International Journal of Community Medicine and Public Health
Raut MK et al. Int J Community Med Public Health. 2018 Jul;5(7):3061-3073
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20182649

Original Research Article

Association between adherence to iron intake and anaemia prevalence among women in Cambodia and India: new evidence from recent global demographic and health surveys

Manoj Kumar Raut[1]*, J. C. Reddy[1], Md. Ataur Rahman[2]

[1]Research and Evaluation, Asia, Nutrition International, Asia Regional Office, New Delhi, India
[2]Health and Nutrition Advisor, Field Support Services Project of Global Affairs Canada, Bangladesh

Received: 19 April 2018
Revised: 31 May 2018
Accepted: 01 June 2018

***Correspondence:**
Dr. Manoj Kumar Raut,
E-mail: rautmanojkumar@gmail.com

ABSTRACT

Background: Anaemia is a global public health problem affecting around 800 million children and women worldwide. Anaemia, defined as a reduced haemoglobin concentration, is associated with increased peri-natal mortality, increased child morbidity and mortality, impaired mental development, impaired immune competence, increased susceptibility to lead poisoning, and decreased performance at work.
Methods: This paper attempts to understand the determinants underlying iron and folic acid intake and correlates of anaemia prevalence in two countries in the Asia region using multivariate binary logistic regression analyses of recent data from the Demographic and Health Surveys of Cambodia and India. The individual level data was analysed, using Predictive Analytics Software for Windows (PASW) 18.0 release.
Results: After adjusting for standard co-variates, reading newspaper and watching television was significantly associated with coverage, while reading newspaper and listening to radio was significantly associated with adherence to iron tablets or syrup in India. In case of both Cambodia and India, those who received at least three antenatal care visits were much more likely to adhere to at least 90 days of iron tablet or syrup or iron and folic acid tablets, more so in Cambodia compared to India. Those who reported to have adhered to at least 90 days of iron and folic acid tablets in India were more likely to be not anaemic unlike in case of Cambodia.
Conclusions: Antenatal care-seeking visits seem to be a particularly effective ways of reaching women and in increasing the likelihood of intake of iron only or iron and folic acid supplements.

Keywords: Anaemia, Antenatal care, Iron and folic acid tablets/syrup supplementation, Mass media

INTRODUCTION

Anaemia is a problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. It occurs at all stages of the life cycle but is more prevalent in pregnant women and young children. The average estimates for all-cause anaemia attributable mortality (both direct and indirect) were 6.37, 7.26 and 3.0% for Africa, Asia and Latin America, respectively.[1] Globally, it is estimated that 32 million (95% CI: 28—36) pregnant women, 496 million non- pregnant women (95% CI: 409-595) and 273 million (95% Credibility Interval [CI]: 241—303) children are anaemic.[2] In 2012, participants in the Sixty-fifth World Health Assembly pledged to reduce the global prevalence of anaemia in women of reproductive age by 50% by 2025.

Anaemia prevention programs through iron folic acid (IFA) supplementation have been implemented across

many countries through supply and demand driven approaches 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, increased birth spacing and social awareness programmes etc. But levels of anaemia are still high because of the levels of iron supplementation is quite low with low adherence to IFA, poor dietary intake, chronic blood loss due to infection such as malaria and hookworm infestation and social myths regarding some foods.

The literature review reveals some significant studies, which document impact on reduction of anaemia through awareness program on consumption of IFA (Srivastava et al) and in one study in Cambodia, which reported on the implementation of a weekly IFA supplementation government programme with secondary-school girls (n= 423), women employed in garment factories (n=478) and rural women (n=639), showed substantial improvements in knowledge about the causes, consequences and prevention of anaemia following promotion through social marketing strategies.[3,4] Certain socio-demographic factors that were significantly associated with the non-use of antenatal IFA supplements were, living in one of the districts in Pakistan (AOR: 1.72), maternal age 45 years and above (AOR: 1.97), no maternal education (AOR: 2.36), no paternal education (AOR: 1.58), belonging to the lowest household wealth index quartile (AOR: 1.47), and no use of antenatal care (ANC) services (AOR: 13.39).[5] In settings where the prevalence of anaemia among pregnant women is lower than 20%, intermittent use of iron and folic acid supplements by non-anaemic pregnant women is recommended to prevent anaemia and improve gestational outcomes.[6]

In this regards, this paper attempts to understand the determinants underlying iron intake and anaemia in two countries in Asia using multivariate statistical analyses of the most recent data from the Demographic and Health Surveys in Cambodia and India. Cambodia was selected as the adherence to IFA is about three-fourths compared to less than a third in case of India. There seems to be an opportunity for India to learn from Cambodia to act towards an increase in adherence to IFA.

Socio-demographic health and nutrition profile of the two countries: The projected population in the mid- year of 2017 in Cambodia is about 16 million and about 1,339 million in India (UN, 2017). The population density of Cambodia is 49 and 382 in case of India. The total fertility rate is 2.7 in Cambodia and 2.44 births per woman in India and the crude birth rate varies from 24.5 births per thousand mid-year population in Cambodia to 20.0 in case of India. The infant mortality rate varies from 25 infant deaths per thousand live births in Cambodia to as high as 37 in case of India. The under-five mortality rate varies from 29 under-five deaths per thousand live births in case of Cambodia to as high as 43 in case of India (SOWC, UNICEF, 2017). The maternal mortality ratio varies from 161 maternal deaths per 100,000 live births in Cambodia to as high as 174 in case of India.

