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The Role of Health Facilities in Supporting Adherence to Iron-Folic Acid Supplementation during Pregnancy: A Case Study using DHS and SPA Data in Haiti and Malawi

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A Case Study using DHS and SPA Data in Haiti and Malawi

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ABSTRACT

Background: Maternal anemia is a major public health problem in many low- and middle-income countries. To prevent anemia and improve neonatal health, daily consumption of iron and folic acid (IFA) supplements during pregnancy is recommended as part of routine antenatal care (ANC) services. In Malawi and Haiti, however, consumption of IFA supplements during pregnancy remains suboptimal. To inform policy and program implementation, this study examined the IFA-related services provided in health facilities and their association with women's adherence to IFA supplementation during pregnancy.

Methods: The study used data from the 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. The DHS surveys collected GPS data for enumeration areas (clusters), while the SPA surveys collected GPS data for health facilities. For the analysis, 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 supplements to clients, and client counseling on IFA. Facility-level variables were aggregated to the DHS cluster level to measure the IFA-related service environment for women who received ANC services for their most recent live birth in the 2 years preceding the 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 individual-level factors that might be associated with IFA supplement consumption.

Results: More than two-thirds of ANC facilities 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 were observed to receive IFA supplements or a prescription for IFA supplements. Counseling on IFA was less common and focused on how to take IFA supplements. Few women in either country received counseling on the side effects of IFA supplements. Overall, only 42% of women in Haiti and 35% of women in Malawi took IFA supplements for at least 90 days. In both countries, the proportion was higher among urban than rural women. 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 supplements. In Haiti, for example, compared with women living in clusters with low-level availability of facilities offering IFA supplements, women in clusters with medium-level availability had 1.7 times higher odds of IFA compliance, and women in clusters with high-level availability had 2.3 times higher odds of compliance. 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: IFA supplement consumption for 90 days or more was low in both countries. Rural women with greater access to health facilities offering ANC with IFA supplements available had a greater likelihood of IFA compliance. Continued efforts are required to address access to IFA supplements through increasing both the use of ANC services and their quality, particularly in provider counseling. As a complement to existing facility-based programs, community-based IFA distribution may provide an opportunity to improve quality of care and to increase IFA supplementation coverage.

Key words: Iron and folic acid (IFA) supplementation, facility-based ANC services, IFA supplement availability, IFA supplement access, IFA counseling, women's IFA supplement adherence, anemia

1 INTRODUCTION

Maternal anemia is estimated to affect 32 million pregnant women globally (Stevens et al. 2013). During pregnancy, women experience increased physiological demands for iron to support fetal development (Bothwell 2000) and, in many settings, iron deficiency is the major contributor to anemia (Kassebaum et al. 2014; WHO 2008). Women in low- and middle-income countries are most affected, with the highest burdens in South Asia and sub-Saharan Africa (Balarajan et al. 2011; Stevens et al. 2013). The consequences of anemia during pregnancy affect both mother and child and include increased risk of preterm birth, low birthweight, and maternal and infant deaths (Daru et al. 2018; Rahman et al. 2016; WHO 2016).

World Health Organization (WHO) guidelines recommend daily iron and folic acid IFA supplementation for pregnant women as part of routine antenatal care (ANC) services to prevent anemia and improve neonatal health (WHO 2016). Studies of national IFA supplementation programs for pregnant women report that facility-based ANC is a common delivery channel for IFA supplementation (Garcia-Casal, Estevez, and De-Regil 2018; Sanghvi, Harvey, and Wainwright 2010). In many countries, however, IFA supplementation is hindered by physical, sociocultural, and economic barriers to ANC and by poor-quality services (Garcia-Casal, Estevez, and De-Regil 2018; Leslie et al. 2017; Siekmans et al. 2018). A few countries have explored community-based IFA supplementation, and although the approach is promising, there are still challenges with its implementation (Garcia-Casal, Estevez, and De-Regil 2018; Kavle and Landry 2018; Lassi and Bhutta 2015).

In Haiti, government policies to address anemia support IFA supplementation as part of routine health services (Republic of Haiti 2013). A mix of public and private health facilities and community agents provide ANC (Ayoya et al. 2014; Durham et al. 2015; Phillips et al. 2017). While coverage of ANC is relatively high in Haiti, maternal anemia remains a serious public health problem, affecting 52% of pregnant women. In the 2017 Haiti Demographic and Health Survey (DHS) survey only 43% of women reported having consumed IFA supplements for at least 90 days during their last pregnancy (Institut Haïtien de l'Enfance - IHE/Haiti and ICF 2018). Similarly, in Malawi, the prevalence of anemia is high, affecting 45% of pregnant women, while only a third of women surveyed in the 2015-16 Malawi DHS reported consumption of IFA supplements during pregnancy (National Statistical Office/Malawi and ICF 2017). Facility and community ANC services are common throughout Malawi, but facility ANC is the primary delivery platform for IFA supplementation (Museka-Saidi et al. 2018). The government provides free ANC and IFA supplements for pregnant women in an effort to address maternal anemia (Government of Malawi 2009; Museka-Saidi et al. 2018).

