Original Research Article

Utilization of maternal health care services and ownership and use of mobile phones among Indian women

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ABSTRACT

Background: Even with years of maternal and child health programmes and interventions, maternal and child health issues persist in India. Given the expansion in the ownership and use of mobile phones, mobile health (mHealth) interventions have been designed and implemented to facilitate MCH services. This study aims to assess whether ownership and use of mobile phones by Indian women are associated with the utilization of maternal health indicators such as antenatal carevand institutional delivery services.

Methods: This study used the latest publically available data on mobile phone use from a nationally representative household survey (n=12047) to examine the association between mobile phone ownership and use, such as access to the Internet or not, texting facility available on the phone or not with having at least four ANC visits or an institutional delivery. The data fitted survey-adjusted logistic regression models adjusted for women's autonomy, access to mass media, and other sociodemographic covariates.

Results: Household ownership of a mobile phone was positively associated with receiving ANC (OR=1.21; CI=1.08-1.36) in fully adjusted models. Women with access to the Internet and SMS facility also had higher odds (OR=2.87; CI=1.54-5.34) of reporting an institutional delivery and receiving an ideal ANC (OR=1.25; CI=1.01-1.64) in the fully adjusted models

Conclusions: Patriarchal social norms potentially affect women's use of mobile phones. mHealth based maternal and child health (MCH) interventions in India, particularly those targeting underprivileged/disadvantaged women, are unlikely to be effective unless measures are made to increase access to, and autonomy in, mobile phone use. Partnering with social scientists in designing such interventions and other policy-relevant implications are discussed.

Keywords: mHealth, Mobile phone ownership, Maternal, Newborn and child health, Health service, MCH

INTRODUCTION

Despite significant improvements in healthcare provision and utilization in India, maternal and child health (MCH) remains a key area requiring public health intervention.[1-3] India had a maternal mortality ratio of 145 per 1,00,000 live births and an infant mortality rate of 30 per 1000 live births in 2017.[4] Neonatal disorders, undernutrition, and iron deficiency feature in the top ten causes of premature death or disability despite decades of rigorous MCH research, policymaking, and programme implementation[2]. With the increasing use of mobile phones across India, mobile health (mHealth) programs have been implemented to promote MCH services.[5,6] Despite criticisms that mHealth is an effective tool mainly for the relatively privileged socioeconomic classes, some evidence suggests that it could also be an effective innovation for improving the health of the underserved socioeconomically disadvantaged and rural populations of India.[7] The ownership and use of mobile phones are key determinants of the success of mHealth interventions.[8]

A 2020 study found that the household ownership of mobile phones was positively associated with selected maternal and reproductive outcomes among Indian women.[9] According to the latest World Bank report, one in five Indians is poor.[10] Thus, the accessibility and affordability of mobile phones remain a concern when evaluating the effectiveness of mHealth interventions.[11] Notably, the cheapest mobile phones cost 500 Indian Rupees (INR) (about one day's minimum wages for manual labour), while a smartphone could cost up to INR 1500.[12] While about 64% of the Indian population owns a mobile phone, most use basic versions that may not have the facilities to receive health intervention benefits, specifically targeting the illiterate population who are usually financially disadvantaged.[13] Given the increasing deployment of mHealth in MCH programs targeting underprivileged populations and the unclear picture about the ability of such individuals to receive the benefits of such interventions, it is important to investigate the role of Indian women's ownership/access to mobile phones in

their healthcare utilization.[6] To our knowledge, no study has examined this relationship in the Indian context. Therefore, we assess whether the ownership and use of mobile phones are associated with the utilization of antenatal care (ANC) and institutional delivery services by Indian women in the reproductive age group in both rural and urban areas.