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

Indicators	Cambodia	India
Projected population, 2017 (in million)	16.0	1,339.2
Population density (persons per sq. km.)	49	382
Overall sex ratio (Males / Females *100) (country censuses)	105	94.3
Life expectancy at birth (in years)	67.6	67.6
Total fertility rate (lifetime births per woman)	2.70	2.44
Crude birth rate (2010-15) (no. of live births per thousand mid-year population)	24.5	20.0
Stunting (height-for-age) (moderate and severe) (%)	32.4	39.0
Wasting (weight-for-height) (moderate and severe) (%)	9.6	15.0
Underweight (weight-for-age) (moderate and severe) (%)	23.9	29.0
Infant mortality rate (no. of infant deaths per thousand live births)	25	37
Under five mortality rate (no. of under-five deaths per thousand live births)	29	43
Maternal mortality ratio (no. of maternal deaths per 100,000 live births)	161	174
Status of human development, UNDP, 2015 (Rank)	143	131
Level of human development, UNDP (2015)	Medium	Medium
GDP per Capita (current US$), World Bank, 2016	1,269.9	1,709.4
World Bank classification, World Bank (June 2017)	Lower middle income	Lower middle income

Source: Demographic and Health Surveys, United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. (2017). Working Paper No. ESA/P/WP/248. (https://esa.un.org/unpd/wpp/publications/Files/WPP2017_KeyFindings.pdf).

The comparative analyses of the two countries reveal that the women who took iron tablets/syrup or iron with folic acid for 90 days or more varies from 75.9% in Cambodia to 38.8% in India, while the anaemia prevalence varied from 45.4% in Cambodia to 53.0% in India. The trends in 90+ days of Iron adherence shows that there is an absolute increase of 4.3 times and a relative increase of 3.3 times between 2005 and 2014 in Cambodia in about 9 years compared to 1.7 and 0.7 times in case of India in about 10 years between 2005-06 and 2015-16. The average annual rate of increase (AARI) was 17.56 between 2005 and 2014 in Cambodia and 5.28 between 2005-06 and 2015-16 in India. The trends in prevalence of any anaemia reveals that the average annual rate of reduction (AARR) from 2005 to 2014 in Cambodia is in range of 0.03 in case of all women aged 15 to 49 years of age, who were anaemic compared to 0.04 in case of India from 2005-06 to 2015-16.

Table 2: Trends in intake of iron tablets or syrup or iron with folic acid tablets adherence in Cambodia and India: 2005 to 2016 (%).

Intake of iron tablets or syrup or iron with folic acid tablets	Cambodia		India	
	DHS 2005	DHS 2014	NFHS-3, 2005-06	NFHS-4, 2015-16
None	36.8	4.4	40.4	23.9
Less than 60 days	30.8	8.2	27.4	28.6
60-89 days	9.0	9.1	9.1	8.7
90+ days	17.6	75.9	23.2	38.8
Average annual rate of increase (AARI) in consumption of iron for 90+ days from 2005 to 2014 for Cambodia and 2005-06 to 2015-16 for India	-	17.63	-	5.28

Source: Demographic and Health Surveys

Table 3: Trends in anaemia prevalence in Cambodia and India: 2005 to 2016 (%).

Prevalence of anaemia	Cambodia			India		
	DHS, 2005	DHS, 2014	Average annual rate of reduction	NFHS-3, 2005-06	NFHS-4, 2015-16	Average annual rate of reduction
Non-pregnant women age 15-49 years who are anaemic (<12.0 g/dL)	44.3	43.8	-0.1	55.2	53.1	-0.4
Pregnant women age 15-49 years who are anaemic (<11.0 g/dL)	57.1	53.1	-0.8	57.9	50.3	-1.4
All women age 15-49 years who are anaemic	46.6	45.4	-0.3	55.3	53.0	-0.4

Source: Demographic and Health Surveys.

Study objectives

The objectives of the study are to examine the association between different socio-demographic characteristics, and iron and folic tablets or syrup adherence and likelihood of not being anaemic in two selected countries in the Asia region.

METHODS

This paper uses data from two Demographic and Health Surveys (DHSs) from Cambodia (2014) and India (2015-16). These surveys were carried out by ICF International, working in close conjunction with in-country research institutes. We used the existing weighted data of currently married women of reproductive age (15-49 years) for our analyses. Individual level datasets were analysed using PASW Statistics 18, Release 18.0 software. Binary logistic regressions were carried out to explore factors associated with adherence to iron tablets or syrup and anaemia prevalence. Logistic regression can be used to predict a dependent variable on the basis of independent variables and to determine the percent of variance in the dependent variable explained by independent variables; to rank the relative importance of independents; to assess interaction effects; and to understand the impact of covariates. 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. Note that logistic regression calculates changes in the log odds of the dependent, not changes in the dependent variable itself, as OLS regression does. In addition to bivariate analysis, multivariate analysis was performed to control for the effects of other factors. Binary logistic regression models were used to explore associations between the dependent variable and independent variables, adjusting for socio-demographic and economic covariates. Three dependent

variables were considered for the analysis. One is for coverage of iron tablets or syrup or iron with folic acid tablets or syrup and the other for consumption of iron tablets or syrup or iron with folic acid tablets or syrup for at least 90 days. The first dependent variable was coded as 1 if the mother had bought or in some other way received iron tablets or syrup and 0 if she had not purchased nor received iron tablets. The second dependent variable was coded as 1 if the mother had bought or in some other way consumed iron tablets or syrup for 90+ days and 0 if she had not consumed iron tablets for 90+ days. The third dependent variable was coded as 0 if the women had any anaemia and 1 if she did not.

