The Role of Health Facilities in Supporting Adherence to Iron-folic Acid in Haiti and Malawi: A Study Linking Health Facility Survey and Population Survey Data

Wenjuan Wang (✉ wenjuan.wang2@nih.gov)

National Institutes of Health

Rukundo Benedict

ICF

Lindsay Mallick

ICF

Research article

Keywords: Iron and folic acid (IFA) supplementation, anemia, facility-based ANC services, IFA supplement availability, IFA counseling

Posted Date: September 30th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-56018/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: Iron-folic acid (IFA) supplementation during pregnancy is key to prevent maternal anemia. In Malawi and Haiti, consumption of IFA supplements remains suboptimal. This study examined the IFA-related services provided in health facilities and their association with women's adherence to IFA supplementation during pregnancy.

Methods: This study used data from the Demographic and Health surveys (DHS) and the Service Provision Assessment (SPA) in Haiti and Malawi. Using GPS data collected in both surveys, each DHS cluster was linked to health facilities surveyed in the SPA within a specified buffer distance (5 km for urban areas and 10 km for rural areas). IFA-related services were examined for health facilities within the buffer, including the availability of IFA supplements, prescription of IFA, and client counseling on IFA. Adherence to IFA supplementation was examined for women who received antenatal care (ANC) for their most recent live birth in the 2 years preceding the DHS survey. Multilevel logistic regressions stratified by urban and rural locale were used to model associations between women's consumption of IFA supplements and the health facility service environment, controlling for relevant covariates.

Results: More than two-thirds of facilities with ANC services in Haiti and almost all ANC facilities in Malawi had IFA supplements available. Over 60% of ANC clients in Haiti and over 80% in Malawi received IFA supplements or an IFA prescription. Counseling on IFA was less common and focused on how to use IFA; few women were counseled on side effects. Only 42% of women in Haiti and 35% of women in Malawi took IFA supplements for at least 90 days. Multivariable models indicated that in both countries, adherence to IFA supplementation in rural areas was significantly associated with a high level of availability of ANC facilities offering IFA. IFA counseling was also positively associated with the IFA supplement adherence in rural Malawi but not in Haiti. IFA supplement adherence was consistently associated with the completion of four or more ANC visits in both countries.

Conclusions: Continued efforts are required to address access to IFA supplements through improving both the use of ANC services and their quality, particularly in provider counseling.

Background

Maternal anemia is estimated to affect 32 million pregnant women globally, with the highest burdens in South Asia and sub-Saharan Africa (1, 2). The consequences of anemia during pregnancy affect both mother and child including increased risk of preterm birth, low birthweight, and neonatal deaths (3–5). Despite the global target of reducing anemia to 50% in women of reproductive age by 2025, the prevalence of anemia remains high, 40% among pregnant women in 2016 and no country is on track to meet the target (6)

Iron deficiency is the major contributor to maternal anemia (7, 8) due in part to the increased physiological demands for iron during pregnancy to support fetal development (9). The World Health Organization (WHO) recommends daily IFA supplementation for pregnant women to prevent anemia and

improve neonatal health (10). In low- and middle-income countries, IFA supplementation is commonly delivered through facility-based antenatal care (ANC) visits (11, 12). However, access to IFA supplements in health facilities is hindered by physical, socio-cultural, and economic barriers to ANC and by poor quality services (11, 13, 14).

In Haiti, government policies to address anemia support IFA supplementation as part of routine ANC services (15) provided by a mix of public and private health facilities and community agents (16–18). While coverage of ANC is relatively high in Haiti, 67% of women received at least 4 ANC visits, maternal anemia affects 52% of pregnant women with large regional differences (19). Similarly, in Malawi, the prevalence of anemia is high, affecting 45% of pregnant women and only 51% of pregnant women had at least 4 ANC visits (20). Facility and community ANC services are common throughout Malawi but facility-based ANC is the primary delivery platform for IFA supplementation and the government provides free ANC and IFA supplements for pregnant women (21, 22).

Several studies have assessed factors related to health providers that affect IFA supplementation, such as IFA supplement availability in health facilities, provider knowledge and training, and follow-up of ANC services (22, 23). However, few have directly linked the supply side—services offered at health facilities—to IFA supplement adherence measured in pregnant women. Our study links data from nationally representative household surveys and health facilities censuses in Haiti and Malawi to identify key factors related to IFA service delivery in health facilities that are associated with IFA supplement adherence among pregnant women. Haiti and Malawi were chosen for the analysis primarily for two reasons: 1) both countries have recent and closely timed a SPA survey and a DHS survey; 2) the SPA survey of health facilities was a census of all health facilities in the country. A health facility census allows linking health facilities to households at geographic areas smaller than region: the DHS cluster level (24). It should be noted that SPA surveys are typically sample surveys of health facilities. Such survey design only permits linking SPA data to DHS data at the regional level.

Methods

The study used data from recent Demographic and Health Surveys (DHS) and Service Provision Assessment (SPA) surveys in Haiti and Malawi - the 2016-17 Haiti DHS and 2015-16 Malawi DHS, and the 2013 Haiti SPA and 2013-14 Malawi SPA. DHS surveys provide information on the adherence to IFA supplementation among pregnant women, as well as on their socio-demographic characteristics and other care-seeking behaviors that may be associated with consumption of IFA supplementation. SPA surveys provide information on IFA-related services at health facilities in the countries, specifically IFA supplement availability, prescription, and counseling. Both countries used the DHS Model Questionnaires that are available in supplementary materials.