Research has focused on several factors related to demand and supply that affect IFA supplementation, including studies using data collected from health facilities (Museka-Saidi et al. 2018; Sununtnasuk, D'Agostino, and Fiedler 2016). However, only limited research has directly linked the supply side—services offered at health facilities—to IFA supplement adherence, as measured among the population in need. Our study links data from nationally representative DHS surveys with data from SPA surveys of health facilities 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 this analysis because in both countries the SPA survey of health facilities was a census of all such facilities in the country, which permits linking health facilities to households at the DHS cluster level (Burgert and Prosnitz 2014).

2 DATA AND METHODS

2.1 Data

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. Data from the 2016-17 Haiti DHS and the 2015-16 Malawi DHS provide information on the adherence to IFA supplementation among pregnant women, as well as on their sociodemographic characteristics and other care-seeking behaviors that may be associated with consumption of IFA supplementation. The 2013 Haiti SPA and the 2013-14 Malawi SPA provide information on IFA-related services at health facilities in the countries, specifically IFA supplement availability, IFA supplement prescription, and counseling about IFA.

2.1.1 DHS surveys

The 2016-17 Haiti DHS and the 2015-16 Malawi DHS are population-based household surveys that provide data on key population and health indicators. Both surveys applied a two-stage cluster sampling design to draw a sample that is representative of the country, for urban and rural areas separately, and for each of the country's geographic regions (Haiti) or districts (Malawi). 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 interviewed in each of the selected clusters. All women age 15-49 in selected households were interviewed with individual questionnaires. 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 successfully 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.

Since our analysis focused on the role of health facilities in women's adherence to IFA supplementation, we restricted the analysis to women who received ANC for their most recent live birth in the 2 years preceding the survey. The choice of 2 years was to better synchronize the timing of the SPA and DHS in each country. 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 (Burgert et al. 2013). 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. The displaced coordinates were released to the public and were used in this analysis.

2.1.2 SPA surveys

The 2013 Haiti SPA and the 2013-14 Malawi SPA are censuses covering all the formal health facilities of the country. The SPA surveys provide data on the availability and readiness of key health services for all

types of formal health facilities in both public and private sectors. They also collected data on the quality of care, such as counseling offered to the clients and physical examinations, through observing service delivery. The SPA surveys collected data on health facilities, health providers, and clients using four types of instruments: the facility inventory questionnaire; health provider interview; consultation observation checklist; and client exit interview. Health providers were randomly selected based on a listing of providers present on the day of the survey, across all provider categories and services. Wherever possible, priority was given to those providers whose consultations were observed or who were interviewed for the facility inventory questionnaire. Consultation observations were conducted only for family planning, ANC, and sick child care. Clients for consultation observations were selected based on the expected number of clients available on the day of the survey. A maximum of 15 consultations were selected for each service. Priority was given to first-visit clients. All observed clients were approached for the exit interview. More information on the survey design and questionnaires can be found in the SPA final reports (Institut Haïtien de l'Enfance - IHE and ICF International 2014; Ministry of Health - MoH/Malawi and ICF International 2014).

The data on health facilities for this analysis came from those 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 2,068 clients were observed. In Malawi, among 632 facilities reported to provide ANC services, ANC observation was conducted in 412 facilities for 2,068 clients. The SPA surveys also collected geolocations of all health facilities interviewed. GPS data on health facilities were publicly released without geographical displacement.

2.1.3 Linking DHS and SPA data

For each country, we linked ANC facilities to DHS clusters 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). More detail about this linkage method is discussed in previous studies (Burgert and Prosnitz 2014). After identifying the facilities within the buffer distance, we summarized data of the linked facilities for each cluster as the cluster-level measurement of the service environment.

2.2 Measurement

The outcome variable—women's adherence to IFA supplementation during pregnancy—was measured with a dichotomous variable that indicates whether or not a woman took IFA supplements for at least 90 days during the pregnancy for her last birth in the 2 years preceding the survey. It should be noted that despite the WHO recommendation of at least 180 supplements starting in the first trimester of pregnancy, many countries still aim for women to receive 90 or more supplements during pregnancy (Sununtnasuk, D'Agostino, and Fiedler 2016). The key predictors are the three IFA-related service environment indicators measured: 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 it had IFA supplements within the expiration date observed in service areas of the facility. For facilities, IFA supplement prescription and IFA counseling were measured using data both from observation of provider-client consultations and from client exit interviews. For prescription, during observation of the ANC consultation the interviewer noted whether the provider prescribed or provided IFA supplements to the client, and then in the exit interview the client was asked if she had received IFA supplements or a prescription for them. A client was considered to have received a prescription only if the interviewer observed it during consultation and if 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 (Assaf, Wang, and Mallick 2016).