Conceptual model

We constructed a conceptual model (Figure 1), based on social determinants of health framework and evidence from previous literature shows the socioeconomic status of Indian women is positively associated with the ownership of mobile phones and autonomy levels which are capable of enhancing knowledge about health-related topics and thereby increases utilization of health services.[14-18] The diagram shows various pathways explaining how ownership and use of the mobile phone can be linked to maternal health.
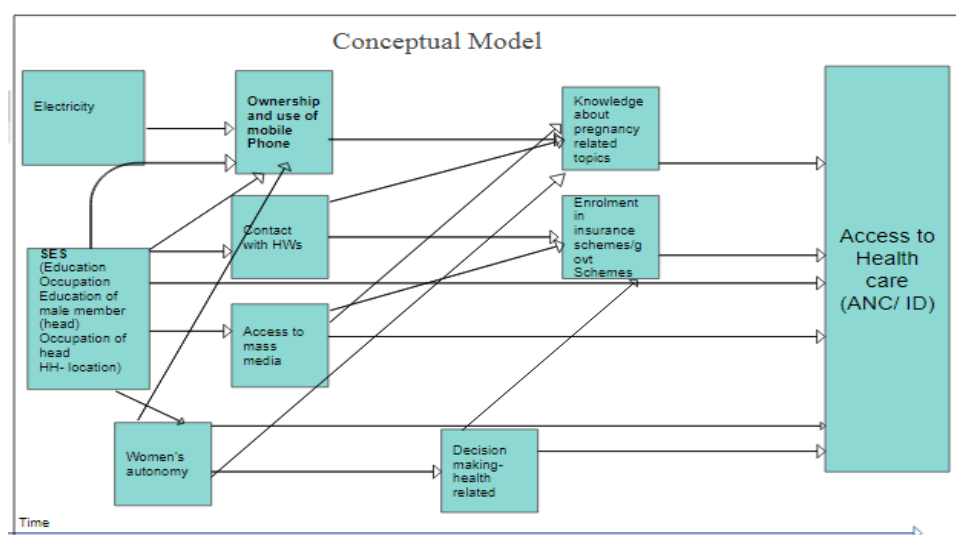

Figure 1: Conceptual model showing the theorized relationships between socioeconomic factors, ownership and use of mobile phone ones, and health outcomes among Indian women

METHODS

Data source

We used data from the second round (2011) of the publicly available India human development survey (IHDS), a nationally representative survey of 42,152 households in 1503 villages and 971 urban neighborhoods across India. Interviews in each household covered topics related to health, economic status, fertility, gender relations, social capital among several others.[19] These are the latest available nationally representative data that link mothers' mobile phone use with their health outcomes.

Participants

We included ever-married women in the reproductive age group (n=39523) with data on whether they had received

ANC or opted for an institutional delivery (n=13925). Observations with complete data on individual ownership of mobile phones and all covariates (12047) were included in the final sample for analysis using the individual ownership of mobile phones as the exposure variable. Missing data on mobility autonomy (783), access to mass media (220), civic participation autonomy (607), relationship with health workers (292) and cash in hand to spend (292) further reduced our analytic sample size. Observations with data on ownership of a mobile phone in their household, after excluding those missing data on covariates, formed the sub-sample for the analysis with household ownership of mobile phones as the exposure (n=10842). This analytic sample further excluded those missing data on mobility autonomy (983), access to mass media (481), civic participation autonomy (857), relationship with health workers (292) and cash in hand to spend (292). Finally, only those who responded

"yes" to the question of whether they owned a mobile phone (n=5548) were included in the analysis related to the access to subscriber's messaging service (SMS) and mobile internet facility. Flowchart showing the inclusion criteria of study participants is depicted in (Figure 2).
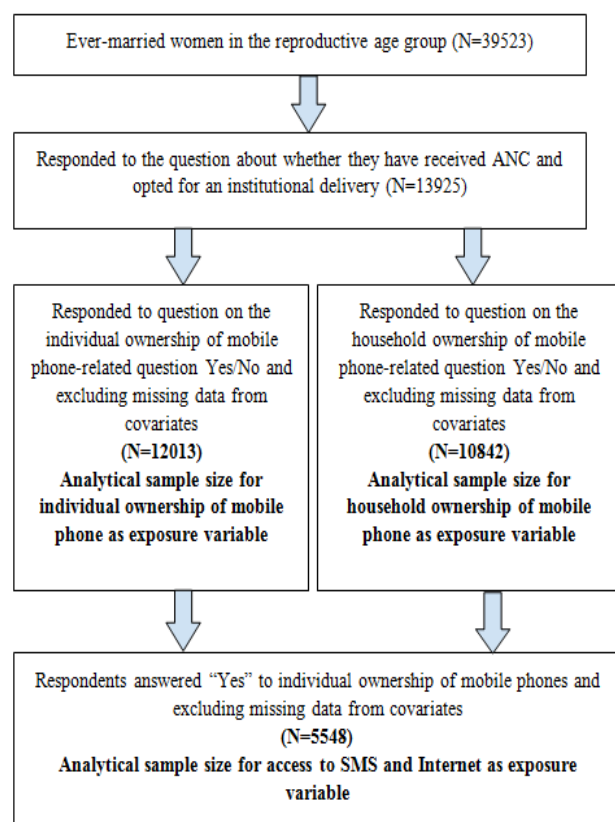

Figure 2: Flowchart showing inclusion criteria of study participants.

