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Original Research Article

## Use of mobile phone for improvement in maternal health: a randomized control trial

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### ABSTRACT

**Background:** The rapid escalation of cellular network coverage and expansion of mobile phone usage has opened up a new way of deploying health services. The mobile app with message facilities help in imparting health education regarding nutrition, iron and folic acid prophylaxis, tetanus toxoid immunization, danger symptoms and signs during pregnancy etc. Present study aimed to improve maternal health and pregnancy outcome by optimum utilization of antenatal, natal and postnatal care services, with the use of mobile phone as a medium of communication between health care provider and community in rural area.

**Methods:** The prospective randomized control study, with two hundred pregnant women each, coming for antenatal visit and having personal mobile phone facility, were randomly allocated to control and intervention group. Control group women received routine antenatal care and advice as per hospital protocol. In addition to routine care and advice, intervention group received mobile phone calls, as reminders about next visit and text messages (SMS) on important aspects of antenatal care at regular intervals. The primary outcome indicators of the study were percentage of pregnant women coming for at least four antenatal visits, percentage of institutional delivery and postnatal check-ups.

**Results:** Women in the intervention group had significantly higher number of antenatal visits, consumption of iron tablets, tetanus toxoid immunization, institutional deliveries and postnatal check-ups as compared to the control group.

**Conclusions:** In the present study, the mobile phone intervention, significantly increased the percentage of women receiving the recommended four antenatal visits and showed a trend towards more women receiving preventive health services. Study gathered good evidence that m-Health tools present an opportunity to influence behaviour change and ensure that women access prevention services, including antenatal, natal and postnatal care. Mobile technology, specifically SMS can be successfully used to extend health information services to pregnant women.

**Keywords:** Antenatal care, M-health, Maternal health, Postnatal visits

### INTRODUCTION

The essential components of antenatal care are screening of pregnant women for high risk factors, performing essential laboratory investigations and provision of advice regarding personal hygiene, nutrition, immunization and regular follow up visits. Literature review suggests that women with regular antenatal visits

have better pregnancy outcome than their counterparts.<sup>1</sup> The reported percentage of antenatal care coverage in India by UNICEF was 37% for four visits and 74% for at least a single visit (2014), institutional delivery rate of 47% and delivery by trained person was 52%.<sup>2</sup> Despite ongoing efforts to improve maternal and child health in developing countries, mortality rates remain much higher than in developed countries.<sup>3</sup> Women in developing

regions face a lifetime risk of maternal death of 1 in 160, as compared with 1 in 3700 for women living in developed regions.<sup>4</sup> These inequalities are driven by many causes, one of which is limited access to preventive services. For example, in low- and middle-income countries, only about 52% of pregnant women receive the World Health Organization- (WHO) recommended minimum of four antenatal visits.<sup>5</sup>

In India, last decade has witnessed extensive networking of mobile phones in rural area. With large number of service providers and large percentage of population with mobile facilities even in rural areas, there is definite scope of optimizing the use of mobile technology for improving maternal health care, especially the antenatal and postnatal period. The field of m-Health, or mobile health, has been proposed as a potential solution to many of the challenges that developing countries face, including workforce shortages, lack of health information, limited training for health workers, and difficulty tracking patients. m-Health projects have been implemented all over the world, using mobile phones for record keeping, data collection, or patient communication.<sup>6</sup>

In India, the use of mobile technology is underutilized in the area of health care delivery. The mobile app with message facilities can also help in imparting health education regarding nutrition, iron and folic acid prophylaxis, tetanus toxoid immunization, danger symptoms and signs during pregnancy etc. Community health awareness can be improved through mobile communication. Overall, it is a cost effective and feasible way to improve community participation in health care delivery in rural area.