DHS surveys

The 2016-17 Haiti DHS and the 2015-16 Malawi DHS are population-based household surveys that applied a two-stage cluster sampling design to draw a sample that is representative of the country. In the first stage, clusters or enumeration areas were selected from the country's most recent census sampling frame with probability proportional to the population size of clusters. In the second stage, a systematic sample of households was selected in each of the sampled clusters. All women age 15–49 in selected households were interviewed with an individual questionnaire. The 2016-17 Haiti DHS selected 450 clusters (152 urban and 298 rural), from which a total of 14,371 women age 15–49 were sampled and interviewed. The 2015-16 Malawi DHS sampled 850 clusters (173 urban and 677 rural), from which a total of 24,562 women age 15–49 were interviewed.

Our analysis focused on women who received antenatal care (ANC) for their most recent live birth in the two years preceding the survey. For Haiti, women living in the metropolitan area were excluded from the analysis because the linkage method used in this study is not appropriate for areas with a high density of population and health facilities, as previous research has shown (Wang, Winner, and Burgert-Brucker 2017). These criteria yielded an analysis sample of 1,732 women in Haiti and 6,568 women in Malawi.

The DHS surveys collected the geographic coordinates of the sampled clusters using Global Positioning System (GPS) receivers (25). The coordinates were geographically displaced to protect participants' confidentiality. Clusters in urban areas were displaced up to a maximum distance of 2 kilometers (km). Rural clusters were displaced up to 5 km, with 1% of randomly selected clusters displaced up to 10 km.

SPA surveys

The 2013 Haiti SPA and the 2013-14 Malawi SPA are censuses, covering all the formal-sector health facilities of the country. Less formal health facilities such as drug stores, are not part of the survey. SPA surveys collect data on health facilities, health providers, and clients using four instruments: the facility inventory questionnaire; health provider interview; consultation observation checklist; and client exit interview. Clients for consultation observations are selected based on the expected number of clients available on the day of the survey. A maximum of 15 consultations are selected for ANC. All observed clients are approached for the exit interview. More information on the survey design and questionnaires can be found in the respective SPA final reports (26, 27).

The data for this analysis came from facilities that provide ANC services and among clients who were observed during ANC consultations and who completed the exit interview. Not all facilities that provide ANC services had clients observed. Out of 827 ANC facilities in Haiti, 451 had observations on ANC, and 1620 clients were observed. Facilities that did not have ANC observations were primarily dispensaries (52%) and health centers (44%). In Malawi, 412 out of 632 ANC facilities had ANC observation for 2,068 clients. Facilities without observations were primarily health centers (68%) and dispensaries (25%). In both countries, private for-profit facilities were more likely to have no ANC observations compared to public and NGO facilities.

The SPA surveys collected geolocations of all health facilities surveyed. These GPS data were released without geographical displacement.

Linking DHS and SPA data

ANC facilities and DHS clusters were linked with their GPS data using a buffer-linkage approach. This approach identified facilities within a specific buffer distance from each of the DHS clusters (5 km for urban clusters and 10 km for rural clusters). These buffer distances were chosen given the displacement radius used for the geolocations of urban DHS clusters (maximum 2 km) and most rural clusters (maximum 5 km). Details on the linkage method have been discussed in other studies (24). We summarized data of the linked facilities for each cluster as the cluster-level measurement of the service environment.

Measurements

The outcome variable—women’s adherence to IFA supplementation during pregnancy—was measured with a dichotomous variable that indicates whether a woman took IFA supplements for at least 90 days during the pregnancy for her last birth in the two years preceding the survey. Despite the WHO recommendation of at least 180 supplements, many countries still aim for women to receive 90 or more supplements during pregnancy (23). The key predictors are the three IFA-related service environment indicators: IFA supplement availability, IFA supplement prescription, and counseling on IFA at health facilities. All three indicators were first measured at the facility level and then summarized to the DHS cluster level.

A facility was considered to have IFA supplements available if the supplements were within the expiration date observed. IFA supplement prescription and IFA counseling were measured using data both from observation of provider-client consultations and from client exit interviews. The prescription variable was based on concordant responses between the observation of the ANC consultation and the exit interview. A client was considered to have received a prescription only if the interviewer observed it during the ANC consultation and the client also reported it in the exit interview. This dual approach was to avoid the bias associated with clients over-reporting services received, as found in previous research (28).

For IFA counseling, two aspects were assessed: counseling on how to take IFA supplements, and counseling on side effects of IFA. For each aspect, the client was considered as receiving counseling only if she was observed to have received it and she also reported having received it in the exit interview. A dichotomous indicator of any IFA counseling was created, as to whether the client received counseling on either of the two aspects. We calculated the proportion of clients in each facility counseled about IFA and used it as the facility-level indicator on IFA counseling. The facility-level indicators on IFA supplement availability, prescription, and counseling were then aggregated to the DHS cluster level, as described below.