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 if in the exit interview she also reported having receiving it. 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 supplements 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 within the specific buffer distance from the cluster, we counted the number of facilities with IFA supplements available. Using the terciles of the total number of facilities with IFA supplements available within the buffer distance from the cluster, 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 for it, we classified clusters 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 we grouped clusters into three levels of prescription according to the terciles of the percentage of clients who were given IFA supplements. Clusters with an average percentage falling in the top 33% were considered in the high-level prescription group; those with an average percentage in the bottom 33% were categorize in the low-level group, and the rest were put in the medium-level group. Some clusters did not have data for this indicator because they were linked to ANC facilities without observations of service delivery. These clusters were kept in the regression analysis but were classified into a separate group.

The cluster-level indicator on IFA counseling was measured with the average percentage of clients among the linked facilities who were counseled. For both Haiti and Malawi, the clusters were then categorized into three groups based on the percentages of clients who were counseled. Clusters with an average percentage falling in the top 33% were considered in the high-level counseling group; those with an average percentage in the bottom 33% were categorized in the low-level counseling group, and the rest were put in the medium-level counseling group. As with the IFA supplement prescription indicator, the IFA counseling indicator is not available for clusters that did not link to a facility with ANC observation data.

2.3 Statistical Analysis

Separate analysis was conducted for urban and rural areas because of the potential differences in the health service environment and individual health behaviors (Burgert and Prosnitz 2014). In Haiti, since women in the metropolitan area were excluded from the analysis, as discussed earlier, urban areas are defined as urban areas other than the metropolitan area. 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 household-level clustering was omitted since few women who had a child in the 2 years preceding the survey lived in the same household. 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 regression model included three IFA-related indicators and other covariates. The IFA supplement prescription indicator and the IFA counseling indicator were highly correlated in Malawi, but not in Haiti. Therefore, for Malawi we fitted one model including each indicator, together with the IFA supplement availability indicator and other covariates.

3 RESULTS

3.1 Sample Characteristics

The majority of health facilities in Haiti and Malawi provide ANC services. Appendix Table 1 shows the percent distribution of ANC facilities by selected facility background characteristics. In Haiti, out of 905 facilities interviewed, 827 provide ANC services. In rural areas of Haiti most ANC facilities are dispensaries (59%), while in urban areas, health centers are the primary type (65%). In rural areas 44% of ANC facilities are government-managed compared with 38% private not-for-profit facilities. In urban areas private not-for-profit facilities provide a greater share of ANC services than the government, while private for-profit facilities also play a major role. A large proportion of facilities are located in the Aire Metropolitaine/Reste-Ouest region, for both rural and urban areas.

In Malawi, 632 out of 977 facilities reported providing ANC services, with the majority located in rural areas. Over 80% of ANC facilities in rural areas are health centers, but in urban areas ANC facilities are more evenly distributed across the three types (hospital, health center, and dispensary). In both urban and rural areas the government health sector is the primary source of ANC services, with a greater share of private-for-profit ANC facilities in urban than rural areas. Among the three regions in Malawi, the North region has the smallest percentage of ANC facilities, for both rural and urban areas.

Our study focused on women with a live birth in the 2 years preceding the survey and who had at least one ANC visit during pregnancy. As Appendix Table 2 shows, in both Haiti and Malawi a larger proportion of women in rural areas than urban areas had four or more children, had less education, and were in the lowest two household wealth quintiles. In Malawi a greater percentage of women in rural areas than urban areas were employed, because in rural areas most women work in agriculture. 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 than in Haiti attended the recommended number of ANC visits. 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.

