



Factors associated with use of maternal health services in Haiti: a multilevel analysis

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ABSTRACT

Objective. To assess factors associated with utilization of maternal health services (MHS) among women giving birth in Haiti from 2007–2012.

Methods. Observational data derived from the 2012 Haiti Mortality, Morbidity and Service Use Survey are analyzed. Multilevel analytic methods are used to assess factors associated with use of antenatal services and skilled birth attendance (SBA).

Results. The strongest adjusted predictors include child's birth rank, household poverty, and community media saturation. The odds of obtaining four antenatal care visits decrease by 53% (odds ratio (OR) = 0.47; 95% confidence interval (CI): 0.37-0.57) with high birth rank and by 37% (OR = 0.63; 95% CI: 0.51-0.78) with household poverty, and increase by 38% (OR = 1.38; 95% CI: 1.01-1.88) with high community media saturation. The odds of using SBA at delivery decrease by 72% (OR = 0.28; 95% CI: 0.22-0.34) with high birth rank and by 42% (OR = 0.58; 95% CI: 0.46-0.73) with household poverty, and increase by 92% (OR = 1.92; 95% CI: 1.41-2.61) with high community media saturation. Use of antenatal services is strongly associated with SBA (OR = 2.20; 95% CI: 1.85-2.61). Significant clustering of use of MHS exists at the community level.

Conclusions. Factors associated with use of MHS operate at multiple levels. Efforts to promote such services should identify and pay special attention to the needs of multiparous and uneducated women, address the distance-decay phenomenon, and improve access for the poor. Community mobilization efforts designed to change norms hindering the use of MHS are also relevant.

Key words

Maternal health services, health services accessibility, equity in access, multilevel analysis, Haiti.

Use of quality maternal health services (MHS) is central to the achievement of the Millennium Development Goals (MDGs), especially MDG 5, which seeks to: (a) reduce the maternal mortality ratio by three quarters between 1990 and 2015; and (b) achieve universal access to reproductive health services by 2015 (1). For many developing countries, prog-

ress toward the goals remains slow and achievement of the targets uncertain. For example, whereas the maternal mortality ratio (MMR) declined by about 47 percent between 1990 and 2010 overall, regional disparities persist, with MMR in developing countries 15 times higher, on average, than in developed nations (2).

Increasing access to skilled attendance at delivery and antenatal care services are key interventions that have proved effective for reducing maternal mortality and morbidity (3, 4). The World Health

Organization (WHO) recommends that all women should obtain at least four antenatal visits and be attended by a skilled birth attendant during childbirth (5). Many women in developing countries do not obtain the recommended services (6).

There have been significant improvements in reproductive health outcomes in Haiti. For example, facility delivery increased from 25% in 2005–2006 to 36% in 2012, during which period the proportion of births assisted by a trained provider increased from 26% to 37%

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(7). Similarly, MMR declined by 43% between 1990 and 2010. Nonetheless, reproductive health indicators in Haiti remain among the worst in the world. MMR was estimated at 350 deaths per 100 000 births in 2012 (6). According to the 2012 Enquête Mortalité, Morbidité et Utilisation des Services (EMMUS-V), whereas 90.3% of pregnant women obtained at least one antenatal visit with a skilled provider, only 67.3% obtained the recommended four visits, and only 35.9% of women had their most recent birth in a health facility (7).

The factors linked with use of MHS vary across and within cultures (8), and associations have been observed at the individual, interpersonal, community, health sector and policy levels. At the individual level, such factors include woman's age, parity, education, ethnicity, and religious affiliation (8–15). Moreover, several studies have found use of antenatal care to be one of the strongest determinants of use of skilled birth attendance or institutional delivery (12, 14, 16).

At the household level, studies have found high level of autonomy, egalitarian sharing of conjugal decision-making power, high education of husband and high household socio-economic status to be positively associated with use of MHS (8, 13, 17, 18). Some studies examining the role of contextual factors found that significant correlates include presence of a health facility within the community, distance to health facilities, and condition of access roads (10, 12, 17, 19). For example, in rural Haiti, mountainous terrain and distance to the nearest hospital significantly decrease the odds of using skilled attendance at birth (10). Other studies have focused on community compositional effects, finding that at the community level the proportion of educated people, poverty level, media saturation, and prevalence of norms for small family size are important correlates of use of MHS (8, 10, 11, 20).