Among the facilities linked to a cluster (i.e. facilities within the specified buffer), we counted the number of facilities with IFA supplements available. Using the terciles of the total number of facilities with IFA

supplements, we categorized clusters into groups with three levels of availability—low, medium, and high. The categorization was separate for urban and rural areas.

The IFA supplement prescription indicator at the cluster level was categorized differently for the two countries. For Malawi, because of the skewed distribution of the percentage of clients in linked facilities who received IFA supplements or a prescription, clusters were classified into two groups: low level of prescription if not all clients were given or prescribed IFA supplements; and high level of prescription if all clients were given or prescribed IFA supplements. For Haiti, the distribution of the percentage of clients in linked facilities who received IFA supplements was less skewed, so clusters were grouped into three levels of prescription according to the terciles of the percentage of clients who were given IFA supplements: low, medium, and high. Some clusters did not have data for this indicator due to linking to facilities without ANC observations. These clusters were categorized into a separate group.

The cluster-level indicator on IFA counseling was measured with the average percentage of clients who were counseled among the linked facilities. For both Haiti and Malawi, the clusters were then categorized into three groups based on the percentages of clients who were counseled: low, medium, and high. As with the IFA supplement prescription indicator, clusters linked to only facilities without ANC observation data were in a separate category of the IFA counseling indicator.

Statistical Analysis

Separate analysis was conducted for urban and rural areas. Multilevel (individual-level and cluster-level) random-intercept logistic regression models were fitted to examine how the IFA service indicators (measured at the cluster level) were associated with women's adherence to IFA supplementation (measured at the individual level). Multilevel models accounted for the clustering effect, since individuals living in the same clusters might have similar characteristics. The models controlled for other factors that might be associated with IFA supplement consumption. These included women's education, parity, employment status, household wealth status, region, exposure to mass media, and number of ANC visits during pregnancy, as well as the timing of the first ANC visit. The IFA supplement prescription indicator and the IFA counseling indicator were highly correlated in Malawi but not in Haiti. Therefore, for Malawi we fit two separate models including each indicator, together with the IFA supplement availability indicator and other covariates.

Results

Sample descriptions

The majority of health facilities in Haiti (827 out of 905) and Malawi (632 out of 977) provide ANC services. Appendix Table 1 shows the percent distribution of ANC facilities by selected facility background characteristics. Our study focused on women with a live birth in the two years preceding the survey and who had at least one ANC visit during pregnancy. Appendix Table 2 shows background characteristics of women and their antenatal care attendance. In Haiti, attending four or more ANC visits

was common among women, at 64% in rural areas and 85% in urban areas, while 54% of rural women and 70% of urban women attended their first ANC visit during the first trimester. In Malawi, a lower proportion attended the recommended number of ANC visits than in Haiti. About half of rural women (48%) and 59% of urban women attended four or more ANC visits, while only 23% and 26%, respectively, had their first visit during the first trimester.

The IFA-related Service Environment in Health Facilities

Figure 1 and Figure 2 present the availability of IFA supplements, prescription of IFA supplements, and counseling on IFA in health facilities. In Malawi, almost all ANC facilities, whether rural or urban, had IFA supplements available on the day of the survey, over 80% of the clients were prescribed IFA supplements, and 60% of ANC clients in urban areas and 58% of clients in rural areas received any counseling on IFA. In Haiti, 67% of rural ANC facilities and 75% of urban facilities had IFA supplements, 62% and 72% of clients in urban and rural areas were prescribed IFA supplements, and less than a third of clients received any counseling on IFA. In both countries, counseling on side effects was much less common than counseling on how to use IFA supplements.

When linking each DHS cluster to ANC facilities within the specific buffer from the cluster (10 km for rural areas and 5 km for urban areas), in Malawi the number of linked facilities ranged from 0-17 facilities in rural and from 0-19 facilities in urban, with the median at just 2 and 6 facilities respectively. The ranges were similar in Haiti (Appendix Table 3).

Women's IFA Adherence

Overall, 42% of women in Haiti and 35% of women in Malawi with a birth in the two years preceding the survey took IFA supplements for at least 90 days. In both countries a higher proportion of women in urban areas (58% in Haiti and 44% in Malawi) adhered to the IFA supplementation compared with women in rural areas (40% in Haiti and 32% in Malawi).

Figure 3 indicates the variations in women's adherence to IFA supplementation according to various levels of IFA supplement availability, prescription, and counseling at nearby health facilities. In rural areas of both Haiti and Malawi, women's adherence is significantly associated with the availability of ANC facilities with IFA. There were no significant associations in urban areas of either Haiti or Malawi. The bivariate association between women's adherence and IFA supplement prescription in health facilities are not significant in both countries for neither urban nor rural areas. IFA supplement adherence is positively associated with IFA counseling in rural Malawi, but the associations are not significant in urban areas of Malawi or in both rural and urban areas of Haiti.