3.2 The IFA-related Service Environment in Health Facilities

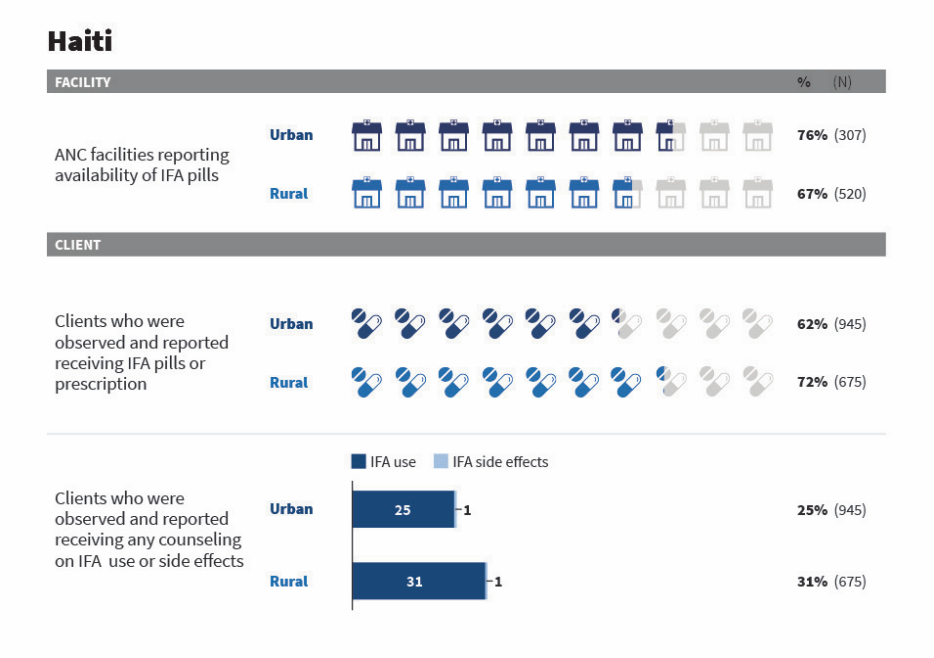
Figure 1 presents the availability of IFA supplements, prescription of IFA supplements, and counseling on IFA in health facilities in Haiti and Malawi by rural-urban residence. In Malawi, almost all ANC facilities, whether rural or urban, had IFA supplements available on the day of the survey. In Haiti, only about two-thirds of rural ANC facilities and three-fourths of urban facilities had IFA supplements available.

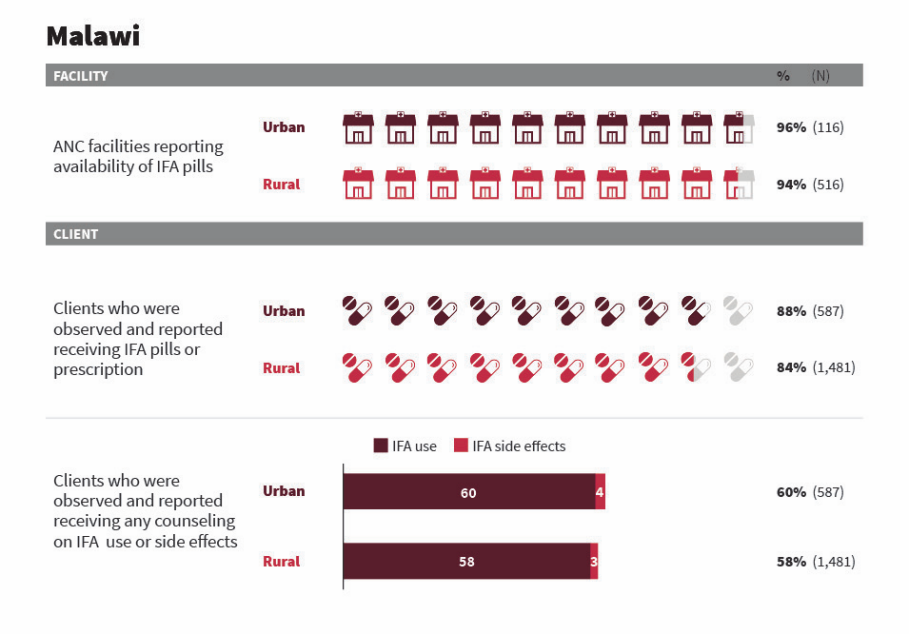
In Malawi, among facilities with ANC clients observed and interviewed, in both urban and rural areas, over 80% of the clients were given or prescribed IFA supplements. The percentage was lower in Haiti, where 72% of clients in rural areas and 62% in urban areas were given IFA supplements or a prescription for it.

Counseling on IFA was more common in Malawi than Haiti, provided for 60% of ANC clients in urban areas and 58% of clients in rural areas. In Haiti, less than a third of clients received any counseling on IFA. In both countries, however, counseling on side effects of IFA supplements was much less common than

counseling on how to take IFA supplements. In Haiti, less than 2% of clients observed received counseling on side effects. Similarly, in Malawi the counseling observed focused on how to take IFA supplements, while few women—just 4% in urban areas and 3% in rural areas—received counseling on its side effects.

Figure 1 Percentage of ANC facilities that have IFA supplements available, percentage of clients that received IFA supplements, and percentage counseled about IFA, by residence





When linking each DHS cluster to ANC facilities with IFA supplements within the specific buffer from where women live (10 km for rural areas and 5 km for urban areas), in Malawi the number of facilities within the specific buffer ranged from 0-17 facilities in rural areas and from 0-19 facilities in urban areas,