**METHODS**

The prospective randomized control study on use of mobile phone in improvement of maternal health was carried out at Rural Medical College, Loni, Ahmednagar for a period of one year. Two hundred pregnant women each, coming for antenatal visit and having personal mobile phone facility, were randomly allocated to control and intervention group. Control group women received routine antenatal care and advice as per hospital protocol. In addition to routine care and advice, intervention group received mobile phone calls, as reminders about next visit and text messages (SMS) on important aspects of antenatal care at regular intervals. All women were advised for institutional delivery and to report for postnatal visits. The primary outcome indicators of the study were percentage of pregnant women coming for at least four antenatal visits, percentage of institutional delivery and postnatal check-ups. Secondary outcome measures were percentage of pregnant women who received prophylactic iron tablets for minimum three months, percentage of women who received injection tetanus toxoid, percentage of women who had undergone ultra-sonography for anomaly scan. Other measurable

indicators were total weight gain by pregnant woman during pregnancy, birth weight of baby, need for parenteral and blood transfusion, perinatal mortality and maternal medical and obstetrical complications.

**RESULTS**

Women in the intervention group had significantly higher number of antenatal visits as compared to the control group (Table 1). They visited clinic more often than prescribed minimum schedule of visits.

**Table 1: Distribution of cases as per total number of antenatal visits.**

Total number of antenatal visits	Group	
	A (Control) N=200	B (Intervention) N=200
1-2	52 (26.00%)	06 (03.00%)
3-4	101 (50.50%)	79 (39.50%)
5-6	33 (16.50%)	67 (33.50%)
>6	14 (07.00%)	48 (24.00%)
Total	200	200

Chi square test p value-<0.0001-statistically significant

Women from intervention group (81%) had consumed iron and calcium tablets for more than three months, after enrolment in the study, as compared to women in control group (69%) (Table 2).

**Table 2: Distribution of cases as per consumption of oral hematinics drugs.**

Consumption of oral haematonic drugs	Group	
	A (Control) N=200	B (Intervention) N=200
≤1month	12 (06.00%)	04 (02.00%)
2months	28 (14.00%)	06 (03.00%)
3 months	22 (11.00%)	28 (14.00%)
>3 months	138 (69.00%)	162 (81.00%)
Total	200 (100%)	200 (100%)

Chi square test p value-<0.0001- Statistically significant

The immunization coverage of tetanus toxoid (Inj TT) among pregnant women was 97.00% in intervention group, as against 87.00% in control group (Table 3).

**Table 3: Distribution of cases as per tetanus toxoid immunization.**

Number of	Group	
	A (Control) N=200	B (Intervention) N=200
Primi (2 doses)	84.11%	97.29%
Multi (Single booster dose)	91.39%	96.62%
Total	87.50%	97.00%

Chi square test p value-<0.0002- Statistically significant

**Table 4: Distribution of cases as per performance of ultrasonography for anomaly scan.**

Obstetric ultrasound examination	Group	
	A (Control) N=200	B (Intervention) N=200
Second trimester anomaly scan	89/112 (79.46%)	111/120 (92.50%)
Third trimester scan	155/200 (77.50%)	189/200 (94.50%)
Total	244/312 (78.20%)	300/320 (93.75%)

Chi square test p value-<0.0001- Statistically Significant

Satisfactory weight gain (>10kg) was observed in 35.00% of pregnant women from intervention group as against 25.00% in control group. Ultrasound examination for anomaly scan was performed in 93.00% women from intervention group as compared to 79.00% from control group (Table 4).

**Table 5: Distribution of cases as per hemoglobin level at the time of delivery.**

Haemoglobin level at the time of delivery	Group	
	A (Control) N=157	B (Intervention) N=170
<6 grams	02 (01.27%)	00 (00.00%)
6-8 grams	10 (06.36%)	05 (02.94%)
8-10 grams	59 (37.57%)	53 (31.17%)
>10 grams	86 (54.77%)	112 (65.88%)
Total	157 (100%)	170 (100%)

Chi square test p value-0.0119- Statistically significant

Thirty six percent of women in intervention group had anemia of variable severity, as against forty five percent in control group. Majority of women with anemia had hemoglobin level in between 6-8 grams percent (Table 5).