Results of Multivariable Analysis

For Haiti, one model was fitted separately for urban and rural areas including all three IFA-related service indicators and other potential confounders (Table 1). In rural areas of Haiti, there was a significant association between women's adherence to IFA supplementation and the number of health facilities offering ANC with IFA supplements available within the buffer distance after adjusting for individual and household background characteristics, number of ANC visits and the timing of the first visit. Compared with women in DHS clusters with low availability of facilities with IFA supplements, women in clusters with medium-level availability of facilities with IFA supplements had 1.7 times higher odds of taking IFA supplements for at least 90 days (95% CI, 1.14 - 2.68), and women in clusters with high availability had 2.3 times higher odds (95% CI: 1.16 - 4.54). No significant association was found for the IFA supplement prescription and IFA counseling indicators in the rural model. In urban areas of Haiti, IFA supplement prescription was found to be negatively associated with adherence to IFA supplementation. Women in clusters with a high level of facilities providing IFA supplement prescription had 66% lower odds of taking IFA supplementation for 90 days compared with those in clusters with a low level of prescription (95% CI: 0.15-0.74). However, the association of adherence with availability of IFA supplements and counseling on IFA was not significant in urban areas. As expected, the number of ANC visits was positively and significantly associated with IFA supplement adherence in both rural and urban areas. No significant association was found for other covariates.

Table 1
Results of multivariable logistic regressions of IFA supplement consumption for at least 90 days, Haiti

	Rural		Urban	
Variables	AOR	95% CI	AOR	95% CI
Availability of ANC facilities with IFA supplements				
Low	1.00		1.00	
Medium	1.75*	1.14 - 2.69	0.94	0.43 - 2.08
High	2.30*	1.16 - 4.57	0.55	0.23 - 1.33
IFA supplement prescription				
Low	1.00		1.00	
Medium	1.36	0.83 - 2.24	0.66	0.32 - 1.38
High	0.85	0.48 - 1.49	0.34**	0.15 - 0.74
IFA counseling				
Low	1.00		1.00	
Medium	0.80	0.45 - 1.41	1.32	0.65 - 2.66
High	0.90	0.54 - 1.52	1.38	0.67 - 2.84
Parity				
1	1.00		1.00	
2-3	0.98	0.58 - 1.66	1.29	0.76 - 2.18
4-5	1.28	0.80 - 2.04	1.15	0.47 - 2.83
6+	0.70	0.42 - 1.19	0.79	0.22 - 2.86
Education				
None	1.00		1.00	
Primary	0.84	0.56 - 1.25	0.98	0.33 - 2.91
Secondary or higher	0.98	0.61 - 1.59	1.46	0.45 - 4.70
Employment				

Unemployed	1.00		1.00	
Employed	1.43*	1.04 - 1.97	0.64	0.37 - 1.11
Household wealth status				
Poor	1.00		1.00	
Middle	1.05	0.69 - 1.60	1.90	0.87 - 4.14
Rich	1.11	0.63 - 1.94	2.00	0.86 - 4.67
Frequent exposure to mass media				
No	1.00		1.00	
Yes	1.12	0.83 - 1.52	0.65	0.34 - 1.24
Had 4 or more ANC visits				
No	1.00		1.00	
Yes	4.92***	3.44 - 7.04	5.44***	2.51 - 11.80
First ANC in first trimester				
No	1.00		1.00	
Yes	1.35	0.98 - 1.87	1.09	0.66 - 1.81
Region				
Aire Metropolitaine/Reste-Ouest	1.00		1.00	
Sud-Est	0.82	0.36 - 1.88	0.23	0.04 - 1.30
Nord	1.29	0.52 - 3.19	0.58	0.19 - 1.76
Nord-Est	1.33	0.47 - 3.78	0.72	0.19 - 2.83
Artibonite	1.07	0.49 - 2.32	1.20	0.31 - 4.65
Centre	1.40	0.65 - 2.99	0.55	0.14 - 2.17
Sud	1.34	0.53 - 3.40	0.28	0.04 - 1.87
Grand-Anse	1.23	0.47 - 3.23	1.13	0.21 - 5.98
Nord-Ouest	1.08	0.48 - 2.42	0.71	0.19 - 2.69

Nippes	1.09	0.45 - 2.65	8.38	0.36 - 195.09
Number of clusters	285		93	
Number of women	1343		389	
AOR= adjusted odds ratio; CI= Confidence interval				
***p<0.001, **p<0.01, *p<0.05				

For Malawi, due to the high correlation between the IFA supplement prescription and IFA counseling indicators, two models were fitted for each category of residence (Table 2). Model I included the indicators on IFA supplement availability and IFA supplement prescription as well as other covariates. Model II replaced the IFA supplement prescription variable with the IFA counseling variable while other variables in Model I remained. In both models for rural areas, the availability of IFA supplements was significantly associated with IFA supplement adherence. Women in DHS clusters with high availability of facilities with IFA supplements were more likely to adhere to IFA supplementation for 90 days compared with women in clusters with low availability after controlling for the other two IFA-related service variables. IFA counseling was also positively associated with women's adherence to IFA supplementation in rural areas (Model II). Compared to women in clusters with a low level of counseling, those in clusters with a high level of counseling had 44% higher odds of taking IFA supplements for at least 90 days (95% CI: 1.14 - 1.83). Region, woman's educational attainment, having four or more ANC visits, and early initiation of ANC were also associated with adherence, but the significance varied by place of residence. In urban areas of Malawi, we did not find any of the three IFA-related service variables to be associated with women's adherence to IFA supplementation.