There is a dearth of information on the factors associated with use of MHS in Haiti, with the few existing studies tending to focus on prenatal care (18), rural women (10), or delay to access (21). These studies have underscored the importance of maternal education, knowledge about pregnancy care, whether the pregnancy was wanted or not, service availability, physical accessibility and quality of services in determining utili-

zation. This paper attempts to bridge the knowledge gap by assessing multilevel correlates of use of MHS (i.e. antenatal care and skilled birth attendance) among women of reproductive age in Haiti. Recent data from a large-scale household survey conducted after the 2010 earthquake provide a valuable opportunity to examine the factors associated with maternal healthcare utilization in Haiti, especially in light of the magnitude of the devastation and the subsequent influx of international financial and technical assistance.

MATERIALS AND METHODS

Data

This paper analyzes observational data from the 2012 EMMUS-V conducted by the Institut Haitien de l'Enfance (IHE) with technical assistance from Measure DHS (7). The data were collected between January and June 2012 through a structured survey questionnaire that targeted women of reproductive age. The survey followed standard ethical procedures, including informed consent, voluntary participation, and respect of participants' privacy and confidentiality. The survey protocol was approved by the National Ethics Committee in Haiti and the Institutional Review Board of ICF International. Survey respondents were selected through a multi-stage process that included successively selecting clusters, households and individual respondents. Details about the sampling procedure are presented in the survey report (7) available on the Measure DHS website (www.dhsprogram.com). A total of 14 287 women were successfully interviewed during the survey. Of these, 5 414 gave birth between 2007 and 2012, and constitute the study population. The analyses presented here focus specifically on the most recent birth.

Measures

Two outcome variables are examined: (1) receiving at least four antenatal visits during the pregnancy of the most recent birth, and (2) use of skilled birth attendants (including doctors, nurses, nurse-midwives and auxiliary nurses) for the most recent birth.

For each outcome, the predictive value of several independent variables (covariates) was assessed. Included variables re-

lated to the child, the mother, the household and the community. For skilled birth attendance, the predictive value of number of antenatal care visits and the quality of antenatal care received were also examined. A detailed description of all variables is presented in Table 1.

Statistical Analysis

Two analytic methods were employed. First, simple logistic regression estimates were derived of the unadjusted association between the dependent variable and each covariate. Then, multilevel analyses were used to re-estimate these associations while adjusting for other covariates. The data are nested—women within households within communities—and therefore some of the assumptions underlying traditional regression modeling are not valid. These include the assumption of independence among women within the same community and that of equal variance across communities (22). In particular, individuals within the same community are likely to be more similar than those from different communities. Multilevel modeling is ideal for analyzing nested data because it does not require the assumption of independence of observations within groups.

For multilevel analyses, an empty model (Model 0) with no covariates was used to assess the presence of significant clustering in the use of MHS. A second model (Model 1) with characteristics of the child, mother and household as covariates was then estimated. Finally, a full model (Model 2) including all variables in Model 1 along with community-level variables was produced. The *gllamm* command in Stata 12 (StataCorp LP, College Station, TX, USA) was used for all model estimations (23). In the multilevel analyses, the magnitudes of relationships between the dependent variable and each of the independent variables (i.e. fixed effects) were assessed using odds ratios and their confidence intervals. To evaluate the significance of community-level clustering of the dependent variable (i.e. random effects), log-likelihood ratio tests with one-sided p-values were employed, since the null value is on the border of the parameter space.