Covariates in the model

Based on an extensive literature review, the analysis of these two surveys considered the following covariates:

Independent covariates

Background -community & household level covariates

- Place of residence: urban/rural
- Ownership of assets: wealth quintiles (poorest to richest)

Socio-economic covariates-individual level

- Education of the mother
- Mother's employment status: Working currently/ not working currently

Demographic covariates-individual level

- Age group of woman: seven five year age groups from 15 to 49 years of age
- Total children ever born: Have 2 or more children/ have more than 2 children

Exposure to communication

- Newspaper
- Radio
- Television

Receipt of antenatal care visits

Received less than three antenatal care visits/received three or more antenatal care visits.

Receipt of iron tablets or syrup of iron with folic acid or syrup

Received iron tablets or syrup or iron with folic acid tablets or syrup/did not receive iron tablets or syrup or iron with folic acid tablets or syrup

Adherence to iron tablets or syrup of iron with folic acid or syrup for at least 90 days

Consumed iron tablets or syrup or iron with folic acid tablets or syrup for 90 or more days/ did not consume iron tablets or syrup or iron with folic acid tablets or syrup for 90 or more days

Dependent variables

- Receipt of iron tablets/syrup or iron and folic acid tablets/syrup.
- Adherence to iron tablets/syrup or iron and folic acid tablets/syrup for at least 90 days.
- Likelihood of not having anaemia.

RESULTS

Sub-national trends in anaemia prevalence and iron and folic acid adherence

The sub-national trends in AARR in Cambodia at the region (province) level shows that the highest reduction being observed is in Banteay Meanchey region followed by Siem Reap. In case of India, in the states and union territories, the highest reduction is observed in Sikkim and Mizoram followed by Assam. The highest increase in iron adherence for 90+ days is observed in Mondol Kiri/Rattanak Kiri followed by Kampong Thom. In India, the highest increase in iron and folic acid adherence for 90+ days is observed in Manipur followed by Meghalaya.

Results of the bivariate analyses

A bivariate analysis was conducted for receipt of iron tablets/syrup as well as for consumption of iron tablets/ syrup for 90+ days. The variables considered for analysis were various background level and individual level socio-demographic and socio-economic covariates. Results indicate that a significantly higher proportion of women residing in urban areas received iron tablets or syrup as compared to rural areas across all countries similarly, adherence for 90+ days was also found to be higher among the women residing in urban areas in both the countries and more so in Cambodia. The receipt and adherence to IFA was also higher among the literates, higher among those who had two or less two children, higher among the households belonging to the higher socio-economic status, higher among those who were exposed to mass media communication channels of newspaper, radio and television. Looking at the exposure to different mediums of communication, it was found that a significant proportion of women who read newspaper and watched television adhered to IFA as compared to those women who do not read newspaper and does not watch television across both the countries. A significant proportion of women who received at least 3 ANCs received and adhered to iron for at least 90 days in both the countries.

Table 4: Prevalence of anaemia in women of reproductive age group (15-49 years) in Cambodia by Province, 2005 to 2014 (%).

Sl. No	Country/Province	Any anaemia	Any anaemia	Average annual rate of reduction (AARR) in Anaemia	90+ adherence to iron	90+ adherence to iron	Average annual rate of increase (AARI) in adherence
		DHS, 2005	DHS, 2014		DHS, 2005	DHS, 2014	
	Cambodia	46.7	45.4	-0.31	17.6	75.5	15.68
1	Banteay Meanchey	57.1	30.5	-6.73	22.9	88.3	14.45
2	Kampong Cham	41.3	52.0	2.59	6.2	65.5	26.59
3	Kampong Chhnang	55.9	53.0	-0.59	16.6	94.4	18.98
4	Kampong Speu	58.0	53.3	-0.93	16.0	79.2	17.34
5	Kampong Thom	57.4	44.6	-2.76	6.5	78.3	28.26
6	Kandal	45.9	49.4	0.82	11.9	79.0	20.84
7	Phnom Penh	29.3	41.7	4.00	16.0	79.2	17.34
8	Prey Veng	40.3	46.9	1.70	28.1	87.8	12.07
9	Pursat	52.4	46.6	-1.29	53.0	80.6	4.28
10	Svay Rieng	49.4	45.7	-0.86	39.3	78.2	7.12
11	Takeo	46.8	35.4	-3.05	18.9	86.7	16.45
12	Battambang/Krong Pailin	53.1	42.5	-2.44	8.7	50.1	19.13
13	Mondol Kiri/Rattanak Kiri	44.3	41.7	-0.67	5.2	63.3	28.39
14	Preah Vihear/Stueng Treng	62.6	53.7	-1.69	12.5	38.5	11.91
15	Kratie	38.5	46.2	2.05	18.0	74.0	15.18
16	Siem Reap	56.2	41.1	-3.42	18.4	73.1	14.79
17	Otdar Mean Chey	57.1	48.3	-1.84	15.6	76.8	17.28
18	Kampot/Krong Kep	42.3	44.1	0.46	21.9	80.0	13.83
19	Krong Preah Sihanouk/Kaoh Kong	46.3	43.7	-0.64	26.7	66.7	9.59

Source: Demographic and Health Surveys: 2005 and 2014.