Table 2

Results of multivariable logistic regressions of IFA supplement consumption for at least 90 days, Malawi

	Rural				Urban			
	Model I		Model II		Model I		Model II	
Variables	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Availability of ANC facilities with IFA supplements								
Low	1.00		1.00					
Medium	1.15	0.90 - 1.48	1.11	0.86 - 1.44	1.74	0.97 - 3.13	1.62	0.89 - 2.93
High	1.51**	1.16 - 1.96	1.46**	1.11 - 1.92	1.29	0.74 - 2.26	1.64	0.93 - 2.87
IFA supplement prescription								
Low	1.00							
High	1.08	0.87 - 1.33			1.56	0.85 - 2.86		
IFA counseling								
Low			1.00					
Medium			1.32	0.98 - 1.76			0.84	0.48 - 1.46
High			1.44**	1.14 - 1.83			1.52	0.85 - 2.71
Parity								
1								
2-3	0.86	0.71 - 1.03	0.85	0.71 - 1.02	0.73	0.48 - 1.10	0.74	0.49 - 1.12
4-5	0.84	0.68 - 1.03	0.83	0.67 - 1.03	0.91	0.55 - 1.51	0.89	0.53 - 1.48
6+	0.80	0.60 -	0.80	0.60 -	1.11	0.47 - 2.63	1.04	0.43 -

		1.07		1.06				2.54
Education								
None								
Primary	1.17	0.91 - 1.52	1.15	0.89 - 1.49	2.02	0.63 - 6.42	1.98	0.63 - 6.23
Secondary or higher	1.57**	1.14 - 2.15	1.53**	1.12 - 2.10	2.02	0.62 - 6.54	1.95	0.63 - 6.08
Employment								
Unemployed								
Employed	1.06	0.90 - 1.23	1.05	0.90 - 1.23	0.86	0.56 - 1.33	0.86	0.56 - 1.34
Household wealth status								
Poor								
Middle	1.09	0.89 - 1.34	1.09	0.89 - 1.33	0.40	0.15 - 1.10	0.38	0.13 - 1.10
Rich	1.14	0.94 - 1.39	1.13	0.93 - 1.38	0.66	0.30 - 1.49	0.68	0.31 - 1.54
Region								
Northern								
Central	0.95	0.73 - 1.24	0.96	0.74 - 1.24	1.77	0.90 - 3.47	1.42	0.71 - 2.82
Southern	0.76*	0.59 - 0.98	0.77*	0.60 - 0.98	0.93	0.51 - 1.71	0.81	0.42 - 1.56
Frequent exposure to mass media								
No								
Yes	1.09	0.92 - 1.29	1.09	0.92 - 1.29	0.94	0.61 - 1.46	0.92	0.59 - 1.42
Had 4 or more ANC visits								

No								
Yes	2.02***	1.71 - 2.38	2.01***	1.70 - 2.38	1.95***	1.34 - 2.82	1.94***	1.33 - 2.82
First ANC in first trimester								
No								
Yes	1.14	0.96 - 1.36	1.14	0.96 - 1.36	1.44	0.97 - 2.15	1.54*	1.02 - 2.33
Number of clusters	676				172			
Number of women	5668				900			
AOR= Adjusted odds ratio; CI=Confidence interval								
***p<0.001, **p<0.01, *p<0.05								

Discussion

IFA supplementation during pregnancy is an important intervention for reducing maternal and infant mortality. In both Haiti and Malawi adherence to IFA (taking supplements for at least 90 days) during pregnancy was low, especially among rural women, and in rural areas it was significantly associated with access to health facilities offering ANC with IFA supplements available. Our findings support studies of programs in low- and middle-income countries showing that limited access to IFA supplements is a barrier to adherence (14, 23).

In our study, IFA supplements were commonly available in formal-sector ANC facilities in both countries, and especially Malawi, where over 90% of facilities reported availability of IFA supplementation. This may reflect the government of Malawi's efforts in increasing supply and providing free IFA supplementation to pregnant women (22, 29).

While high levels of IFA supplement availability at health facilities are encouraging, they do not necessarily imply high levels of access, because women have to reach facilities first. Factors such as geographic distance to health facilities could affect women's access to ANC services and therefore affect access to IFA supplementation. Our analysis found that 32% of rural women in Malawi lived in an area without a health facility or only one facility offering IFA supplements within 10 km, which would make it difficult for many women to access IFA supplements. Museka-Saidi and colleagues (22) also found that long distance to health facilities is one of the key barriers to IFA supplement access for women in remote rural areas in Malawi. In Haiti's mountainous rural areas, physical access to services is a strong determinant of use of health care (30, 31). Although most health facilities in Haiti and Malawi had IFA

supplements in stock on the day of the survey, SPA surveys do not provide information about stocking levels or the duration and frequency of stock-outs. Studies have reported supply outages in health facilities due to various reasons and that women who came for ANC services were not able to receive IFA supplementation as a result (22, 32).

