108 (1.036-1.184)	***	6.3	1.645 (1.500-1.804)	***
No caste or tribe	3.8	1.058 (0.948-1.182)	n.s.	4.9	2.026 (1.621-2.531)	***
<b>Socio-economic covariate</b>						
Wealth Quintile						
Poorest <sup>Ref</sup>	23.3			22.7		
Poorer	21.1	1.174 (1.115-1.236)	***	21.0	1.048 (1.004-1.094)	**
Middle	19.9	1.448 (1.366-1.534)	***	19.6	1.186 (1.128-1.246)	***
Richer	19.0	1.680 (1.572-1.795)	***	19.3	1.330 (1.256-1.408)	***
Richest	16.7	2.089 (1.938-2.252)	***	17.5	1.524 (1.424-1.631)	***
<b>Individual Level covariates</b>						
Education of the Respondent						
Non-Literate <sup>Ref</sup>	27.6			19.4		
Literate	72.4	1.380 (1.319-1.444)	***	80.6	1.492 (1.431-1.556)	***
<b>Demographic covariates</b>						
Age group of the woman						
15-19 years <sup>Ref</sup>	3.4			3.1		
20-24 years	31.4	1.044 (0.955-1.141)	n.s.	29.3	0.986 (0.907-1.071)	n.s.
25-29 years	37.6	1.176 (1.075-1.286)	***	38.8	1.082 (0.995-1.177)	n.s.
30-34 years	18.3	1.271 (1.153-1.400)	***	19.6	1.245 (1.139-1.361)	***
35-39 years	6.9	1.329 (1.190-1.483)	***	7.2	1.289 (1.168-1.422)	***
40-44 years	1.9	1.210 (1.049-1.396)	***	1.6	1.336 (1.171-1.524)	***
45-49 years	0.5	1.165 (0.937-1.448)	n.s.	0.4	1.151 (0.884-1.498)	n.s.
<b>Total children ever born</b>						
Have 2 or less than 2 children <sup>Ref</sup>	68.0			70.6		
Have more than 2 children	32.0	0.728 (0.698-0.759)	***	29.4	0.687 (0.662-0.714)	***
<b>Communication exposure covariates</b>						
<b>Mass Media</b>						
Newspaper						
Does not read newspaper <sup>Ref</sup>	65.1			69.5		
Reads newspaper	34.9	1.149 (1.100-1.201)	***	30.5	1.055 (1.016-1.095)	***
Radio						
Does not listen to radio <sup>Ref</sup>	86.2			87.9		
Listens to radio	13.8	0.930 (0.883-0.978)	***	12.1	0.892 (0.850-0.936)	***
Television						
Does not watch television <sup>Ref</sup>	28.6			30.5		
Watches Television	71.4	1.311(1.252-1.372)	***	69.5	1.353 (1.302-1.406)	***
<b>Health covariates</b>						
Receipt of at least 3 ANC's						
Received less than 3 ANC's <sup>Ref</sup>	34.5			25.8		
Received 3+ ANC's	65.5	2.695 (2.576-2.819)	***	74.2	2.397 (2.307-2.489)	***
Counselling by a health worker						
No <sup>Ref</sup>	72.4			44.3		
Yes	27.6	1.489 (1.429-1.553)	***	55.7	1.162 (1.124-1.200)	***

Dependent variable: Adherence to iron tablets or syrup and iron and folic acid tablets or syrup for at least 90 days: coded as 0 if the women had not consumed iron tablets or syrup for at least 90 days and 1 if she did. Note: 95% CI: Confidence Interval \*: p<0.05: Statistically Significant at 5% level \*\*: p<0.01: Statistically Significant at 1% level, \*\*\*: p<0.001: Statistically Significant at 0.1% level, n.s.: Not significant. <sup>ref</sup> Refers to reference category.