Table 5: Prevalence of anaemia in women of reproductive age group (15-49 years) in India by State, 2005-06 to 2015-16 (%).

Sl. No	Country/States/Union Territories	Any anaemia	Any anaemia	Average annual rate of reduction (AARR) in Anaemia	90+ adherence to IFA	90+ adherence to IFA	Average annual rate of increase (AARI) in adherence
		NFHS–3, 2005 -06	NFHS–4, 2015-16		NFHS–3, 2005 -06	NFHS–4, 2015-16	
	India	55.3	53.0	-0.42	23.1	38.8	5.32
1	Andaman and Nicobar Islands	-	65.7	-	-	67.0	-
2	Andhra Pradesh	62.9	60.0	-0.47	-	65.0	-
3	Arunachal Pradesh	50.6	40.3	-2.25	11.2	15.4	3.24
4	Assam	69.5	46.0	-4.04	16.2	42.8	10.20
5	Bihar	67.4	60.3	-1.11	9.7	14.2	3.88
6	Chandigarh	-	75.9	-	-	60.5	-
7	Chhattisgarh	57.5	47.0	-2.00	20.7	46.2	8.36
8	Dadra and Nagar Haveli	-	79.5	-	-	52.8	-
9	Daman and Diu	-	58.9	-	-	41.6	-
10	Goa	44.3	52.5	1.71	68.6	78.4	1.34
11	Gujarat	38.0	31.3	-1.92	37	45.4	2.07
12	Haryana	55.3	54.9	-0.07	26.7	44.5	5.24
13	Himachal Pradesh	56.1	62.7	1.12	37.9	64.8	5.51
14	Jammu & Kashmir	43.3	53.4	2.12	27.6	39.9	3.75
15	Jharkhand	52.1	40.3	-2.54	14.2	24.4	5.56
16	Karnataka	69.5	65.2	-0.64	39.3	52.9	3.02
17	Kerala	51.5	44.8	-1.38	75.1	77.3	0.29

Continued.

Sl. No.	Country/ States/ Union Territories	Any anaemia	Any anaemia	Average annual rate of reduction (AARR) in Anaemia	90+ adherence to IFA	90+ adherence to IFA	Average annual rate of increase (AARI) in adherence
		NFHS–3, 2005 -06	NFHS–4, 2015-16		NFHS–3, 2005 -06	NFHS–4, 2015-16	
18	Lakshadweep	32.8	34.2	0.42	-	85.8	-
19	Madhya Pradesh	55.9	52.5	-0.64	12.4	32.7	10.18
20	Maharashtra	-	-	-	31.4	51.4	5.05
21	Manipur	48.4	48.0	-0.08	13.1	48.0	13.87
22	Meghalaya	35.7	26.4	-2.97	16.7	49.8	11.55
23	Mizoram	47.2	56.2	1.76	24.7	58.9	9.08
24	Nagaland	38.6	22.5	-5.25	3.5	7.8	8.34
25	New Delhi	-	23.9	-	39.5	60.8	4.41
26	Odisha	61.2	51.0	-1.81	33.8	44.6	2.81
27	Puducherry	-	52.4	-	-	69.4	-
28	Punjab	38.0	53.5	3.48	27.9	55.3	7.08
29	Rajasthan	53.1	46.8	-1.25	13.1	24.2	6.33
30	Sikkim	60.0	34.9	-5.27	38.7	78.6	7.34
31	Tamil Nadu	53.2	55.1	0.35	41.6	69.0	5.19
32	Telangana	-	56.7	-	-	62.9	-
33	Tripura	65.1	54.5	-1.76	18	26.8	4.06
34	Uttar Pradesh	49.9	52.4	0.49	8.8	18.1	7.48
35	Uttarakhand	55.2	45.2	-1.98	26.4	32.3	2.04
36	West Bengal	63.2	62.5	-0.11	25.7	42.8	5.23

Source: Demographic and health surveys: 2005-06 and 2015-16, Stat Compiler.

Table 6: Socio-economic, demographic and health variables in Cambodia and India, demographic and health surveys (%).

Predictors used in the model	Cambodia, DHS 2014	India, NFHS -4, 2015-16
N	5,678	182,096
Background– Community level covariate		
Place of residence		
Rural	85.6	70.3
Urban	14.4	29.7
Background– Individual level covariates		
Education of the Respondent		
Non-Literate	13.2	27.6
Literate	86.8	72.4
Demographic covariates		
Age group of the woman		
15-19 years	3.4	3.4
20-24 years	24.3	31.3
25-29 years	29.9	37.6
30-34 years	26.2	18.3
35-39 years	10.3	6.9
40-44 years	4.3	1.9
45-49 years	1.5	0.6
Total children ever born		
Have 2 or less than 2 children	65.8	68.1
Have more than 2 children	34.2	31.9
Socio-economic covariates		
Respondent's work status		
Not working currently	34.8	97.0
Working currently	65.2	3.0

Continued.