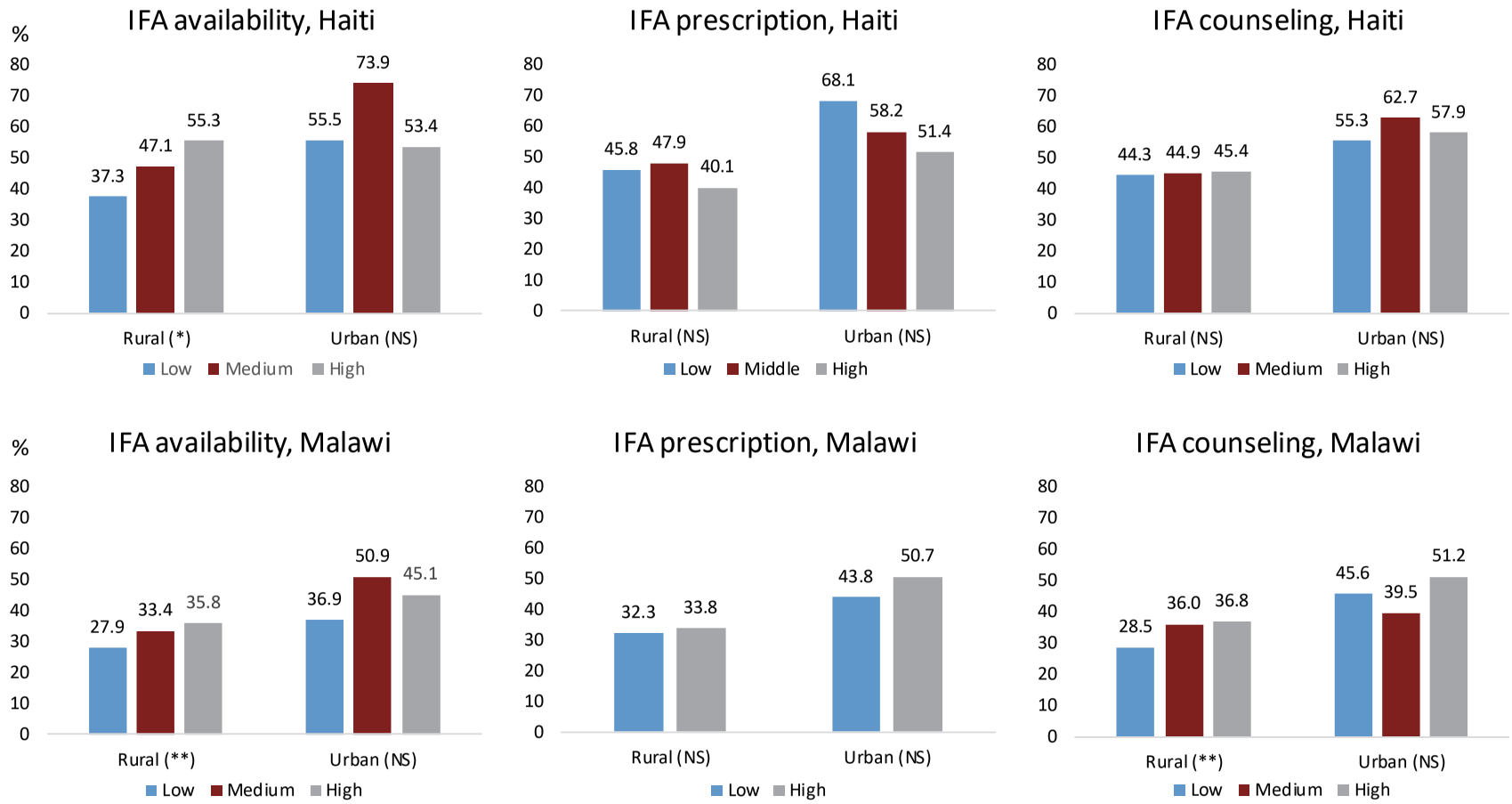
with the median at just 2 and 6 facilities, respectively. The ranges were similar in Haiti but with a higher median number of facilities within the buffer (Appendix Table 3). With regard to IFA supplement prescription, only 22% of rural women lived in an area where all observed clients in linked facilities were given a prescription.

3.3 Women's IFA Supplementation Adherence

Overall, 42% of women in Haiti and 35% of women in Malawi with a birth in the 2 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 2 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 both Haiti and Malawi, women's adherence appears to be associated with the availability of facilities offering ANC with IFA supplements available. In rural areas, IFA supplement adherence increases incrementally with the level of availability. For example, 37% of women in rural Haiti in the low-level IFA supplement availability group took IFA supplements for at least 90 days compared with 55% of those in the high-level group. In Malawi, 28% of rural women in the low-level IFA supplement availability group versus 36% of those in the high-level group took IFA supplements for at least 90 days. In urban areas of Malawi, women living in an area with low availability of IFA supplements had the poorest adherence to IFA supplementation. Although adherence appears to be better in the medium-level availability group than the other two groups, the differences are not significant in either Haiti or Malawi.