RESULTS

Overall, 67.9% (95% CI: 65.5%, 70.3%) of the women who gave birth during the

TABLE 1. Definition of variables

Variable	Definition
Timing of birth	Binary variable distinguishing between children born before 2010 and those born between 2010 and the time of the survey in 2012. ^a
Birth rank	Ordinal variable classifying children by birth rank: first, second, and third or higher.
Number of antenatal visits	Binary variable distinguishing women obtaining the recommended four antenatal visits (or more) and those obtaining three or fewer.
Quality of antenatal care (based on number of components of care received)	Score variable derived from six components of antenatal care which the World Health Organization has determined essential for every pregnant woman (self-reported): <ol style="list-style-type: none"> 1. Whether weight was measured during an antenatal visit; 2. Whether blood pressure was measured during an antenatal visit; 3. Whether a urine sample was taken for analysis during an antenatal visit; 4. Whether a blood sample was taken for analysis during an antenatal visit; 5. Whether information was provided about possible pregnancy-related complications during an antenatal visit; and, 6. Whether the woman bought or was given iron tablets during an antenatal visit. <p>Ideally, all pregnant women should have received these six components of care. A binary indicator for high quality of care was created, distinguishing between scores below 6 (low quality) and scores of 6 (high quality).</p>
Woman's age	Binary variable distinguishing women 15–24 years old from women 25–49 years old.
Woman's education	Ordinal variable based on the highest level of education attained: no formal education, primary education, and secondary or higher.
Woman's current marital status	Categorical variable based on current marital status: never married, married, placée (common law union), living together, and divorced, separated or widowed.
Whether pregnancy was wanted	Binary variable distinguishing women who reported that their pregnancy was desired at the time and those who stated that they either did not want to have any more children or “would have loved to wait” for some time before conceiving.
Religion	Categorical variable classifying respondents into three groups: Catholic, Protestant and Voodoo worshippers.
Sex of head of household	Binary variable distinguishing male-headed households from female-headed households.
Household poverty	Asset-based binary variable classifying women into poor or non-poor.
Type of place of residence	Binary variable distinguishing urban from rural communities.
Proportion of women in community with post-primary education	Categorical variable derived from the non-self proportion of women in the same community as the index woman who reported having post-primary education. Classified into tertiles: low (0–32.0%), medium (32.1–60.0%) and high (60.1–100%).
Proportion of women in community who perceived distance to health facility to be a big problem	Categorical variable derived from the non-self proportion of women in the same cluster as the index woman who reported that distance to a health facility was a big problem affecting their ability to obtain medical help for themselves. Classified into tertiles: low (0–27.4%), medium (27.5–59.1%) and high (59.2–100%).
Proportion of women in community who reported ideal family size of less than three children	Categorical variable derived from the non-self proportion of women in the same cluster as the index woman who reported ideal family size of two or fewer children. Classified into tertiles: low (0–43.9%), medium (44.0–57.9%) and high (58.0–87.5%).
Media saturation in community of residence	Categorical variable derived from the non-self mean of the number of mass media (radio, newspaper and television) to which women in the same cluster of residence as the index woman are exposed. Classified into tertiles: low (0–0.81), medium (0.82–1.42) and high (1.43–2.55).

^a The Haiti earthquake occurred on January 12, 2010.

five years preceding the survey obtained at least four antenatal visits for their most recent birth, and 41.2% (95% CI: 38.6%, 43.8%) benefited from skilled assistance during delivery. A few women (10.3%; 95% CI: 6.8%–13.7%) that did not receive any antenatal care used skilled attendance at delivery. Nonetheless, most (97.6%; 95% CI: 96.8%–98.4%) who received skilled birth attendance at delivery had obtained at least one antenatal visit.

Bivariate Analysis

Table 2 presents estimates from the simple logistic regression models. For antenatal care, these unadjusted results indicate negative associations with birth

rank, Voodoo religion, household poverty, and community-level perception that distance to health facility is a big problem for obtaining medical help for self. In contrast, positive associations were observed with birth timing before the earthquake, education, older age, married status, wanting the pregnancy, female-headed households, urban residence, community-level prevalence of educated women, low ideal family size, and media saturation.

For skilled delivery, negative associations were seen with birth rank, household poverty, and prevalence of the perception that distance to health facility is a big problem for obtaining medical help for self. Women who were currently married or “placée” (i.e. in a common

law union) were less likely to have used skilled birth attendants compared to never married women. In contrast, there was a positive relationship between skilled assistance and number of antenatal visits, high quality antenatal care, education, female-headed households, wanting the pregnancy, and birth timing before the earthquake. Urban residence and community-level prevalence of educated women, low family size ideals and media saturation were also positively associated with skilled delivery.

Multilevel Analysis

While the bivariate associations reported above did not adjust for interrelationships among covariates, multivari-

TABLE 2. Distribution of sociodemographic characteristics and odds ratios from simple logistic regression of use of maternal health services on selected variables, Haiti 2012