Predictors used in the model	Cambodia, DHS 2014	India, NFHS -4, 2015-16
Wealth quintile		
Poorest	22.9	23.4
Poorer	20.4	21.2
Middle	18.8	19.9
Richer	18	19
Richest	19.9	16.6
Communication exposure		
Mass media		
Newspaper		
Does not read newspaper	79.8	65.1
Reads newspaper	20.2	34.9
Radio		
Does not listen to radio	50.6	86.2
Listens to radio	49.4	13.8
Television		
Does not watch television	29.3	28.6
Watches Television	70.7	71.4
Receipt of at least 3 ANCs		
Received less than 3 ANCs	11.5	34.5
Received 3+ ANCs	88.5	65.5
Iron receipt		
Did not receive or bought any iron supplements or syrup	4.3	22.0
Received or bought iron supplements or syrup	95.7	78.0
Iron adherence (90+ days of iron supplementation or syrup)		
Did not consume iron supplementation for 90 or more days	24.1	61.2
Consumed iron supplementation or syrup for 90 or more days	75.9	38.8

Source: Demographic and health surveys.

Table 7: Receipt of iron or iron and folic acid supplements by socio-economic and demographic variables in Cambodia and India (%).

Predictors used in the model	Cambodia, DHS 2014			India, NFHS -4, 2015-16		
	Non-iron receivers/ buyers	Iron receivers/ buyers	Prob.	Non-iron & folic acid receivers/ buyers	Iron & folic acid receivers/ buyers	Prob.
N	244	5,434		39,944	142,152	
Background- community level covariate						
Rural	4.7	95.3		24.6	75.4	
Urban	2.1	97.9**	0.001	15.6	84.4***	0.000
Individual level covariates						
Education of the respondent						
Non-Literate	12	88		37.4	62.6	
Literate	3.1	96.9***	0.000	16.1	83.9***	0.000
Demographic covariates						
Age group of the woman						
15-19 years	4.6	95.4		20	80	
20-24 years	2.8	97.2		20	80	
25-29 years	3.2	96.8		20.7	79.3	
30-34 years	3.6	96.4		23.3	76.7	
35-39 years	7	93		28.4	71.6	
40-44 years	13.4	86.6		38.6	61.4	
45-49 years	17.4	82.6***	0.000	49.5	50.5***	0.000

Continued.

Predictors used in the model	Cambodia, DHS 2014			India, NFHS -4, 2015-16		
	Non-iron receivers/ buyers	Iron receivers/ buyers	Prob.	Non-iron & folic acid receivers/ buyers	Iron & folic acid receivers/ buyers	Prob.
Total children ever born						
Have 2 or less than 2 children	2.2	97.8		17.3	82.7	
Have more than 2 children	8.2	91.8***	0.000	31.9	68.1***	0.000
Socio-economic covariates						
Respondents work status						
Not working currently	3.6	96.4		22	88	
Working currently	4.7	95.3	0.068	20.9	79.1	0.053
Wealth quintile						
Poorest	9	91		35.8	64.2	
Poorer	4.6	95.4		24.7	75.3	
Middle	3.7	96.3		18.5	81.5	
Richer	1.6	98.4		14.8	85.2	
Richest	1.7	98.3***	0.000	11.2	88.8***	0.000
Communication exposure – Mass media						
Newspaper						
Does not read newspaper	4.9	95.1		27	73	
Reads newspaper	1.8	98.2***	0.000	12.6	87.4***	0.000
Radio						
Does not listen to radio	4.7	95.3		22.3	77.7	
Listens to radio	3.9	96.1	0.169	19.4	80.6***	0.000
Television						
Does not watch television	8.3	91.7		36.9	63.1	
Watches Television	2.6	97.4***	0.000	15.9	84.1***	0.000
Receipt of at least 3 ANCs						
Received less than 3 ANCs	33.1	66.9		39.9	60.1	
Received 3+ ANCs	0.6	99.4***	0.000	12.5	87.5***	0.000

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. Source: Demographic and Health Surveys.

Table 8: Adherence to iron or iron and folic acid intake for at least 90 days by socio-economic and demographic variables in Cambodia and India (%).

Predictors used in the model	Cambodia, DHS 2014			India, NFHS -4, 2015-16		
	Non-iron adherers	Iron adherers	Prob.	Non-iron & folic acid adherers	Iron & folic acid adherers	Prob.
N	1,369	4,308		111,460	70,637	
Background- community level covariate						
Rural	24.5	75.5		66	34	
Urban	21.8	78.2	0.089	49.9	50.1***	0.000
Individual level covariates						
Education of the respondent						
Non-literate	35.4	64.6		78.5	21.5	
Literate	22.4	77.6***	0.000	54.6	45.4***	0.000
Demographic covariates						
Age group of the woman						
15-19 years	24.2	75.8		64.1	35.9	
20-24 years	24.1	75.9		61.2	38.8	
25-29 years	22.5	77.5		59.4	40.6	
30-34 years	21.9	78.1		60.8	39.2	
35-39 years	28.1	71.9		65.4	34.6	
40-44 years	31.7	68.3		73.9	26.1	
45-49 years	45.3	54.7***	0.000	81	19.0***	0.000

Continued.