Figure 2 Women's adherence to IFA supplementation by levels of IFA availability, prescription, and counseling at nearby facilities



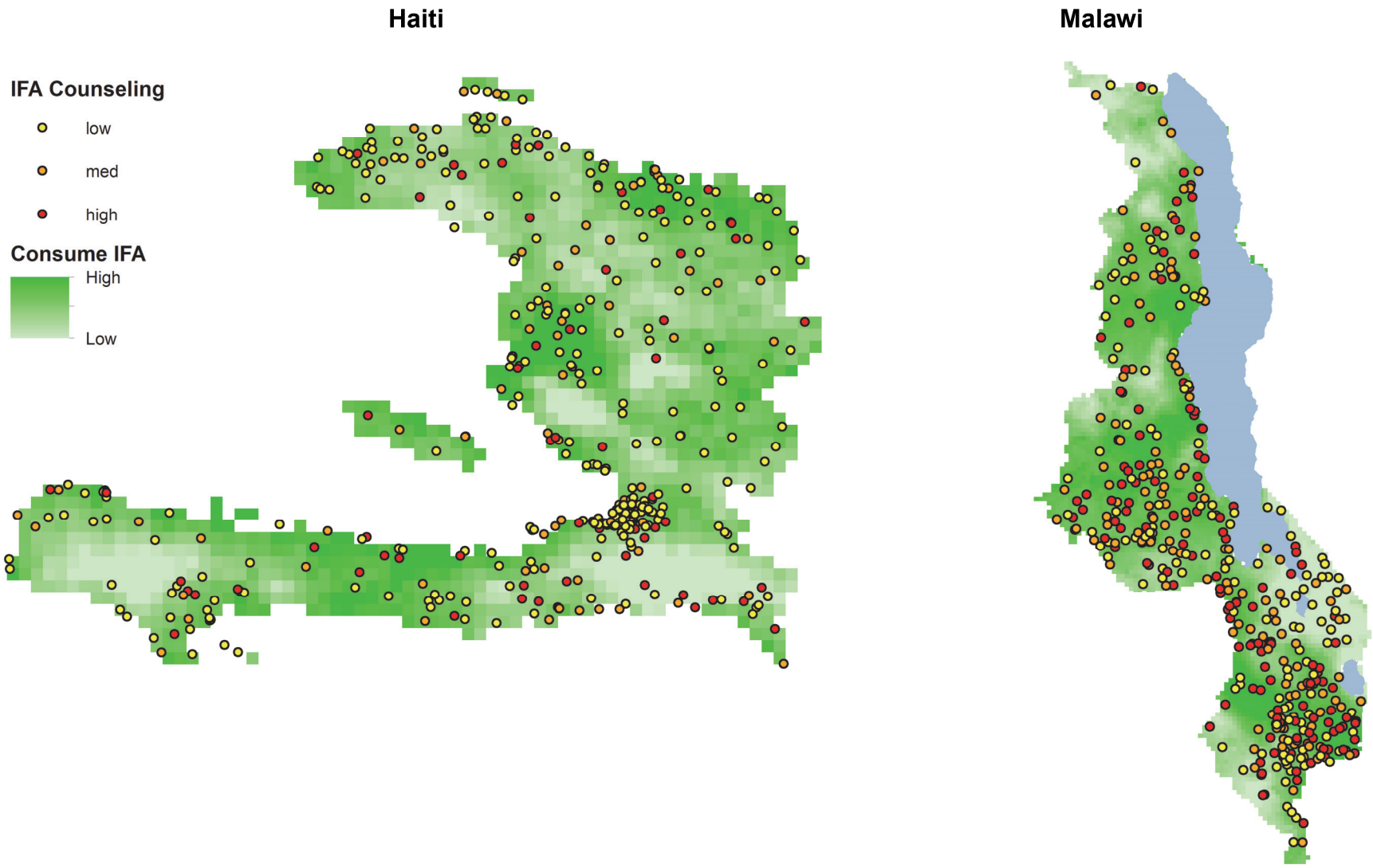
**p<0.01 *p<0.05; NS=not significant

The bivariate associations between women's IFA supplement adherence and prescription of IFA supplements in health facilities are less consistent. The differences in Malawi between the low-level and high-level adherence groups are small and not statistically significant. While IFA supplement adherence appears to be negatively associated with IFA supplement prescription in urban areas of Haiti, the association is not significant.

IFA supplement adherence is also positively associated with IFA counseling in rural Malawi. Among women who lived in an area with a low level of counseling provided in health facilities, only 29% took IFA supplements for at least 90 days, while adherence was better for women in the high-level counseling group, at 37%. The bivariate association is not significant in urban areas of Malawi or in both rural and urban areas of Haiti.

Figure 3 visualizes the bivariate relationship between interpolated IFA supplement adherence among pregnant women for at least 90 days from low (light green) to high (dark green) and client counseling in health facilities (dots). In general, areas with more facilities with high level of client counseling on IFA (higher density of red dots) coincide with areas where there is a higher level of IFA supplement adherence (dark green areas).