Socio-demographic characteristic	No.	%	At least four antenatal visits	Use of skilled birth attendance
Timing of birth				
After the earthquake (RC)	3 320	61.3	1.00	1.00
Before the earthquake	2 094	38.7	1.44 (1.27–1.64) ^a	1.18 (1.04–1.35) ^b
Birth rank				
1st (RC)	1 695	31.3	1.00	1.00
2nd	1 165	21.5	0.77 (0.63–0.94) ^b	0.49 (41.1–57.5) ^a
3rd or higher	2 554	47.2	0.49 (0.41–0.58) ^a	0.24 (0.21–0.28) ^a
Birth was wanted				
No (RC)	2 732	50.5	1.00	1.00
Yes	2 682	49.5	1.54 (1.30–1.81) ^a	1.33 (1.16–1.54) ^a
Number of antenatal visits				
Three visits or fewer (RC)	1 761	32.1	—	1.00
Four visits or more	3 653	67.9		3.97 (3.29–4.81) ^a
Quality of antenatal care (based on number of components of care received)				
Fewer than 6 (Low Quality; RC)	3 011	55.6	—	1.00
Six (High Quality)	2 403	44.4		2.53 (2.20–2.92) ^a
Woman's age				
15–24 years old (RC)	1 633	30.2	1.00	1.00
25–49 years old	3 781	69.8	1.31 (1.12–1.54) ^a	0.88 (0.76–1.02)
Woman's Education				
No formal education (RC)	1 132	20.9	1.00	1.00
Primary	2 404	44.4	1.64 (1.35–1.98) ^a	2.36 (1.84–3.02) ^a
Secondary and above	1 878	34.7	4.90 (3.89–6.17) ^a	9.40 (7.12–12.42) ^a
Woman's current marital status				
Never married (RC)	322	5.9	1.00	1.00
Married	1 278	23.6	1.76 (1.26–2.46) ^a	0.75 (1.56–0.99) ^b
Placée (Common law union)	2 533	46.8	0.94 (0.71–1.25)	0.41 (0.31–0.54) ^a
Living together	802	14.8	1.23 (0.87–1.77)	0.80 (0.59–1.07)
Divorced/separated/others	479	8.9	1.16 (0.79–1.71)	0.67 (0.48–0.93) ^b
Sex of head of household				
Male (RC)	3 228	59.6	1.00	1.00
Female	2 186	40.4	1.15 (1.00–1.33) ^a	1.59 (1.37–1.83) ^a
Household wealth				
Non-poor (RC)	2 888	53.3	1.00	1.00
Poor	2 526	46.7	0.33 (0.27–0.40) ^a	0.14 (0.12–0.17) ^a
Type of place of residence				
Rural (RC)	3 446	63.6	1.00	1.00
Urban	1 968	36.4	2.11 (1.68–2.65) ^a	1.35 (3.41–5.56) ^a
Woman's religion				
Catholic (RC)	2 370	43.8	1.00	1.00
Protestant	2 578	47.6	1.12 (0.94–1.32)	1.30 (1.10–1.53) ^c
Voodoo, others	466	8.6	0.68 (0.52–0.89) ^c	0.98 (0.75–1.28)
Proportion of women in community with post-primary education				
Small (RC)	2 257	41.7	1.00	1.00
Medium	1 844	34.1	1.77 (1.39–2.26) ^a	2.85 (2.16–3.78) ^a
Large	1 313	24.2	4.06 (3.20–5.15) ^a	8.58 (6.39–11.55) ^a
Proportion of women in community who perceived distance to health facility to be a big problem				
Small (RC)	1 492	27.6	1.00	1.00
Medium	1 835	33.9	0.57 (0.43–0.75) ^a	0.36 (0.28–0.48) ^a
Large	2 087	38.5	0.36 (0.28–0.47) ^a	0.17 (0.13–0.23) ^a
Proportion of women in community who reported ideal family size of less than three children				
Small (RC)	2 161	39.9	1.00	1.00
Medium	1 692	31.2	1.90 (1.45–2.48) ^a	3.04 (2.23–4.15) ^a
Large	1 561	28.8	2.65 (21.0–3.33) ^a	4.48 (3.31–6.07) ^a
Media saturation in community of residence				
Low (RC)	2 131	39.4	1.00	1.00
Medium	1 844	34.0	1.79 (1.38–2.32) ^a	2.89 (2.16–3.86) ^a
High	1 439	26.6	3.69 (2.92–4.66) ^a	8.17 (6.17–10.82) ^a

RC: reference category.

^a $P < .001$.^b $P < .05$.^c $P < .01$.

able multilevel analysis allowed for such adjustment.

Antenatal Care

The condition number for each of the three models is low, indicating that the models are well conditioned (Table 3). The condition number tends toward infinity with increasing collinearity, with numbers above 30 potentially indicating serious issues (24). The intra-class correlation (ICC) of 17.9% observed for the empty model (Model 0) indicates a fair amount of similarity within communities in terms of individual use of antenatal health services. In Model 1, clustering at the community level remains significant although of a lower magnitude than in the empty model. Collectively, the covariates were statistically significant in explaining the use of antenatal care, yielding a proportional reduction in variance at the community level of 41%. After controlling for other variables, sex of household head was not significantly associated with use of antenatal care. In contrast, the negative associations with child's birth rank, Voodoo religion, and household poverty were confirmed, as was the positive relationship with whether the pregnancy was wanted, education, older age, and married or placée status (compared to being never married). In Model 2, even with community compositional and contextual variables in the model, the community-level random effects remain strong. The compositional and contextual variables contribute relatively little to explaining differences in use of antenatal care. Indeed, the only significant community-level variables are the prevalence of post-primary education and media saturation.