Predictors used in the model	Cambodia, DHS 2014			India, NFHS -4, 2015-16		
	Non-iron adherers	Iron adherers	Prob.	Non-iron & folic acid adherers	Iron & folic acid adherers	Prob.
Total children ever born						
Have 2 or less than 2 children	20.7	79.3		55.6	44.4	
Have more than 2 children	30.8	69.2***	0.000	73.2	26.8***	0.000
Socio-economic covariates						
Respondents work status						
Not working currently	24.4	75.6		61.6	38.4	
Working currently	23.9	76.1	0.692	59.3	40.7**	0.006
Wealth Quintile						
Poorest [Ref]	35	65		79.6	20.4	
Poorer	24.3	75.7		68.5	31.5	
Middle	23.7	76.3		58.3	41.7	
Richer	18.4	81.6		50.6	49.4	
Richest	16.9	83.1***	0.000	41.9	58.1***	0.000
Communication exposure- Mass media						
Newspaper						
Does not read newspaper	25.3	74.7		68.1	31.9	
Reads newspaper	19.7	80.3***	0.000	48.4	51.6***	0.000
Radio						
Does not listen to radio	26.5	73.5		61.7	38.3	
Listens to radio	21.7	78.3***	0.000	58.4	41.6***	0.000
Television						
Does not watch television	32.1	67.9		78.8	21.2	
Watches television	20.8	79.2***	0.000	54.2	45.8***	0.000
Receipt of at least 3 ANCs						
Received less than 3 ANCs	73.5	26.5		81.3	18.7	
Received 3+ ANCs	17.7	82.3***	0.000	50.7	49.3***	0.000

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. Source: Demographic and Health Surveys

Results of the multivariate binary logistic regression analyses

Predictors used in the model

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.

Working status of women was also found to play a significant role; as a significant proportion of working women received iron tablets/syrup as compared to non-working women in India unlike in Cambodia. Looking at the exposure to different mediums of communication, it was found that a significant proportion of women who watched television received and adhered to IFA as compared to those women who do not watch television in India. A significant proportion of women who received at least 3 ANCs received and adhered to iron for at least 90 days in both the countries.

Those who had received at least three antenatal care visits, were 10.984 times in Cambodia and to 2.854 times in India, who 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.

After adjusting for standard co-variates, those who were in the age group of 20 to 24 year of age, those who worked currently, were more likely not be at risk of anaemia in Cambodia, while, education of the mother, higher socio-economic status, exposure to newspaper and radio, adherence to at least 90 days of IFA supplementation were found to be statistically associated with lower risk of anaemia in India.

Table 9a: Adjusted Odds ratio (AOR) with 95% confidence intervals from the multivariate logistic regression (MLR) coverage of iron tablets or syrup or iron and folic acid or syrup in Cambodia and India, demographic and health surveys. Dependent variable: receipt of iron tablets or syrup or iron and folic acid supplements: *coded as 0 if the women had received / bought iron tablets or syrup and 1 if she did.*

Predictors used in the model	Cambodia, DHS, 2014	Prob.	India, NFHS -4, 2015-16	Prob.
N Weighted	5,678		182,096	
N (Unweighted)	5,585		187,629	
Background -community level covariate				
Place of residence				
Rural [Ref]				
Urban	1.039 (0.495-2.181)	0.919	0.964* (0.933-0.997)	0.030
Individual Level covariates				
Education of the Respondent				
Non-Literate [Ref]				
Literate	1.878* (1.307-2.699)	0.001	1.515*** (1.469-1.561)	0.000
Demographic covariates				
Age of the Respondent				
15-19 years [Ref]				
20-24 years	1.082 (0.467-2.508)	0.853	1.010 (0.943-1.083)	0.769
25-29 years	0.869 (0.373-2.026)	0.746	1.072 (1.000-1.150)	0.050
30-34 years	1.043 (0.428-2.544)	0.926	1.099* (1.020-1.184)	0.013
35-39 years	0.806 (0.315-2.067)	0.654	1.054 (0.972-1.144)	0.204
40-44 years	0.426 (0.158-1.150)	0.092	0.862** (0.777-0.956)	0.005
45-49 years	0.661 (0.220-1.983)	0.460	0.721*** (0.620-0.839)	0.000
Total children ever born				
Have 2 or less than 2 children [Ref]				
Have more than 2 children	0.620* (0.404-0.950)	0.028	0.765*** (0.742-0.788)	0.000
Socio-economic covariates				
Respondent's current work status				
Does not work currently [Ref]				
Works currently	0.752 (0.535-1.055)	0.099	1.168*** (1.086-1.255)	0.000
Wealth quintile				
Poorest [Ref]				
Poorer	1.123 (0.743-1.698)	0.583	1.002 (0.969-1.037)	0.892
Middle	0.989 (0.613-1.598)	0.965	1.032 (0.991-1.075)	0.124
Richer	1.107 (0.576-2.126)	0.761	1.067** (1.018-1.118)	0.007
Richest	0.763 (0.351-1.656)	0.494	1.200*** (1.134-1.269)	0.000
Communication exposure- Mass media				
Newspaper				
Does not read newspaper [Ref]				
Reads newspaper	1.093 (0.628-1.904)	0.752	1.272*** (1.230-1.316)	0.000
Radio				
Does not listen to radio [Ref]				
Listens to radio	0.573** (0.411-0.799)	0.001	0.922*** (0.889-0.957)	0.000
Television				
Does not watch television [Ref]				
Watches Television	1.302 (0.904-1.876)	0.156	1.544*** (1.497-1.592)	0.000
Receipt of at least 3 ANCs				
Received less than 3 ANCs [Ref]				
Received 3+ ANCs	71.752** (46.385-110.991)	0.000	3.271***(3.189-3.356)	0.000