Another important factor that determines women's access to IFA supplementation is regular use of ANC services in health facilities, especially early initiation of ANC and completing at least eight visits. We did not find that IFA supplement compliance was associated with the early start of ANC except in one urban model of Malawi, possibly because we looked at 90 days of IFA supplementation rather than 180 days. In contrast, attending four or more ANC visits was consistently associated with IFA supplement adherence for 90 days. This aligns with findings from an analysis of low- and middle-income countries that the number of IFA supplements consumed increased with the number of ANC visits (23). Despite the increasing trends in attending four or more ANC visits in both countries, the current level is still low, especially in rural Malawi. Continued efforts are required to improve ANC attendance, which in turn could improve access to IFA supplementation.

Once a woman reaches a health facility with IFA supplements in stock, the provider's behavior could also affect her receipt of IFA supplements, such as prescribing IFA supplementation. In both Haiti and Malawi, the majority of women were prescribed or provided IFA supplements. Possible reasons for not giving women IFA supplements could be poor provider training, lack of knowledge of inventory, and selective prescription based on pregnancy trimester (14, 23, 33). It is also possible that a woman might not be given IFA supplements because she had already received them during previous ANC visits or from other sources. We did not find a significant association between IFA supplement prescription and adherence, except in urban areas in Haiti. Interestingly, in urban areas of Haiti our regression results showed that IFA supplement prescription was inversely associated with adherence. This could be because urban women are able to access IFA supplements outside of the formal health facilities that are included in SPA surveys—for example at pharmacies. Alternatively, it could be that urban women might have a greater range of options for ANC services and therefore be able to bypass nearby facilities to reach a preferred facility further away (30).

Another important provider behavior is the level and quality of IFA counseling offered at facilities. In both countries, counseling on IFA was infrequent, especially counseling on side effects. Fear of side effects of supplements and cultural misconceptions about IFA supplements could be important barriers to compliance (22, 34). Counseling around these topics provides an avenue to dispel myths and address concerns. Our findings that IFA supplement compliance is significantly associated with IFA counseling in rural Malawi support studies that have identified barriers to IFA adherence such as a lack of awareness among pregnant women of the need to take IFA supplements, how to take them correctly, and common side effects of IFA (14, 23). Strengthening IFA counseling during ANC visits on potential side effects and what to do when side effects occur is likely to improve IFA supplement adherence. We found that a large number of health facilities that report routinely providing counseling may not actually be providing it; in Malawi 57% of facilities reported that they routinely provide counseling services on IFA, but observation

data showed that about 20% of facilities did not provide counseling to any of the ANC clients observed (data not shown). Further, facilities may have an insufficient number of staff able to provide the mandated services. In both countries, among providers of ANC services, less than 40% had received training on ANC counseling, and possibly even fewer were trained specifically on IFA counseling. Improvement in relevant training on IFA supplementation for providers could improve the counseling services offered to women and therefore could increase compliance.

While health facilities have played and will continue play an important role in increasing IFA supplementation uptake among pregnant women, other distribution platforms also play a role. Community-based IFA distribution is another viable channel for the distribution of IFA supplements, especially in remote areas with limited access to health facilities or with low levels of use of health facilities for ANC services (35, 36). Advantages of community-based programs include improving IFA supplement access by increasing knowledge and awareness, providing consistent supplies, and encouraging the use of ANC services (35, 37). Through regular contacts with families, community health workers are more likely to reach women in the first trimester of pregnancy and to encourage them to start IFA supplementation early. Further, countries with a component of community-based approaches have made greater progress in IFA supplementation coverage (23). However, community-based distribution programs also have constraints, including limited abilities of community health workers in supply forecasting, monitoring, and storage, as well as inadequate staff training.

Overall, our linkage method has the advantages of addressing issues related to displacement of DHS cluster's GPS location and client's potential bypass of the nearest facility, as discussed in another study (38). Our study examined the components of quality of care separately to explore their relative contributions to IFA supplement adherence among pregnant women. Countries could use this information to help their health systems improve programs. In both Haiti and Malawi, for example, revising the content of provider training and hosting refresher courses could improve counseling on IFA supplementation. Further, the results provide insight on disparities between rural and urban health facilities, which could help programs to allocate resources appropriately.

There are a few limitations to this study. The SPA surveys focus on formal-sector health facilities; independent pharmacies, drug stores, and physician's offices, as well as community-based distribution, could be alternative sources of IFA supplements for some women but they are not captured in SPA surveys. The omission of these sources could affect our results, particularly in urban areas where individuals may have greater access to sources other than health facilities for IFA supplements. This could be in part the reason for the lack of association shown between IFA supplement adherence and the services provided in health facilities in urban areas. In the SPA surveys, not all ANC facilities had clients observed. Small clinics or dispensaries that do not offer ANC services every day are more likely to be missing in data for client observations. The quality of care provided to women in these facilities may differ from those in the facilities observed. The temporal gap between the IFA supplement adherence measure and the IFA service variables is another limitation. For example, in Haiti, IFA supplement consumption was measured for the most recent birth in the two years before the 2016-17 DHS while the

IFA service variables were measured at the time of the 2013 SPA survey. The results would be affected if the IFA service environment changed over time. Finally, the IFA supplement consumption data collected through interviewing women are also subject to recall bias.