**Table 6: Distribution of cases as per place of delivery.**

Place of delivery	Group	
	A (Control) N=200	B (Intervention) N=200
Pravara rural hospital	157 (78.50%)	170 (85.00%)
Government hospital	10 (05.00%)	06 (03.00%)
Private hospital	11 (05.50%)	07 (03.50%)
Home	12 (06.00%)	02 (01.00%)
Undelivered	10 (05.00%)	15 (07.50%)
Total	200	200

Higher percentage of women from intervention group delivered at Pravara Rural Hospital than control group. Approximately 10% women delivered in either government or private hospitals. Overall percentage of home delivery was 5% (Table 6). The rate of low birth weight babies was 30% in women from intervention group as against 35% in women from control group. The perinatal mortality among babies born at Pravara Rural Hospital was lower in intervention group (2.94%) as compared to control group (3.82%). The need for blood

transfusion for correction of anemia was significantly higher in control group (3.00%) as compared to intervention group (0.00%). Similarly, the need for parenteral iron therapy for correction of iron deficiency anemia was higher in control group (5.00%) as compared to intervention group (2.00%). Overall, 8.00% women required treatment for anaemia in control group as against 2.00% in intervention group. The medical and obstetric maternal complications during pregnancy and labor were 24.00% and 31.00% in intervention and control group respectively. Significantly large number of women from intervention group (85.00%) visited Pravara Rural Hospital, for postnatal check up, as compared to the women from the control group (21.00%) (Table 7).

**Table 7: Distribution of cases as per number of postnatal visits.**

Number of postnatal visits	Group	
	A (Control) N=157	B (Intervention) N=170
0	46 (29.29%)	10 (05.88%)
1	78 (49.68%)	16 (09.41%)
2	32 (20.38%)	141 (82.94%)
3 or more	01 (00.63%)	03 (01.76%)
Total	157 (100.00%)	170 (100.00%)

Chi square test p value-0.0001- Statistically significant

The acceptance of permanent method of contraception (tubal ligation) was higher in intervention group (30.00%) as compared to control group (27.00%). Fifty five percent of women from intervention group and thirty one percent women from control group accepted permanent method of sterilization with two or less number of living children. Maximum number of subjects (98%) from the intervention group expressed satisfaction about mobile phone intervention.

## DISCUSSION

The randomized control trial was conducted to know the usefulness of mobile phone in improving the quality of antenatal care in rural area of Ahmednagar district in Maharashtra state, India. The literature search on the subject revealed that there are very few published studies on the subject in India, where as majority of studies are from African subcontinent.

The present study was conducted at a tertiary care hospital, which drains majority of antenatal and high risk pregnancies from the neighbouring townships. A survey was conducted before beginning of the study to find out the availability of the mobile phone with the study subjects i.e. pregnant women. Survey revealed that 45 percent of women attending antenatal clinic possessed the personal mobile phone and another 40 percent of the women had access to mobile phone at home. Mobile phone was owned by some close relative /family member staying with the pregnant woman. The survey also revealed that women were using mobile phone either for

calling purpose or for receiving the text messages. Mobile users were able to receive and reply to the phone call and text messages. Majority did not have internet facility in the mobile phone. There was good response from the pregnant women regarding willingness to participate in the study. They expressed preference for text messages in local language and a phone call, for establishing communication with them.

Analysis of findings related to number of antenatal visits revealed that women from the intervention group had significantly more number of antenatal visits as compared to the control group. Phenomena of missing of an antenatal visit was predominantly seen in women from control group. Women in intervention group had visited clinic more often than prescribed minimum schedule of visits. As against minimum four antenatal visits prescribed to both control and intervention group, the study subjects from intervention group had more than 6 visits in 24 percent women as against only 6 percent in control group. Similarly, 34 percent women from intervention group had 4-6 visits as compared to 17 percent women from control group. The difference in the percentage of antenatal visits in control and intervention group was statistically significant. Lund et al<sup>7</sup> observed that the mobile phone intervention was associated with an increase in antenatal care attendance. In the intervention group 44% of the women received four or more antenatal care visits versus 31% in the control group (OR, 2.39; 95% CI, 1.03-5.55).