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; [ref] Refers to Reference Category.
Source: Demographic and Health Surveys.

Table 9b: Adjusted Odds Ratio (AOR) with 95% confidence intervals from the multivariate binary logistic regression (MLR) of adherence to iron tablets or syrup or iron and folic acid tablets or syrup for at least 90 days in Cambodia and India, demographic and health surveys (DHS). 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.*

Predictors used in the model	Cambodia, DHS, 2014	Prob.	India, NFHS -4, 2015-16	Prob.
N Weighted	5,678		182,096	
N (Unweighted)	5,585		187,629	
Background: community level covariate				
Place of residence				
Rural [Ref]				
Urban	0.633*** (0.494-0.811)	0.000	1.077*** (1.049-1.102)	0.000
Individual level covariates				
Education of the Respondent				
Non-Literate [Ref]				
Literate	1.160 (0.947-1.420)	0.152	1.410*** (1.369-1.453)	0.000
Demographic covariates				
Age of the Respondent				
15-19 years [Ref]				
20-24 years	0.788 (0.528-1.174)	0.241	1.077* (1.017-1.141)	0.011
25-29 years	0.871 (0.584-1.299)	0.498	1.219*** (1.151-1.292)	0.000
30-34 years	1.027 (0.678-1.556)	0.898	1.320*** (1.242-1.404)	0.000
35-39 years	0.953 (0.605-1.499)	0.834	1.379*** (1.285-1.480)	0.000
40-44 years	0.958 (0.573-1.602)	0.870	1.242*** (1.121-1.377)	0.000
45-49 years	0.714 (0.371-1.375)	0.314	1.207* (1.008-1.445)	0.040
Total children ever born				
Have 2 or less than 2 children [Ref]				
Have more than 2 children	0.758** (0.634-0.906)	0.002	0.707*** (0.688-0.726)	0.000
Socio-economic covariates				
Respondent's current work status				
Does not work currently [Ref]				
Works currently	0.981 (0.851-1.132)	0.796	1.180*** (1.111-1.253)	0.000
Wealth quintile				
Poorest [Ref]				
Poorer	1.402** (1.145-1.716)	0.001	1.150*** (1.110-1.191)	0.000
Middle	1.240* (1.001-1.537)	0.049	1.395*** (1.344-1.448)	0.000
Richer	1.469** (1.163-1.856)	0.001	1.578*** (1.516-1.642)	0.000
Richest	1.892*** (1.428-2.509)	0.000	1.898*** (1.815-1.987)	0.000
Communication exposure – Mass media				
Newspaper				
Does not read newspaper [Ref]				
Reads newspaper	0.935 (0.774-1.129)	0.482	1.153*** (1.125-1.182)	0.000
Radio				
Does not listen to radio [Ref]				
Listens to radio	1.078 (0.934-1.244)	0.303	0.923*** (0.896-0.951)	0.000
Television				
Does not watch Television [Ref]				
Watches Television	1.066 (0.901-1.261)	0.454	1.404*** (1.363-1.447)	0.000
Receipt of at least 3 ANCs				
Received less than 3 ANCs [Ref]				
Received 3+ ANCs	10.894*** (8.940-13.276)	0.000	2.854** (2.785-2.925)	0.000

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.; [ref] Refers to Reference Category.
Source: Demographic and Health Surveys.

Table 10: Adjusted Odds Ratio (AOR) with 95% confidence intervals from the multivariate binary logistic regression (MLR) of anaemia prevalence in Cambodia and India, demographic and health surveys (DHS). Dependent variable: prevalence of any anaemia: *coded as 0 if the women had any anaemia and 1 if she did not.*