**State-wise association of counselling with adherence to IFA**

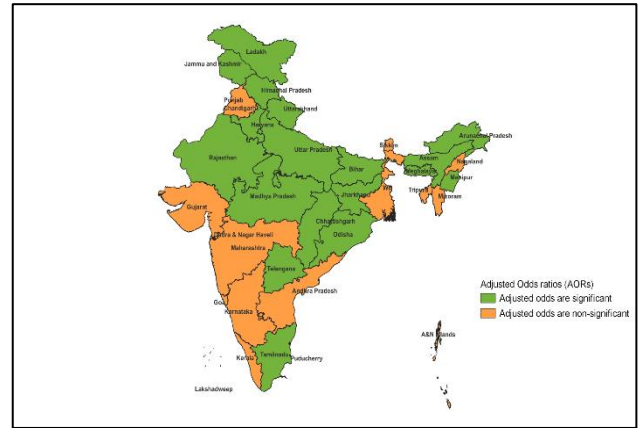
Results shows that across the states and union territories, there were 12 states where women had received counselling from a frontline health and nutrition care worker showed a significant likelihood of adhering to IFA tablets/syrup for at least 90 days in both the rounds of NFHS after adjusting for the potential confounders. These states were Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh, Uttarakhand and Tamil Nadu. There were fourteen states where women who received counselling from a frontline health and nutrition care worker showed a significantly higher likelihood of adhering to IFA supplements/syrup for at least 90 days in at least one round of NFHS. Among the rest of the states and union territories of Andaman and Nicobar Islands, Andhra Pradesh, Dadra and Nagar Haveli, Daman and Diu, Karnataka, Lakshadweep, Manipur, Nagaland and Sikkim, counselling by a frontline health worker was not significantly associated with adherence to IFA among the women in any of the rounds of NFHS.



**Figure 2: India state map with adjusted odds ratios and significance of association between counselling by a health worker and adherence to IFA for 90 or more days in states of India, NFHS-4, 2015-16.**

Note: the boundaries and the names shown and designations used on these maps do not imply official endorsement or acceptance by United Nations.

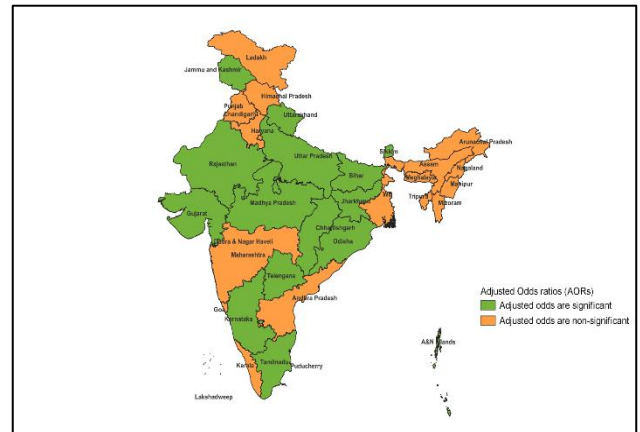
Dependent variable: Adherence to iron tablets or syrup and iron and folic acid tablets or syrup for at least 90 days: coded as 0 if the women had not consumed iron tablets or syrup for at least 90 days and 1 if she did. The model was adjusted for the place of residence, religion of the respondent, caste, ownership of assets, age group of the woman, total children ever born, education of the mother, exposure to newspaper, television, radio and receipt of antenatal care visits.



**Figure 3: India state map with adjusted odds ratios and significance of association between counselling by a health worker and adherence to IFA for 90 or more days in states of India, NFHS-5, 2019-21.**

Note: the boundaries and the names shown and designations used on these maps do not imply official endorsement or acceptance by United Nations.

Dependent variable: Adherence to iron tablets or syrup and iron and folic acid tablets or syrup for at least 90 days: coded as 0 if the women had not consumed iron tablets or syrup for at least 90 days and 1 if she did. The model was adjusted for the place of residence, religion of the respondent, caste, ownership of assets, age group of the woman, total children ever born, education of the mother, exposure to newspaper, television, radio and receipt of antenatal care visits.



**Figure 4: India state map with adjusted odds ratios and significance of association between counselling by a health worker and adherence to IFA for 90 or more days in states of India, NFHS-5, 2019-21.**

Note: the boundaries and the names shown and designations used on these maps do not imply official endorsement or acceptance by United Nations.