Conclusions

In this study we linked household surveys and facility surveys and identified important gaps in IFA supplementation programming among health facilities in Malawi and Haiti and their impact on IFA supplement adherence among pregnant women. Although the prevalence of IFA supplementation was low, for rural women the likelihood of compliance increased with greater access to health facilities offering ANC with IFA supplements available. In settings with lower levels of use of the ANC services that health facilities provide, as in rural Malawi, continued efforts are required to identify and address the barriers to use of services, both on the demand and supply sides. In settings with high levels of regular use of ANC services, as in Haiti, efforts are needed to improve the quality of care in health facilities, particularly for provider counseling. As a complement to existing facility-based programs, community-based programs could provide an opportunity to improve quality of care and to increase coverage of IFA supplementation during pregnancy.

Abbreviations

ANC: Antenatal care; AOR: Adjusted odds ratio; CI: Confidence interval; DHS: Demographic and Health Survey; GPS: Global positioning system; IFA: Iron-folic acid; SPA: Service Provision Assessment

Declarations

Acknowledgements

We thank Erin Milner and Jeniece Alvey for their review of an earlier draft of the paper.

Authors contribution

WW, RB, and LM designed the study; WW and RB performed the analysis and drafted the paper; WW, RB, and LM revised the paper. All authors reviewed and approved the final version of the paper.

Funding

This study was supported by the United States Agency for International Development (USAID) through The Demographic and Health Surveys (DHS) Program. Funding for the submission as made possible through The Bill and Melinda Gates Foundation.

Ethics approval and consent to participate

Both DHS and SPA data used in this study are publicly accessible on the DHS Program website: www.dhsprogram.com. The Institutional Review Board of ICF and the Ethics Review Committees of Malawi and Haiti reviewed and approved the respective DHS and SPA surveys. The purpose of the surveys was explained to the survey participants and informed written consent was obtained from all women included in this study. The collected data were kept confidential in compliance to established Human Subject Protection guidelines.

Availability of data and materials

The DHS and SPA datasets used in the current study are publicly available on the DHS Program website: www.dhsprogram.com

Competing interest

The authors declare that they have no competing interests.

Consent for publication

Not applicable

References

1. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. *The Lancet Global Health*. 2013;1(1):e16-e25.
2. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. *The Lancet*. 2011;378(9809):2123-35.
3. Daru J, Zamora J, Fernández-Félix BM, Vogel J, Oladapo OT, Morisaki N, et al. Risk of maternal mortality in women with severe anaemia during pregnancy and post partum: a multilevel analysis. *The Lancet Global Health*. 2018;6(5):e548-e54.
4. Rahman MM, Abe SK, Rahman MS, Kanda M, Narita S, Bilano V, et al. Maternal anemia and risk of adverse birth and health outcomes in low- and middle-income countries: systematic review and meta-analysis. *Am J Clin Nutr*. 2016;103(2):495-504.
5. WHO. Guideline: Daily iron supplementation in adult women and adolescent girls. Geneva: World Health Organization; 2016.

6. Development Initiatives. 2018 Global Nutrition Report: Shining a light to spur action on nutrition. Bristol, UK: Development Initiatives; 2018.
7. Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N, Lozano R, et al. A systematic analysis of global anemia burden from 1990 to 2010. *Blood*. 2014;123(5):615-24.
8. WHO. Worldwide prevalence of anaemia 1993–2005: WHO global database on anaemia Geneva: World Health Organization; 2008.
9. Bothwell TH. Iron requirements in pregnancy and strategies to meet them. *Am J Clin Nutr*. 2000;72(1 Suppl):257S-64S.
10. WHO. WHO recommendations on antenatal care for a positive pregnancy experience. 2016.
11. Garcia-Casal MN, Estevez D, De-Regil LM. Multiple micronutrient supplements in pregnancy: Implementation considerations for integration as part of quality services in routine antenatal care. Objectives, results, and conclusions of the meeting. *Matern Child Nutr*. 2018;14 Suppl 5:e12704.
12. Sanghvi TG, Harvey PWJ, Wainwright E. Maternal iron–folic acid supplementation programs: Evidence of impact and implementation. *Food Nutr Bull*. 2010;31(2).
13. Leslie HH, Malata A, Ndiaye Y, Kruk ME. Effective coverage of primary care services in eight high-mortality countries. *BMJ Global Health*. 2017;2(3).
14. Siekmans K, Roche M, Kung'u JK, Desrochers RE, De-Regil LM. Barriers and enablers for iron folic acid (IFA) supplementation in pregnant women. *Matern Child Nutr*. 2018;14 Suppl 5:e12532.
15. Republic of Haiti. Plan Stratégique National de Nutrition 2013-2018. Port-au-Prince, Haiti: Ministry of Public Health and Population; 2013.
16. Ayoya MA, Heidkamp R, Ngnie-Teta I, Mamadoultaiou A, Daniel EF, Durandisse EB, et al. Precipitous nutrition of children and women in Haiti: analyses of data from 1995 to 2012. *Ann N Y Acad Sci*. 2014;1309:37-62.
17. Durham J, Michael M, Hill PS, Paviagnani E. Haiti and the health marketplace: the role of the private, informal market in filling the gaps left by the state. *BMC Health Serv Res*. 2015;15:424.
18. Phillips E, Stoltzfus RJ, Michaud L, Pierre GLF, Vermeylen F, Pelletier D. Do mobile clinics provide high-quality antenatal care? A comparison of care delivery, knowledge outcomes and perception of quality of care between fixed and mobile clinics in central Haiti. *BMC Pregnancy Childbirth*. 2017;17(1):361.
19. Institut Haïtien de l'Enfance - IHE/Haiti, ICF. Haiti Enquête Mortalité, Morbidité et Utilisation des Services 2016-2017 - EMMUS-VI. Pétiön-Ville/Haïti: IHE/Haiti, ICF; 2018.
20. National Statistical Office/Malawi, ICF. Malawi Demographic and Health Survey 2015-16. Zomba, Malawi; 2017.
21. Government of Malawi. Malawi National Multi-Sector Nutrition Policy 2018-2022. Blantyre Malawi: Department of Nutrition, HIV and AIDS; 2018.
22. Museka-Saidi TM, Mlambo TT, Aburto N, Keith RS. Strengthen iron folate supplementation of pregnant women in Ntchisi District, Malawi. *World Nutrition*. 2018;9(3):254-60.