Figure 3 **Women's adherence to IFA supplementation and IFA counseling at nearby health facilities**



3.4 Results of Multivariable Analysis

We ran random-intercept multilevel logistic regression models to examine the association between women's adherence to IFA supplements and the IFA-related service environment indicators after controlling for other covariates. Tables 1 and 2 show the results of the regression analysis for Haiti and Malawi, respectively.

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 other covariates. 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 were less likely to adhere to IFA supplementation for 90 days compared with those in clusters with a low level of prescription. 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. However, attending the first ANC visit during the first trimester was not associated with IFA supplement adherence in Haiti.

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 available				
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

Continued...

Table 1—*Continued*

Variables	Rural		Urban	
	AOR	95% CI	AOR	95% CI
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	1,343		389	

***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, we fitted two models for each category of residence (that is, two for urban and two for rural) (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 offering ANC with IFA supplements were more likely to adhere to IFA supplementation for 90 days compared with women in clusters with low availability. This association holds 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 with 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). Among other covariates, woman's educational attainment and having four or more ANC visits were also significantly associated with adherence. 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 available								
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 - 1.07	0.80	0.60 - 1.06	1.11	0.47 - 2.63	1.04	0.43 - 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	5,668				900			

***p<0.001, **p<0.01, *p<0.05

4 DISCUSSION

IFA supplementation during pregnancy is an important intervention for reducing maternal and infant mortality. This study examined the relationship between the health facility service environment and women's adherence to IFA supplementation in Malawi and Haiti. We found that the IFA service environment in health facilities was significantly associated with adherence, but varied by country and by rural-urban residence. In addition, our analysis illustrates how the DHS household surveys and the SPA health facility surveys can be linked to provide a better understanding of the impact of programmatic interventions and to identify gaps in service delivery.

In both countries adherence to IFA supplements (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 (Siekmans et al. 2018; Sununtnasuk, D'Agostino, and Fiedler 2016). 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 (Government of Malawi 2009; Museka-Saidi et al. 2018).

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 (2018) also found that long distance to health facilities is one of the key barriers to IFA supplementation 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 (Gage et al. 2018; Peragallo Urrutia et al. 2012). Although most health facilities in Haiti and Malawi had IFA supplements in stock on the day of the survey, the data available in 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 (Museka-Saidi et al. 2018; Young, Ali, and Beckham 2009).

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 attending the recommended four or more ANC visits during pregnancy. We did not find that IFA supplement compliance was associated with the early start of ANC, however, 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 is consistent with findings from a multi-country analysis that the number of IFA supplements consumed increased with the number of ANC visits (Sununtnasuk, D'Agostino, and Fiedler 2016). Despite the increasing trends in attending four or more ANC visits in both countries, the current level is still low, especially in rural Malawi. The majority of women who attended ANC did not

start until after the first trimester. Continued efforts are required to improve ANC attendance, which in turn would 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 giving a prescription for IFA supplementation. In both Haiti and Malawi, the majority of women, though not all, 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 (Mallick, Temsah, and Benedict 2018; Siekmans et al. 2018; Sununtnasuk, D'Agostino, and Fiedler 2016). 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 (Gage et al. 2018). Our analysis only linked urban women to health facilities within a buffer zone of 5 km. Adherence to IFA supplementation not only reflects access and adequate counseling during ANC visits, but could also reflect a number of demand-side factors, such as individual acceptance of IFA supplements, cultural beliefs associated with taking medicines during pregnancy, and forgetting to take the prescribed supplements, as well as having a supporting family environment (Kamau, Mirie, and Kimani 2018; Martin et al. 2017; Wiradnyani et al. 2016).

Another important provider behavior is the level and quality of IFA counseling offered. In both countries studied, observation and client's report of consultation showed that counseling on IFA was infrequent, especially counseling on side effects. Fear of side effects of supplements and cultural misconceptions about IFA supplements were reported as important barriers to compliance (Maina-Gathigi et al. 2013; Museka-Saidi et al. 2018). Our findings that IFA supplement compliance is significantly associated with IFA counseling in rural Malawi support studies in many low-income countries that have identified such barriers to IFA supplement adherence 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 (Siekmans et al. 2018; Sununtnasuk, D'Agostino, and Fiedler 2016). 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. For example, in Malawi, 57% of facilities in the SPA reported that they routinely provide counseling services on IFA, but observation of consultations with clients showed that about 20% of facilities did not provide counseling to any of the ANC clients observed, while 17% counseled less than half of the clients. A further question is whether facilities have sufficient 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 had received training 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 to play an important role in increasing IFA supplementation uptake in low- and middle-income countries, other distribution platforms also play a role

(MCSP 2017). 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 (Kavle and Landry 2018; Pokharel, Maharjan, and Mathema 2011). Community-based programs have shown advantages in improving IFA supplement access by increasing knowledge and awareness, providing consistent supplies, and encouraging the use of ANC services (Kavle and Landry 2018; Perry and Zulliger 2012). 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. Community-based distribution of IFA supplements is associated with improved results for multiple maternal and neonatal health outcomes (Bhutta et al. 2008), and countries with a component of community-based approaches have made greater progress in IFA coverage (Sununtnasuk, D'Agostino, and Fiedler 2016). 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. Despite the active role of community-based programs in improving IFA supplementation coverage, further work is warranted to assess their cost-effectiveness (MCSP 2017). Clear guidelines and regulations on the content of work and training of community health workers are also needed (Perry and Zulliger 2012).