Dependent variable: Adherence to iron tablets or syrup and iron and folic acid tablets or syrup for at least 90 days: coded as 0 if the women had not consumed iron tablets or syrup for at least 90 days and 1 if she did. The model was adjusted for the place of residence, religion of the respondent, caste, ownership of assets, age group of the woman, total children ever born, education of the

mother, exposure to newspaper, television, radio and receipt of antenatal care visits.

The pattern plotted in the India state-wise map reveals a north-south divide. The states in the northern region and some of the north-eastern states reveal that counselling by a health worker is significantly associated with adherence to IFA, while the major south Indian states, except the socially developed states of Kerala, Tamil Nadu and Goa, where it is significantly associated (Figures 2 and 3).

It was also analyzed to see specifically if nutrition education and counselling was associated with adherence to iron-containing supplements in the recent most round of 2019-21. Those who had received health and nutrition education and counselling from a frontline health and nutrition care worker in 16 states and union territories

were more likely to adhere to at least 90 days of iron tablets or syrup or iron and folic acid tablets supplementation after adjusting for the potential confounders. These states were namely Andaman and Nicobar Islands, Chhattisgarh, Gujarat, Jammu and Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Odisha, Puducherry, Rajasthan, Sikkim, Tamil Nadu, Telangana, Uttar Pradesh and Uttarakhand (Figure 4).

In order to present the relative importance of the considered indicators, we used feature importance from the random forest analyses algorithm, which is considered quite robust among all the decision tree models and regression algorithms. This analysis reveals that receipt of at least four ANC visits was found to be the most important feature/factor associated with adherence to iron-containing supplements.

**Table 5: Adjusted odds ratio (AOR) with 95% confidence intervals from the multiple logistic regression (MLR) of adherence to iron tablets or syrup or iron and folic acid tablets or syrup for at least 90 days in the states of India, National Family Health Surveys 4 and 5, 2015-21.**

Country/states/ union territories	NFHS-4, 2015-16			NFHS-5, 2019-21		
	Received counselling from a frontline health care worker (%)	Adjusted odds ratio (95% CI) for counselling by a frontline health worker	Significance	Received counselling from a frontline health care worker (%)	Adjusted odds ratio (95% CI) for counselling by a frontline health worker	Significance
India	27.6	1.489 (1.429-1.553)	***	55.7	1.162 (1.124-1.200)	***
Andaman and Nicobar Islands	38.3	0.735 (0.477-1.134)	n.s.	21.9	0.798 (0.296-2.155)	n.s.
Andhra Pradesh	45.9	1.068 (0.866-1.317)	n.s.	67.4	1.159 (0.917-1.466)	n.s.
Arunachal Pradesh	4.4	1.029 (0.734-1.992)	n.s.	18.2	1.358 (1.090-1.691)	***
Assam	23.0	1.505 (1.307-1.732)	***	35.8	1.242 (1.102-1.399)	***
Bihar	11.6	1.253 (1.042-1.507)	**	50.4	1.311 (1.180-1.457)	***
Chandigarh	27.8	-	-	43.1	1.194 (0.376-3.785)	n.s.
Chhattisgarh	55.6	1.534 (1.338-1.759)	***	70.1	1.367 (1.167-1.601)	***
Dadra and Nagar Haveli*	30.8	1.400 (0.789-2.485)	n.s.	62.7	1.092 (0.654-1.824)	n.s.
Daman and Diu	14.3	1.661 (0.966-2.855)	n.s.	-	-	-
Goa	43.9	4.915 (2.314-0.441)	***	41.9	1.630 (0.628-4.232)	n.s.
Gujarat	39.7	1.294 (1.093-1.531)	***	62.2	1.145 (0.983-1.334)	n.s.
Haryana	27.5	1.782 (1.497-2.122)	***	58.8	1.433 (1.215-1.690)	***
Himachal Pradesh	26.9	1.569 (1.218-2.020)	***	32.6	1.317 (1.018-1.705)	**
Jammu and Kashmir	11.5	1.137 (0.925-1.398)	n.s.	25.7	1.503 (1.245-1.815)	***
Jharkhand	25.9	1.375 (1.190-1.588)	***	61.3	1.221 (1.078-1.382)	***
Karnataka	31.9	1.093 (0.878-1.361)	n.s.	72.4	0.857 (0.722-1.018)	n.s.
Kerala	18.9	1.934 (1.336-2.799)	***	25.8	0.898 (0.643-1.255)	n.s.
Ladakh	-	-	-	41.3	1.675 (1.103-2.542)	**
Lakshadweep	6.7	0.663 (0.122-3.608)	n.s.	13.0	2.333 (0.444-12.266)	n.s.
Madhya Pradesh	34.9	1.217 (1.106-1.340)	***	72.1	1.378 (1.242-1.529)	***
Maharashtra	25.8	1.059 (0.866-1.296)	n.s.	44.5	1.211 (1.048-1.398)	***
Manipur	0.3	2.198 (0.610-7.925)	n.s.	16.2	1.036 (0.742-1.447)	n.s.
Meghalaya	19.9	1.152 (0.854-1.554)	n.s.	24.4	0.712 (0.547-0.926)	*
Mizoram	23.6	1.711 (1.176-2.490)	***	28.8	0.830 (0.613-1.123)	n.s.
Nagaland	0.3	2.190 (0.459-10.453)	n.s.	14.2	0.786 (0.497-1.243)	n.s.
New Delhi	6.4	1.892 (0.988-4.110)	n.s.	42.0	1.849 (1.459-2.344)	***
Odisha	52.6	1.146 (1.025-1.282)	**	79.5	1.322 (1.133-1.542)	***
Puducherry	48.0	0.368 (0.190-0.716)	***	47.3	1.957 (0.885-4.327)	n.s.