23. Sununtnasuk C, D'Agostino A, Fiedler JL. Iron+folic acid distribution and consumption through antenatal care: identifying barriers across countries. *Public Health Nutr.* 2016;19(4):732-42.
24. Burgert CR, Prosnitz D. Linking DHS household and SPA facility surveys: Data considerations and geospatial methods. Rockville, Maryland, USA: ICF International; 2014.
25. Burgert CR, Colston J, Roy T, Zachary B. Geographic displacement procedure and georeferenced data release policy for the Demographic and Health Surveys. Calverton, Maryland, USA: ICF International; 2013.
26. Institut Haïtien de l'Enfance - IHE, ICF International. Haïti Évaluation de la Prestation des Services de Soins de Santé 2013. Rockville, Maryland, USA: IHE and ICF International; 2014.
27. Ministry of Health - MoH/Malawi, ICF International. Malawi Service Provision Assessment 2013-14. Lilongwe, Malawi: MoH/Malawi and ICF International; 2014.
28. Assaf S, Wang W, Mallick L. Provider counseling and knowledge transfer in health facilities of Haiti, Malawi, and Senegal. Rockville, Maryland, USA: ICF International; 2016.
29. Government of Malawi. National Nutrition Policy and Strategic Plan. Blantyre, Malawi: Department of Nutrition, HIV and AIDS; 2009.
30. Gage AD, Leslie HH, Bitton A, Jerome JG, Joseph JP, Thermidor R, et al. Does quality influence utilization of primary health care? Evidence from Haiti. *Globalization and Health.* 2018;14(1):59.
31. Peragallo Urrutia R, Merisier D, Small M, Urrutia E, Tinfo N, Walmer DK. Unmet health needs identified by Haitian women as priorities for attention: a qualitative study. *Reprod Health Matters.* 2012;20(39):93-103.
32. Young S, Ali SM, Beckham S. The Potential Role of Private Pharmacies in Maternal Iron Supplementation in Rural Tanzania. *Food and Nutrition Bulletin.* 2009;30(1):16-23.
33. Mallick L, Temsah G, Benedict RK. Facility-based nutrition readiness and delivery of maternal and child nutrition services using service provision assessment surveys. Rockville, Maryland, USA: ICF; 2018.
34. Maina-Gathigi L, Omolo J, Wanzala P, Lindan C, Makokha A. Utilization of Folic Acid and Iron Supplementation Services by Pregnant Women Attending an Antenatal Clinic at a Regional Referral Hospital in Kenya. *Maternal and Child Health Journal.* 2013;17(7):1236-42.
35. bKavle JA, Landry M. Community-based distribution of iron-folic acid supplementation in low- and middle-income countries: a review of evidence and programme implications. *Public Health Nutr.* 2018;21(2):346-54.
36. Pokharel R, Maharjan M, Mathema P. Success in Delivering Interventions to Reduce Maternal Anemia in Nepal: A Case Study of the Intensification of Maternal and Neonatal Micronutrient Program. Washington DC: A2Z Project: USAID; 2011.
37. Perry H, Zulliger R. How effective are community health workers. An overview of current evidence with recommendations for strengthening community health worker programs to accelerate progress

in achieving the health-related Millennium Development Goals. Baltimore: Johns Hopkins Bloomberg School of Public Health; 2012.

38. Wang W, Winner M, Burgert-Brucker CR. Limited Service Availability, Readiness, and Use of Facility-Based Delivery Care in Haiti: A Study Linking Health Facility Data and Population Data. Glob Health Sci Pract. 2017;5(2):244-60.

Figures

Haiti

Figure 1

Percentage of ANC facilities that have IFA supplements available, percentage of clients that received IFA supplements, and percentage counseled about IFA in Haiti, by residence

Malawi

Figure 2

Percentage of ANC facilities that have IFA supplements available, percentage of clients that received IFA supplements, and percentage counseled about IFA in Malawi, by residence

Figure 3

Women's adherence to the IFA supplementation by levels of IFA availability, prescription, and counseling at nearby facilities

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [AppendixTables.docx](#)