Skilled Birth Attendance

The empty model (Model 0) reveals considerable clustering in use of skilled attendance: 35.9% of the variance in this outcome is due to factors operating at the community level (Table 4). Model 1 shows that, after controlling for confounding factors, neither whether the pregnancy was wanted nor marital status were significantly associated with use of skilled birth attendance. In contrast, the odds of use of skilled birth attendance decreased significantly with birth rank, household poverty, and hav-

ing given birth before the earthquake. Obtaining at least four antenatal visits increased the odds of skilled attendance two-fold while high quality antenatal

care increased them by about 50%. Compared to no formal education, primary education increased the odds of use of skilled birth attendance by 32% whereas

TABLE 3. Odds ratios from multilevel regression^a of use of antenatal care (at least four visits) on selected variables, Haiti 2012

Socio-demographic characteristic	Model 0 ^b	Model 1 ^c	Model 2 ^d
Timing of birth	—		
After the earthquake (RC)		1.00	1.00
Before the earthquake		1.14 (0.99–1.30) ^e	1.12 (0.97–1.28)
Baby's rank of birth	—		
1st (RC)		1.00	1.00
2nd		0.61 (0.49–0.74) ^f	0.61 (0.49–0.74) ^f
3rd or higher		0.46 (0.36–0.57) ^f	0.47 (0.37–0.58) ^f
Birth was wanted	—		
No (RC)		1.00	1.00
Yes		1.34 (1.17–1.54) ^f	1.35 (1.19–1.56) ^f
Woman's age	—		
15–24 years old (RC)		1.00	1.00
25–49 years old		1.92 (1.60–2.32) ^f	1.89 (1.56–2.27) ^f
Woman's Education	—		
No formal education (RC)		1.00	1.00
Primary		1.54 (1.30–1.82) ^f	1.51 (1.28–1.79) ^f
Secondary and above		3.1 (2.48–3.83) ^f	2.91 (2.33–3.62) ^f
Woman's current marital status	—		
Never married (RC)		1.00	1.00
Married		2.44 (1.75–3.39) ^f	2.46 (1.77–3.43) ^f
Placée (Common law union)		1.71 (1.26–2.30) ^f	1.713 (1.26–2.31) ^f
Living together		1.50 (1.10–2.06) ^g	1.51 (1.10–2.08) ^h
Divorced/separated/others		1.60 (1.12–2.28) ^h	1.59 (1.12–2.27) ^h
Woman's religion	—		
Catholic (RC)		1.00	1.00
Protestant		0.92 (0.79–1.06)	0.92 (0.79–1.06)
Voodoo, others		0.75 (0.59–0.96) ^g	0.74 (0.58–0.94) ^g
Sex of head of household	—		
Male (RC)		1.00	1.00
Female		1.01 (0.87–1.16)	1.00 (0.87–1.16)
Household wealth	—		
Non-poor (RC)		1.00	1.00
Poor		0.51 (0.43–0.60) ^f	0.63 (0.51–0.78) ^f
Type of place of residence	—		
Rural (RC)			1.00
Urban			0.88 (0.66–1.16)
Proportion of women in community with post-primary education	—		
Small (RC)			1.00
Medium			0.96 (0.76–1.21)
Large			1.38 (1.00–1.90) ^g
Proportion of women in community who perceived distance to health facility to be a big problem	—		
Small (RC)			1.00
Medium			0.96 (0.74–1.26)
Large			0.92 (0.68–1.25)
Proportion of women in community who reported ideal family size of less than three children	—		
Small (RC)			1.00
Medium			1.15 (0.92–1.44)
Large			1.18 (0.92–1.52)
Media saturation in community of residence	—		
Small (RC)			1.00
Medium			1.22 (0.98–1.54) ^e
Large			1.38 (1.01–1.88) ^g
Random Effects			
Community-level variance (Std. Error)	0.715 ^f (0.088)	0.420 ^f (0.064)	0.395 ^f (0.062)
Intra-class correlation	0.179	0.113	0.107
Log-likelihood	–3 271.5	–3 030.5	–3 018.1
Condition number	1.21	13.71	16.47

(Continues)

TABLE 3. Continued

Socio-demographic characteristic	Model 0 ^b	Model 1 ^c	Model 2 ^d
Proportional reduction in variance ⁱ	—	0.41	0.06
Number of groups	445	445	445
Number of observations	5 414	5 414	5 414

RC: reference category.