Continued.

	NFHS-4, 2015-16			NFHS-5, 2019-21		
<b>Punjab</b>	25.3	1.593 (1.300-1.952)	***	38.6	1.069 (0.893-1.280)	n.s.
<b>Rajasthan</b>	17.2	1.696 (1.479-1.944)	***	54.3	1.206 (1.087-1.339)	***
<b>Sikkim</b>	33.3	0.780 (0.522-1.166)	n.s.	45.8	1.709 (0.918-3.181)	n.s.
<b>Tamil Nadu</b>	46.8	1.233 (1.049-1.449)	**	62.3	1.561 (1.257-1.939)	***
<b>Telangana</b>	31.0	0.943 (0.737-1.209)	n.s.	62.2	1.329 (1.134-1.556)	***
<b>Tripura</b>	23.0	2.585 (1.814-3.683)	***	42.8	0.961 (0.748-1.234)	n.s.
<b>Uttar Pradesh</b>	10.8	1.385 (1.225-1.566)	***	59.9	1.143 (1.058-1.234)	***
<b>Uttarakhand</b>	24.3	1.552 (1.293-1.862)	***	58.2	1.308 (1.059-1.614)	**
<b>West Bengal</b>	50.0	1.179 (1.004-1.384)	**	44.4	0.937 (0.784-1.120)	n.s.

Dependent variable: Adherence to iron tablets or syrup and iron and folic acid tablets or syrup for at least 90 days: coded as 0 if the women had not consumed iron tablets or syrup for at least 90 days and 1 if she did. The model was adjusted for the place of residence, religion of the respondent, caste, ownership of assets, age group of the woman, total children ever born, education of the mother, exposure to newspaper, television, radio and receipt of antenatal care visits. Note: 95% CI: confidence interval \*: p<0.05: statistically significant at 5% level \*\*: p<0.01: statistically significant at 1% level, \*\*\*: p<0.001: statistically significant at 0.1% level, n.s.: not significant. <sup>ref</sup>Refers to reference category. ±AOR refers to both Dadra and Nagar Haveli and Daman and Diu in NFHS-5