Predictors used in the model	Cambodia, DHS, 2014	Prob.	India, NFHS -4, 2015-16	Prob.
N Weighted	5,678		182,096	
N (unweighted)	5,585		187,629	
Background community level covariate				
Place of residence				
Rural [Ref]				
Urban	1.082 (0.855-1.370)	0.511	1.022 (0.998-1.047)	0.067
Individual level covariates				
Education of the Respondent				
Non-Literate [Ref]				
Literate	0.873 (0.708-1.077)	0.205	1.088*** (1.060-1.116)	0.000
Demographic covariates				
Age of the respondent				
15-19 years [Ref]				
20-24 years	1.351 (0.937-1.948)	0.107	1.105*** (1.048-1.166)	0.000
25-29 years	1.693** (1.175-2.439)	0.005	1.206*** (1.142-1.273)	0.000
30-34 years	1.300 (0.889-1.902)	0.176	1.240*** (1.171-1.313)	0.000
35-39 years	1.272 (0.836-1.935)	0.261	1.224*** (1.147-1.305)	0.000
40-44 years	1.451 (0.890-2.367)	0.136	1.288*** (1.179-1.406)	0.000
45-49 years	0.723 (0.364-1.437)	0.355	1.287*** (1.121-1.477)	0.000
Total children ever born				
Have 2 or less than 2 children [Ref]				
Have more than 2 children	0.990 (0.832-1.178)	0.913	0.930*** (0.908-0.953)	0.000
Socio-economic covariates				
Respondent's current work status				
Does not work currently [Ref]				
Works currently	1.184* (1.032-1.360)	0.016	0.930* (0.880-0.983)	0.010
Wealth quintile				
Poorest [Ref]				
Poorer	1.145 (0.936-1.401)	0.187	1.104*** (1.701-1.137)	0.000
Middle	1.424** (1.151-1.763)	0.001	1.200*** (1.161-1.240)	0.000
Richer	1.542*** (1.231-1.932)	0.000	1.324*** (1.276-1.374)	0.000
Richest	1.428** (1.095-1.862)	0.009	1.466*** (1.407-1.528)	0.000
Communication exposure – Mass media				
Newspaper				
Does not read newspaper [Ref]				
Reads newspaper	0.999 (0.834-1.197)	0.991	1.075*** (1.050-1.101)	0.000
Radio				
Does not listen to radio [Ref]				
Listens to radio	0.904 (0.787-1.038)	0.153	1.071*** (1.042-1.101)	0.000
Television				
Does not watch Television [Ref]				
Watches Television	0.893 (0.756-1.054)	0.893	0.971 (0.954-1.005)	0.117
Receipt of at least 3 ANCs				
Received less than 3 ANCs [Ref]				
Received 3+ ANCs	0.935(0.745-1.173)	0.561	1.008 (0.986-1.030)	0.470
Iron or iron and folic acid adherence				
Did not consume iron tablets or syrup/ iron and folic tablets or syrup for 90+ days [Ref]				
Consumed iron tablets or syrup / iron and folic tablets or syrup for 90+ days	1.175 (0.996-1.387)	0.056	1.024*(1.004-1.045)	0.021

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; [ref] Refers to Reference Category. Source: Demographic and Health Surveys.

DISCUSSION

The comparative analyses of the two countries reveal that the women who took iron tablets/ syrup or iron with folic acid for 90 days or more varies from 75.9% in Cambodia to 38.8% in India, while the anaemia prevalence varied from 53.0% in India to 45.4% in Cambodia. The improvement in iron adherence is higher in Cambodia, while the decline in anaemia prevalence is higher in case of India.

CONCLUSION

There is an urgent need to address the situation of anaemic in the Asia region and specifically in these two low middle income countries with medium level human development with high prevalence anaemia falling under the category of severe public health problem. Antenatal care visits seem to be the key to increased adherence to iron and folic supplementation in these two countries.

ACKNOWLEDGEMENTS

The authors acknowledge the use of the data published on the public domain by DHS program implemented by ICF International and partners Blue Raster, The Futures Institute, The Johns Hopkins Bloomberg School of Public Health Center for Communication Programs (JHUCCP), PATH, and Vysnova, and two new partner organizations in 2013—EnCompass and Kimetrica.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Procedures and questionnaires for standard DHS surveys have been reviewed and approved by ICF Institutional Review Board (IRB)

REFERENCES

1. Brabin BJ, Hakimi M, Pelletier D. An analysis of anaemia and pregnancy-related maternal mortality. J Nutr. 2001;131(2):604-14.
2. WHO. The global prevalence of anaemia in 2011. World Health Organization. 2015. Available at: http://apps.who.int/iris/bitstream/10665/177094/1/9789241564960_eng.pdf. Accessed on 3 March 2018.
3. Srivastava RK, Kotecha PV, Singh V, Srivastava M. Community Based Intervention (CBI) for Demand Generation of IFA Consumption among Rural Pregnant Women. Int J Recent Scientific Res. 2015;6(7):5023-6.
4. Kanal K, Busch-Hallen J, Cavalli-Sforza T, Crape B, Smitasiri S. Weekly iron–folic acid supplements to prevent anaemia among Cambodian women in three settings: process and outcomes of social marketing and community mobilization. Nutr Rev. 2005;63(12):126-33.
5. Nisar YB, Dibley MJ, Mir AM. Factors associated with non-use of antenatal iron and folic acid supplements among Pakistani women: a cross sectional household survey. BMC Pregnancy Childbirth. 2014;14:305.
6. WHO. Guideline: Intermittent iron and folic acid supplementation in non-anaemic pregnant women. WHO; Geneva, 2012.

Cite this article as: Raut MK, Reddy JC, Rahman MA. Association between adherence to iron intake and anaemia prevalence among women in Cambodia and India: new evidence from recent global demographic and health surveys. Int J Community Med Public Health 2018;5:3061-73.