^a Estimated using gllamm command in Stata.^b Empty model.^c Model includes only individual and household variables.^d Full model includes individual, household and community-level variables.^e $P < .1$.^f $P < .001$.^g $P < .05$.^h $P < .01$.ⁱ Compared to the previous model.TABLE 4. Results (odds ratio) of multilevel regression^a (adjusted) of use of skilled attendance at delivery on selected variables, Haiti 2012

Socio-demographic characteristic	Model 0 ^b	Model 1 ^c	Model 2 ^d
Timing of birth	—		
After the earthquake (RC)		1.00	1.00
Before the earthquake		0.83 (0.71–0.96) ^e	0.79 (0.68–0.92) ^f
Birth rank	—		
1st (RC)		1.00	1.00
2nd		0.41 (0.33–0.50) ^g	0.40 (0.33–0.49) ^g
3rd or higher		0.27 (0.22–0.34) ^g	0.28 (0.22–0.34) ^g
Pregnancy was wanted	—		
No (RC)		1.00	1.00
Yes		1.05 (0.90–1.22)	1.09 (0.94–1.27)
Number of antenatal visits	—		
Three visits or fewer (RC)		1.00	1.00
Four visits or more		2.28 (1.91–2.70) ^g	2.20 (1.85–2.61) ^g
Quality of antenatal care (based on number of components of care received)			
Fewer than 6 (Low quality; RC)		1.00	1.00
Six (High quality)		1.50 (1.29–1.74) ^g	1.51 (1.30–1.75) ^g
Woman's age	—		
15–24 years old (RC)		1.00	1.00
25–49 years old		1.52 (1.25–1.85) ^g	1.47 (1.21–1.79) ^g
Woman's Education	—		
No formal education (RC)		1.00	1.00
Primary		1.32 (1.06–1.64) ^e	1.26 (1.01–1.57) ^e
Secondary and above		2.65 (2.08–3.39) ^g	2.34 (1.83–2.99) ^g
Woman's current marital status	—		
Never married (RC)		1.00	1.00
Married		1.10 (0.78–1.55)	1.15 (0.82–1.61)
Placée (Common law union)		0.88 (0.64–1.21)	0.91 (0.66–1.24)
Living together		0.85 (0.61–1.18)	0.89 (0.63–1.23)
Divorced/separated/others		0.75 (0.52–1.09)	0.75 (0.52–1.08)
Woman's religion	—		
Catholic (RC)		1.00	1.00
Protestant		1.25 (1.07–1.46) ^f	1.26 (1.08–1.47) ^f
Voodoo, others		1.30 (0.99–1.69) ^h	1.23 (0.94–1.60)
Sex of head of household	—		
Male (RC)		1.00	1.00
Female		1.29 (1.11–1.51) ^g	1.25 (1.07–1.46) ^f
Household wealth	—		
Non-poor (RC)		1.00	1.00
Poor		0.28 (0.24–0.34) ^g	0.58 (0.46–0.73) ^g
Type of place of residence	—		
Rural (RC)		—	1.00
Urban		—	1.35 (1.03–1.77) ^e
Proportion of women in community with post-primary education	—	—	
Small (RC)			1.00
Medium			1.13 (0.88–1.46)
Large			1.61 (1.17–2.22) ^f

(Continues)

post-primary education more than doubled them. Skilled birth attendance was also positively associated with living in a female-headed household, older age, and being a Protestant.

When community-level variables were introduced in Model 2, community-level random effects remained strong, as evidenced in the community-level variance and the intra-class correlation. Furthermore, the data reveal strong compositional effects. Specifically, living in a community with a large proportion of women with post-primary education increased the odds of use of skilled birth attendance by 61%. Similarly, the odds of use of skilled attendance increased with the level of community media saturation.

DISCUSSION

This study shows that variables associated with use of MHS in Haiti operate at various levels. There are commonalities and differences in the factors associated with use of antenatal care and skilled birth attendance. For both outcome variables, higher birth rank is significantly associated with lower use of MHS, echoing studies in Nigeria (11) and Kenya (13), although another study from Nigeria failed to demonstrate this relationship (8). A possible explanation for these results is that high-parity women have less desire to use MHS due to a belief that they have experience with pregnancy and childbirth and therefore do not need such services. Additionally, a higher child-dependency ratio in higher-parity women may lead to structural barriers related to cost and time which prevent them from seeking MHS.