**Table 6: Adjusted odds ratio (AOR) with 95% confidence intervals from the multiple logistic regression (MLR) of adherence to iron tablets or syrup or iron and folic acid tablets or syrup for at least 90 days in the states of India, National Family Health Survey 5, 2019-21.**

Country/states/union territories	Received health and nutrition education counselling from a frontline health care worker (%)	Adjusted odds ratio (95% CI) for receipt of health and nutrition education counselling from a frontline health care worker	Significance
<b>India</b>	84.87	1.461 (1.383-1.544)	***
<b>Andaman and Nicobar Islands</b>	80.44	5.475 (1.175-25.523)	***
<b>Andhra Pradesh</b>	95.47	0.813 (0.378-1.748)	n.s.
<b>Arunachal Pradesh</b>	69.91	1.315 (0.878-1.970)	n.s.
<b>Assam</b>	73.74	1.161 (0.981-1.374)	n.s.
<b>Bihar</b>	66.57	1.308 (1.106-1.549)	**
<b>Chandigarh</b>	89.26	4.766 (0.250-90.930)	n.s.
<b>Chhattisgarh</b>	94.34	1.648 (1.166-2.330)	**
<b>Dadra and Nagar Haveli and Daman and Diu</b>	95.85	2.495 (0.469-13.281)	n.s.
<b>Goa</b>	86.16	3.209 (0.790-13.041)	n.s.
<b>Gujarat</b>	95.85	1.592 (1.083-2.340)	*
<b>Haryana</b>	87.97	1.111 (0.795-1.551)	n.s.
<b>Himachal Pradesh</b>	84.76	1.007 (0.698-1.454)	n.s.
<b>Jammu and Kashmir</b>	70.76	1.553 (1.114-2.165)	***
<b>Jharkhand</b>	81.36	1.425 (1.154-1.760)	**
<b>Karnataka</b>	92.95	0.659 (0.484-0.896)	**
<b>Kerala</b>	68.27	1.068 (0.680-1.677)	n.s.
<b>Ladakh</b>	80.17	0.805 (0.316-2.050)	n.s.
<b>Lakshadweep</b>	52.89	0.104 (0.010-1.114)	n.s.
<b>Madhya Pradesh</b>	91.56	1.600 (1.313-1.949)	***
<b>Maharashtra</b>	85.3	0.969 (0.717-1.311)	n.s.
<b>Manipur</b>	6.91	1.274 (0.496-3.270)	n.s.
<b>Meghalaya</b>	79.99	1.072 (0.808-1.422)	n.s.
<b>Mizoram</b>	70.78	0.684 (0.433-1.081)	n.s.
<b>Nagaland</b>	12.79	1.009 (0.362-2.809)	n.s.
<b>NCT of Delhi</b>	83.07	1.311(0.758-2.266)	n.s.
<b>Odisha</b>	94.66	1.863 (1.374-2.526)	***
<b>Puducherry</b>	86.10	4.268 (1.079-16.879)	*
<b>Punjab</b>	78.14	0.905 (0.663-1.234)	n.s.
<b>Rajasthan</b>	80.94	1.664 (1.373-2.016)	***
<b>Sikkim</b>	83.77	5.582 (1.963-15.872)	**
<b>Tamil Nadu</b>	94.61	1.561 (0.989-2.466)	*
<b>Telangana</b>	96.20	1.725 (1.116-2.668)	*

Continued.

Country/states/union territories	Received health and nutrition education counselling from a frontline health care worker (%)	Adjusted odds ratio (95% CI) for receipt of health and nutrition education counselling from a frontline health care worker	Significance
Tripura	71.78	0.980 (0.711-1.352)	n.s.
Uttar Pradesh	81.22	1.449 (1.284-1.636)	***
Uttarakhand	77.23	1.635 (1.198-2.233)	**
West Bengal	84.45	0.873 (0.682-1.199)	n.s.