Outcome variables

Our first outcome was an "ideal ANC" defined as a report of four or more antenatal care visits during the last pregnancy. A binary variable "ideal ANC" was created which was assigned the value '1' if they reported four or more ANCs and '0' otherwise. The second outcome was "institutional delivery" indicating whether they delivered their last baby at a health facility or not. Using the information on whether the participants reported giving birth to their youngest child at home or public/private facilities, we created a binary variable that denoted deliveries at any health facility as institutional delivery and others as not (0).

Exposure variables

Individual ownership of mobile phones, access to the Internet, and availability of texting facilities were the exposure variables of interest. We used data on questions asking whether or not participants, or their households, owned a mobile phone. We coded women as mobile phone owners and non-mobile phone owners, defined as women who did or did not have access to a mobile phone on their own (individual ownership) or in their household (household ownership). Similarly, we created binary variables indicating women with and without Internet access and women with and without SMS (simple texting) facility.

Covariates

We included the following covariates, details of categories are shown in (Table 1): age (continuous, in years), income (categorical), caste (categorical) household location (urban/rural) participant's access to mass media (yes/no), number of children (continuous), whether they received financial assistance for childbirth or not (yes/no), women's autonomy indicators such as mobility autonomy level (ordinal) and civic participation autonomy levels (ordinal), cash in hand for household expenditures, health decision making (categorical), health-related knowledge (categorical) and acquaintance with health workers (yes/no). Calculation of autonomy variables has been shown in (Table 2).

Table 1: Socio-demographic characteristics of the sub-sample of Indian mothers included in the analysis of ownership and use of mobile phones with access to MCH health services (n=12013).

Sociodemographic characteristics	N	%
Maternal age, mean (SD)	29 (5.4)	--
Maternal education (years)	6.65 (4.9)	
Maternal education		
Zero years of schooling	3118	26.0
1-7 years	2886	24.0
8-12 years	4898	40.5
College and above	1145	9.5
Geographical location		
Urban	3938	32.7
Rural	8109	67.3
Religion		
Hindu	9568	79.4
Muslim	1784	14.8
Others	695	5.8

Continued.

Sociodemographic characteristics	N	%
Caste		
General	3459	28.7
Other backward classes [a]	4775	39.7
Scheduled caste [a]	2765	23.0
Scheduled tribe [a]	1048	8.3
Access to mass media		
No access	2147	17.9
Sometimes	9342	77.5
Regular access	558	4.6
Own a mobile phone		
Yes	5931	49.2
No	6116	50.8
Household own a mobile phone		
Yes	10090	83.8
No	1957	16.2
Mobility autonomy		
High	5021	41.7
Low	4525	37.6
No autonomy	2501	18.7
Civic participation autonomy		
High	72	0.6
Low	3460	28.7
No autonomy	8514	7.07
Cash in hand for household expenditures		
Yes	10605	88.2
No	1423	11.8

[a]These three are historically underprivileged caste groups in India.

Table 2: Calculation of autonomy related variables.

Variable	Items included	Calculation method	Variable type
Mobility Autonomy	Whether a woman can go alone to the local health center? Whether a woman can go alone to the homes of relatives/friends in the neighborhood? Whether a woman can go alone to the kirana (grocery) shop? Whether a woman can travel a short distance alone by bus or train?	An index- by adding these mobility variables. Each of these variables takes a value of 1 or 0 The index- value between 0 and 4.	Categorical Low 0-1, Medium 2-3, High 4
Civic participation Autonomy	Whether a woman participated in an SHG, a women's association, or in a political organization. Whether a woman participated in a credit society? Whether a woman participated in a women's association? Whether a woman participated in a political organization?	An index- by adding variables. Each of these variables takes a value of 1 or 0. The index- value between 0 and 4. Low 0-1, Medium 2-3, High 4	

Statistical method

Demographic patterning in the ownership of mobile phones was described using frequency and percentages. This patterning in our sub-samples for each outcome was compared with the sociodemographic distribution in the larger ever-married women's sample. Survey-adjusted logistic regression models adjusting for women's autonomy, education, occupation, household location, household income, religion, caste and access to mass media were fit. Odds ratios (OR) and 95% confidence intervals (CI) are reported. We used STATA version 12.0 (StataCorp, Texas) to conduct data analysis, and set alpha at 0.05.