Women's education is also associated with both outcomes. Studies have consistently reported a positive link between education and use of MHS in developing countries (25), including in Haiti (10, 18) and Kenya (15). This relationship makes intuitive sense since education is a marker for various other factors that affect health-seeking behaviors. It is reasonable to argue that, compared with their uneducated peers, educated women have better access to health-protective information, possess a level of health literacy that allows them to make the right choices about their health, and are better placed to overcome cultural barriers to maternal health care use (8, 26). Furthermore, education changes a woman's atti-

TABLE 4. Continued

Socio-demographic characteristic	Model 0 ^b	Model 1 ^c	Model 2 ^d
Proportion of women in community who perceived distance to health facility to be a big problem	—	—	
Small (RC)			1.00
Medium			0.89 (0.69–1.15)
Large			0.68 (0.50–0.92) ^e
Proportion of women in community who reported ideal family size of less than three children	—	—	
Small (RC)			1.00
Medium			1.24 (0.97–1.57) ^h
Large			1.23 (0.95–1.60)
Media saturation in community of residence	—	—	
Low (RC)			1.00
Medium			1.59 (1.24–2.03) ^g
High			1.92 (1.41–2.61) ^g
Random effects			
Community-level variance (Std. Error)	1.844 ^g (0.188)	0.536 (0.085)	0.399 (0.071) ^g
Intra-class correlation	0.359	0.140	0.108
Log-likelihood	-3 178.2	-2 675.4	-2 637.6
Condition number	1.124	14.876	17.1
Proportional reduction in variance ⁱ	—	0.71	0.25
Number of groups	445	445	445
Number of observations	5414	5414	5414

RC: reference category.

^a Estimated using gllamm command in Stata.

^b Empty model.

^c Model includes only individual and household variables.

^d Full model includes individual, household and community-level variables.

^e $P < .05$.

^f $P < .01$.

^g $P < .001$.

^h $P < .1$.

ⁱ Compared to the previous model.

tudes towards traditional gender norms, while also changing the expectations of her significant others regarding compliance with traditional gender roles (27). Lack of education can create social distance between pregnant women and service providers, thereby leading to poor quality client-provider interactions and discouraging use of services (28).

Consistent with prior research in Haiti (10, 21) and elsewhere (8, 14, 17), this study found a negative relationship between household poverty and use of MHS. Like education, poverty is a structural factor that affects a woman's ability to seek health care through multiple mechanisms, including availability of services, financial accessibility, geographic accessibility, knowledge about services, attitudes towards services, and provider attitudes (29).

While there was no strong independent association between birth timing and antenatal care attendance, children born before the earthquake were significantly less likely than their younger peers to have benefited from skilled birth attendance. It is not clear if this relationship is due to increased demand

for skilled delivery care, substantive improvement in availability or quality of delivery services or simply the result of the influx of international medical assistance subsequent to the earthquake.

Consistent with previous studies, data presented here show that the number of antenatal visits is significantly associated with increased odds of using skilled attendance at delivery (12, 14, 16). Antenatal care affords a woman the opportunity to be educated about birth preparedness and the need to deliver in a health facility, which in turn may affect her decision to use skilled birth attendance. It is also possible that women who see no need for antenatal care similarly eschew skilled birth attendance, especially if their pregnancy has been problem-free.

One innovation in this study was assessment of the relationship between the quality of antenatal care (measured as the number of essential components of care received) and use of skilled birth attendance. High-quality antenatal care is associated with increased odds of using skilled birth attendance even after controlling for the number of antenatal care visits.

This study suggests significant community compositional effects on use of MHS although the findings are not consistent across the two outcome variables. Community compositional effects appear more conspicuous for use of skilled attendance than for antenatal care. The finding that the prevalence of post-primary education among women in the community of residence is associated with both use of antenatal care and skilled attendance at birth is consistent with one study from India (30) but inconsistent with another from Nigeria (20).

Two other community compositional factors are significantly associated with use of skilled attendance at birth: prevalence of the perception that distance to health facility is a big problem for accessing health care services for self and media saturation. The negative relationship between use of skilled birth attendance and the prevalence of the perception that distance to health facility constitutes a problem is consistent with the distance-decay phenomenon (i.e. the decrease in use of health care as distance to health facilities increases) that several studies have highlighted in Haiti (10, 21) and elsewhere (9, 12). The strong association of use of skilled attendance at birth and community media saturation is similar to findings from a study in Nigeria (8).

There was significant clustering of use of MHS at the community level even after controlling for variables at the individual, household and community levels. In other words, there are unobserved community-level factors that affect use of MHS. While this study does not allow for direct identification of these factors, possible candidates include existing interventions promoting use of MHS within the community, the existence of unmeasured community norms that support or hinder their use, and the presence and acceptability of alternatives to health services within and in the proximity of the community. One relevant area of future research is to examine how communities with different levels of MHS differ in use of such services.