Dependent variable: Adherence to iron tablets or syrup and iron and folic acid tablets or syrup for at least 90 days: coded as 0 if the women had not consumed iron tablets or syrup for at least 90 days and 1 if she did. The model was adjusted for the place of residence, religion of the respondent, caste, ownership of assets, age group of the woman, total children ever born, education of the mother, exposure to newspaper, television, radio and receipt of antenatal care visits. Note: 95% CI: confidence interval \*: p<0.05: statistically significant at 5% level \*\*: p<0.01: statistically significant at 1% level, \*\*\*: p<0.001: Statistically Significant at 0.1% level, n.s.: Not significant. <sup>ref</sup> Refers to reference category.  $\pm$ AOR refers to both Dadra and Nagar Haveli and Daman and Diu in NFHS-5

**Table 7: Variable importance based on the random forests (RF) analyses of adherence to iron tablets or syrup or iron and folic acid tablets or syrup for at least 90 days in the states of India, National Family Health Survey, 2019-21.**

Ranking	Factors	Importance (%)
1	Receipt of at least four ANC visits	20
2	Household wealth Index	15
3	Religion of the respondent	15
4	Watching of Television	5
5	Counselling on health and nutrition education by a frontline health worker	5
6	Listening to radio	4
7	Education of the women	4
8	Urban and rural residence	4
9	Number of total children ever born	4
10	Reading of newspaper	3

## DISCUSSION

Results indicate that place of residence, wealth quintile, literacy, exposure to different mediums of communications i.e. television, radio, newspaper, receipt of at least three ANC services had a significant impact on adherence for IFA tablets for 90 or more days in both the rounds of NFHS. Similarly, women belonging to urban areas, higher wealth quintile, watching TV, listening to radio and watching newspaper and received at least three ANC services and received counselling by health worker were more likely to adhere to IFA consumption for at least 90 days as compared to their counterparts compared through the analysis. State-wise results of multiple logistic regression also indicate that in many states' Receipt of counselling' by the health and nutrition care worker showed a higher likelihood of adhering to IFA tablets for 90 or more days by the women and in the same continuum results from random forest analysis indicating that the highest importance provided to 'received at least four ANC visits' variable.

There are few limitations of the study. The associations drawn in the analyses are from the findings of two large scale cross-sectional surveys. They do not establish any causal inference between the outcome and the exposure variable. The primary limitation of cross-sectional studies

is that the temporal link between the outcome and the exposure cannot be determined because both are examined at the same time. The cross-sectional study cannot be used to infer causality because a temporal sequence cannot be established. But, associations between exposure and outcome can be established.

## CONCLUSION

There is an urgent need to address the situation of anaemia in the Asia region and specifically in the country with medium level human development with high prevalence anaemia falling under the category of severe public health problem. Nutrition counselling by a frontline health worker and antenatal care visits seem to be the key to increased adherence to iron and folic supplementation in the country, which would likely contribute to anaemia reduction in pregnancy.

## Recommendations

*Implications of the analyses for practice of interpersonal nutrition counselling*

Based on these analyses, it is suggested that age-appropriate interpersonal nutritional counselling training could be developed. The platform for counselling should

be effective. Inter-personal nutrition counselling could be more effective in an 1-1 session, which is more resource intensive than a 1-group session, which should be taken into consideration by weighing the trade-offs between cost and efficiency. The content of the counselling should be responsive to the intended audience.

#### *Measurement of effectiveness of counselling sessions*

In future surveys, it is recommended that questions should be included about the ambience, platform, content, and mode of interaction like, one-way or two-way for the counselling sessions. Studies should include qualitative methods, for instance the trial for improved practices (TIPs) method, to ascertain the counselling is leading to the intended behaviour change. Observation checklists could be used to observe the counselling sessions to ascertain that the counselling process is followed with active listening, respect, and empathy in a supportive environment.

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*Ethical approval: Procedures and questionnaires for standard DHS surveys have been reviewed and approved by ICF Institutional Review Board (IRB). Additionally, country-specific DHS survey protocols are reviewed by the ICF IRB and typically by an IRB in the host country. ICF IRB ensures that the survey complies with the U.S. Department of Health and Human Services regulations for the protection of human subjects (45 CFR 46), while the host country IRB ensures that the survey complies with laws and norms of the nation: <https://dhsprogram.com/What-We-Do/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm>*

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