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 (Wang, Winner, and Burgert-Brucker 2017). 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 trainer 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 physicians' offices 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 have 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. For example, IFA counseling could be less common in small facilities. In rural Malawi, over 11% of women were linked to facilities without any ANC clients observed. The levels of IFA supplement prescription and counseling in these facilities are unknown.

5 CONCLUSION

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 low levels of use of the recommended ANC services that health facilities provide, as in rural Malawi, continued efforts are required to identify and address the barriers to use of services, on both 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.

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APPENDICES

Appendix Table 1 Percent distribution of health facilities that provide antenatal care services in Haiti and Malawi

	Haiti		Malawi	
Characteristics	Rural	Urban	Rural	Urban
Type of facility				
Hospital	4.2	26.0	9.9	44.4
Health center	37.1	64.8	80.8	24.4
Dispensary, clinic, other	58.7	9.1	9.2	31.3
Managing authority				
Government	43.7	33.3	66.5	48.3
Private not-for-profit (FBO)	38.4	37.1	24.9	17.7
Private for-profit	17.9	29.6	8.6	34.0
Region (Haiti)				
Aire Metropolitaine/Reste-Ouest	24.2	54.7		
Sud-Est	9.6	4.2		
Nord	8.8	9.1		
Nord-Est	5.6	1.6		
Artibonite	17.8	4.6		
Centre	6.3	3.6		
Sud	6.1	9.8		
Grand-Anse	4.8	4.9		
Nord-Ouest	13.3	4.0		
Nippes	3.5	3.6		
Region (Malawi)				
North			19.2	16.0
Central			36.3	40.8
South			44.5	43.2
Total number of facilities	520	307	516	116

Appendix Table 2 Percent distribution of women who had a birth in the last 2 years by background characteristics

	Haiti		Malawi	
Variables	Rural	Urban	Rural	Urban
Parity				
1	29.2	37.2	26.6	33.9
2-3	37.1	42.0	34.8	46.0
4-5	17.2	14.5	23.4	16.6
6+	16.4	6.3	15.2	3.5
Education				
None	20.3	4.9	13.3	2.6
Primary	46.3	29.8	70.8	40.3
Secondary or higher	33.5	65.4	15.8	57.2
Employment				
Unemployed	41.6	43.9	29.6	43.9
Employed	58.4	56.1	70.4	56.1
Wealth quintile				
Lowest	36.0	0.8	28.7	1.8
Second	32.1	9.9	26.0	2.7
Middle	21.1	27.8	21.4	5.7
Fourth	7.3	37.4	16.9	17.7
Highest	3.5	24.1	7.0	72.1
Region				
Northern			11.7	10.6
Central			42.8	41.3
Southern			45.4	48.2
Frequent exposure to mass media				
No	68.7	65.5	69.5	42.0
Yes	31.3	34.5	30.5	58.0
Had 4 or more ANC visits				
No	35.9	15.3	52.5	41.4
Yes	64.1	84.7	47.5	58.6
First ANC in first trimester				
No	46.5	30.5	77.1	73.6
Yes	53.5	69.5	22.9	26.4
Total number of women	1,343	389	5,668	900

***p<0.001, **p<0.01, *p<0.05

Appendix Table 3 Percent distribution of women by IFA-related service indicators

	Haiti		Malawi	
Variables	Rural	Urban	Rural	Urban
Number of facilities linked to				
Range	0-19	0-16	0-17	0-19
Median	5	3	2	6
IFA supplement prescription (Malawi)				
No facility linked to			3.6%	1.2%
Low			41.1%	77.1%
High			44.2%	21.6%
No clients observed			11.1%	0.1%
IFA supplement prescription (Haiti)				
No facility linked to	2.1%	2.8%		
Low	35.9%	25.5%		
Medium	31.8%	32.0%		
High	26.6%	30.4%		
No clients observed	3.6%	9.3%		
IFA counseling				
No facility linked to	2.1%	2.8%	3.6%	1.2%
Low	34.2%	31.9%	36.4%	35.4%
Medium	33.2%	31.8%	19.7%	32.9%
High	26.9%	24.2%	29.2%	30.4%
No clients observed	3.6%	9.3%	11.1%	0.1%
Number of women	1,343	389	5,668	900