This study has some limitations that warrant mention. The data analyzed are self-reported and therefore subject to memory lapse and social desirability bias that could have affected the internal validity of the data. The problem of memory lapse may have been minimized

through a focus on the most recent birth within the last five years; however, the issue of social desirability bias cannot be discounted. In other words, it is possible that people provide responses that they believe the interviewer wants to hear. Social desirability bias may skew the study results positively or negatively depending on whether some groups of respondents tend to overstate or understate their use of MHS. Furthermore, the observational data analyzed here do not lend themselves to causal interpretations. In addition, the proxy used for distance to health facility did not measure actual distance but derived from respondents' perceptions about distance to health facility as an obstacle to use. The extent to which this proxy variable truly reflects distance to services is uncertain. Finally, the data analyzed in this paper were not designed to examine the correlates of use of MHS from a

socio-ecological perspective. Therefore, it is possible that some variables do not adequately reflect the factors for which they are used as proxies.

Conclusions

The factors associated with use of MHS in Haiti operate at various levels and include measured and unmeasured variables. The findings here suggest that efforts to promote use of MHS should pay special attention to the needs of multiparous, lowly-educated and poor women. Further research should explore barriers to utilization among these groups of women in order to inform appropriate interventions. Relevant strategies should include specific interventions to address the distance-decay phenomenon and improve access of the poor to MHS; for example, through voucher programs or maternity waiting

homes. The latter were first introduced into Haiti in 2001; there is a need to scale up this intervention and address possible quality-related issues that may affect effectiveness, including staffing, availability of supplies and clean water, and costs to the client. The positive link between quality of antenatal care and skilled delivery underscores the need for improving the quality of antenatal care across the board. In addition, a study that examines clients' definitions and expectations of antenatal care is relevant to designing appropriate health systems improvement efforts. Finally, findings from this study point to the relevance of community mobilization efforts to identify and address community norms and contextual factors hindering the use of MHS.

Conflict of interests. The author declares no conflict of interests.

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RESUMEN

Factores asociados con la utilización de los servicios de salud materna en Haití: un análisis de varios niveles

Objetivo. Evaluar los factores asociados con la utilización de los servicios de salud materna (SSM) por parte de las mujeres que dieron a luz en Haití desde el 2007 al 2012.

Métodos. Se analizan los datos de observación derivados de la Encuesta sobre Mortalidad, Morbilidad y Utilización de Servicios llevada a cabo en Haití el año 2012. Se usan métodos analíticos de varios niveles para evaluar los factores asociados con la utilización de los servicios prenatales y la atención calificada del parto (ACP).

Resultados. Los factores predictivos ajustados más sólidos incluyen el orden de nacimiento del niño, la pobreza familiar y la saturación de medios de comunicación en la comunidad. Las probabilidades de obtener cuatro visitas de atención prenatal disminuyen en 53% (razón de posibilidades (OR) = 0,47; intervalo de confianza (IC) de 95%: 0,37-0,57) si el número de orden de nacimiento es alto, y en 37% (OR = 0,63; IC de 95%: 0,51-0,78) si hay pobreza familiar, y aumenta en 38% (OR = 1,38; IC de 95%: 1,01-1,88) si existe una alta saturación de medios de comunicación en la comunidad. Las probabilidades de utilizar una ACP en el momento de dar a luz disminuyen en 72% (OR = 0,28; IC de 95%: 0,22-0,34) si el número de orden de nacimiento es alto, y en 42% (OR = 0,58; IC de 95%: 0,46-0,73) si hay pobreza familiar, y aumenta en 92% (OR = 1,92; IC de 95%: 1,41-2,61) si existe una alta saturación de medios de comunicación en la comunidad. La utilización de los servicios prenatales se asocia intensamente con la ACP (OR = 2,20; IC de 95%: 1,85-2,61). Existe una agregación significativa del uso de los SSM a escala comunitaria.

Conclusiones. Los factores asociados con el uso de los SSM operan en varios niveles. Las iniciativas para promover el uso de estos servicios deben determinar y prestar especial atención a las necesidades de las mujeres multíparas y sin formación, abordar el fenómeno del deterioro del uso como consecuencia de la distancia y facilitar el acceso a las mujeres pobres. También son pertinentes las iniciativas de movilización comunitaria diseñadas para modificar las normas que obstaculizan el uso de los SSM.

Palabras clave

Servicios de salud materna; accesibilidad a los servicios de salud; equidad en el acceso; análisis multinivel; Haití.