RESULTS

The description of the sub-sample for the analysis on individual ownership of mobile phones (n=12013) is shown in (Table 1). The sociodemographic characteristics

of the other sub-samples were generally similar to the presented subset. The association; odds ratios (OR); 95% confidence intervals (CI) of ownership and use of mobile phones with access to MCH health services are shown in (Table 3). The mean age of the respondents was 29, and they had an average of 6.7 years of schooling. About 75% of them had at least some schooling. The sample was mainly from rural locations (67%) and overwhelmingly identified as Hindu (79.4%). Most reported occasional access to mass media. Only 20% of these mothers were formally employed. Our analytical sub-sample had a slightly higher representation of educated women but a slightly lower proportion of women with high mobility-autonomy than the larger ever-married women's sample.

The unadjusted odds of having an ideal ANC were 1.5 times higher (OR=1.5; CI=1.35-1.62) among those who owned a mobile phone versus those who did not. However, this was no longer associated with both the outcomes after adjusting for socioeconomic status and women's autonomy. In an interesting contrast, the women belonging to households that owned versus not owned a mobile phone had 1.2 times higher odds of reporting an ideal number of ANCs and 1.2 times higher odds of reporting an institutional delivery in fully adjusted models.

The unadjusted odds of having ideal ANC and institutional delivery were higher among those with SMS facilities. The association with having an institutional delivery remained significant in the fully adjusted model (OR=1.28; CI=1.06-1.55). Women with access to the Internet had eight times (8.10; 4.64 -14.11) higher odds of

reporting an institutional delivery and three times higher odds of receiving four or more ANCs. Even after adjusting for all the covariates, the odds of having an institutional delivery were 3 times (OR=2.87; p=0.00) higher among those who had access to the Internet than those who did not.

DISCUSSION

Using data of 12,047 Indian mothers from a nationally representative survey, we found that household ownership of mobile phones was associated with a greater prevalence of receiving ideal ANCs and institutional deliveries while individual ownership of mobile phones was not. Accesses to the Internet or SMS facility were positively associated with completing the ideal number of ANCs and opting for an institutional delivery. These findings are especially notable as they are the first, to our knowledge, to shed light on the nuanced ways mobile phones might influence healthcare utilization among Indian women beyond merely owning a phone.

Most of our findings generally corroborate the results of previous studies of mobile phone ownership and MCH outcomes in other low-to-middle-income countries, but few of them do not. A 2020 study using nationally representative data from India found that the household ownership of mobile phone was positively associated with selected maternal and reproductive outcomes among Indian women.[9] However a 2016 Timor-Leste survey of 581 reproductive age women found that household mobile phone ownership was not associated with MCH related outcomes.[20]

Table 3: The association (odds ratios (OR); 95% confidence intervals (CI)) of ownership and use of mobile phones with access to MCH health services among Indian mothers.

Characteristics related to ownership and use of mobile phones	Outcome variable	Model 1[a] OR (CI)	Model 2[b] OR (CI)	Model 3[c] OR (CI)
Individual mobile phone ownership (n=12013)	Ideal ANC	1.51 (1.35-1.62)	0.94 (0.87-1.02)	0.95 (0.86-1.19)
	Institutional delivery	1.55 (1.45-1.69)	0.83 (0.75-0.91)	0.93 (0.73-1.92)
Household mobile phone ownership (n=10842)	Ideal ANC	2.12 (1.91-2.34)	1.25 (1.12-1.39)	1.21 (1.08-1.36)
	Institutional delivery	2.34 (2.11-2.60)	1.19 (1.06-1.34)	1.21 (1.07-1.37)
Access to SMS (n=5548)	Ideal ANC	2.12 (1.90-2.35)	1.07 (0.94-1.22)	1.21 (0.93-1.23)
	Institutional delivery	2.89 (2.49-3.34)	1.25 (1.05-1.49)	1.28 (1.06-1.55)
Access to the Internet (n=5548)	Ideal ANC	3.00 (2.33-3.84)	1.24 (0.95-1.63)	1.25 (1.01-1.64)
	Institutional delivery	8.10 (4.64-4.11)	2.59 (1.46-4.59)	2.87 (1.54-5.34)

[a]Model 1: Included exposure variable. [b]Model 2: Added age, years of education, household location, income and caste to Model 1.
[c]Model 3: Added mobility autonomy, civic participation autonomy, and cash in hand for household expenditures, health decision making, health-related knowledge and acquaintance with health workers to Model 2.

However, a 2014 randomized controlled trial with 2550 pregnant women in Zanzibar concluded that ownership of mobile phone was associated with better utilization of ANC.[21] Our findings that access to SMS facility, and separately, access to the Internet, were positively associated with the outcomes are in line with previous evidence. For instance, several SMS-based MCH interventions currently being implemented in India were

found to be effective.[22,23] Notably, our findings are about access to SMS facility and the Internet but not their actual use. While all mobile phones have the capability to receive SMS texts, only a subset of mobile phones used in India has Internet capability.

While it may appear to be counter-intuitive, the positive association of household ownership of mobile phones with the outcomes with no evidence of any influence of

individual ownership might be expected in the Indian context. The household ownership of mobile phones may represent the involvement of other family members in exposure to the information that flows through mobile phones. Family members likely make decisions on behalf of the women in their households.[24] The low level of autonomy among most Indian women is further complicated by the gender divide in ownership and use of mobile phones in India. Previous research shows that autonomy levels of women in a patriarchal society such as India is low compared to men.[25] This may reduce women's frequency of decision-making related to the purchase and utilization of digital services and normalise the involvement of men in the family in the decision-making process. Moreover, a woman owning a mobile phone may not be capable of using it to the fullest due to digital illiteracy or the lack of digital autonomy.[26,27] Indian women experience a significant disadvantage in employment status, wages, and social roles, increasing their risk of dependency on men.[25] Our finding regarding household mobile ownership is thus understandable in the Indian context, as also the lack of evidence related to individual mobile-ownership. One possible explanation for the health-promoting role of the ownership of mobile phones by women or their households could be any consequent increase in access to health-related information and health communication practices. This could also be explained by an increased ability to tap into social networks among women who either own or live in a household that owns mobile phones. Mobile phones have been shown to enhance the knowledge about self-care, child health and general health related topics among women and thereby can influence their decision-making capacity.[28,29]

While a simple marker of individual ownership of mobile phones did not make a difference, access to SMS facility on women's phones was associated with completing the ideal number of ANC and having an institutional delivery. This might be explained by the existence of several SMS-based health interventions, many of which were found to be effective.[22,23] While data constraints prevented us from studying SMS use, the evidence from previous studies that have measured SMS-facility practices among Indian women supports our finding.[22,23] Our finding might also reflect the better access to health information, health workers, family and friends due to Internet access, which likely further increase the probability of completing the ideal ANC and opting for an institutional delivery. Notably, SMS is a default facility in all mobile phones. Still, Internet access requires an opt-in with payment, suggesting that a history of access to the Internet may represent more active mobile phone users and potentially more proactive individuals leveraging such access. Taken together, our results suggest that the ownership and use of mobile phones are linked with better maternal healthcare utilization. In a country with an increasing emphasis on mHealth, especially in a post-pandemic scenario where face-to-face interventions may not be as feasible as earlier, there is a need to unpack the complex process underlying Indian

women gaining access to mHealth services. Our findings, aligned with the findings of similar previous studies, support the hypotheses showcased in our conceptual model. Unavailability of data on the frequency of participants' use of mobile phone services, and their autonomy in purchasing and using mobile phone and the Internet, prevented us from performing a nuanced analysis. Missing data was another limitation of this study. No causal claims are made due to the cross-sectional nature of the data. However, these are the only nationally representative data on the access to SMS and Internet among Indian women, therefore yielding a decent analytical sample size while allowing us to minimize confounding by adjusting for a range of relevant covariates. To our knowledge, this is the first study to investigate the potential health benefits of access to mobile phone Internet and SMS facility among Indian women at a time of increasing dependence on mHealth services.

CONCLUSION

mHealth interventions can be a powerful tool in low- and middle-income countries with a large population size and limited health workforce. The post-COVID-19 world may demand interventions which minimize direct contact but ensure better health outcomes. Our study sheds emphasises the importance of incorporating beneficiary-specific factors in designing mHealth interventions. The pathways linking access to, and use of, mobile services with healthcare utilization need an in-depth study to ensure effective planning, designing and implementation of mHealth interventions. mHealth interventions targeting women in India, especially the rural, low-income sub-group, are unlikely to be effective unless simultaneous efforts are made to increase access to, and autonomy in, mobile phone use.

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Cite this article as: Gunamany S, Subramanyam MA. Utilization of maternal health care services and ownership and use of mobile phones among Indian women. Int J Community Med Public Health 2022;9:2239-45.