There was a trend towards improved timing and quality of antenatal care services across all secondary outcome measures although not statistically significant. West DM reported study that m-Health programs had shown positive results.<sup>8</sup> An estimated 281,000 new mothers signed up for the Text4Baby service. Researchers in China have found that —text message and telephone reminders improved appointment attendance by 7 percent and in Malaysia, non attendance dropped by 40 percent among new mothers, who received text reminders of their medical appointments.<sup>8</sup> Lund et al reported that the majority, 59%, of intervention women stated that receiving text messages influenced the number of times they attended antenatal care.<sup>7</sup> In addition, 71% felt that the educational messages helped them in various areas including learning about danger signs in pregnancy and feeling that the health system cared for them.

Watterson JL reported in her review article that, there was some evidence that the m-Health intervention implemented had a positive impact on patient or health worker behaviour.<sup>3</sup> Two of the seven studies examining antenatal care attendance were RCTs. Both studies used text message reminders and education for pregnant women and one also provided the women with mobile-phone vouchers to contact their health worker, if needed. Both studies found a statistically significant increase of over 10% in the proportion of women receiving at least four antenatal care visits between the intervention and

control groups. Another study examined antenatal care attendance before and after implementation of the m-Health application for improved patient records and automated appointment reminders; this study similarly found a statistically significant improvement in on-time antenatal care attendance following implementation. A study conducted in China in which text message were sent as reminders for antenatal care and health advice to an intervention group and found a statistically significant increase in antenatal care attendance, compared to a historic control group.

The remaining studies examining antenatal care attendance found some self-reported behaviour change from both patients and health workers. One study examining postnatal care attendance used a historic control group from the previous 6 months in the same hospital and found that the intervention group, receiving text message appointment reminders, were 50% less likely to fail to attend their appointment. Another study found that women self-reported intended or actual behaviour change, including increased attendance to postnatal care, after receiving voice or SMS messages with education and reminders.

Fedha T in their study of 191 women showed that 7.4% of those followed up had less than 4 antenatal visits, while 18.6% of those not followed up, had less than 4 visits with a p value 0.002, which showed there was significantly higher proportion of women on follow up, who had more than 4 antenatal visits.<sup>9</sup> There was significantly higher proportion of women on follow up, who received diet and place of delivery counselling, malarial prophylaxis, iron and vitamin supplements and de-worming drugs

Noordam AC et al reported the Robust studies providing evidence on the impact of introducing mobile phones to improve the quality or increase the use of maternal health services are lacking.<sup>10</sup> However, there was a broad agreement that access to communication was an essential component of improving the use and quality of maternal health services. The mobile phone had a high potential as it is small, portable, widely used, relatively cheap and the extending network coverage increasingly enables communication with rural and isolated areas. The extremely quick uptake of mobile phones worldwide can shorten delays in seeking and receiving health care.

Beuermann DW et al, reported a study with the main findings suggesting that SMS increased the number of prenatal care visits by 5 percent and the number of prenatal care visits attended on time by 10 percent.<sup>11</sup> However, these effects were stronger for more educated women with easier access to health centres. Car, Josip et al reported three studies with moderate quality evidence that mobile text message reminders improved the rate of attendance at healthcare appointments compared to no reminders (risk ratio (RR) 1.10 (95% confidence interval (CI) 1.03 to 1.17)).<sup>12</sup>

Kaewkungwal J et al in their study revealed that the module improved ANC/EPI coverage in the study area along the country border including for both Thai and non-Thai mothers and children, who were either permanent resident or migrants; numbers of ANC and EPI visit on-time as per schedule significantly increased; there was less delay of antenatal visits and immunizations.<sup>13</sup> Mushamiri I et al Study concluded that the incorporation of m-Health tools in CHW programs improved the adherence to ANC and PNC and enhanced PMTCT efforts.<sup>14</sup> Datta SS et al reported that seventy per cent of pregnant women were willing to receive health information via text messages, and 98.33 per cent believed text messages could effectively spread health messages.<sup>15</sup> A significant increase in knowledge was observed following delivery of the text messages. These findings suggested that mobile communication between health care provider and pregnant women, could create awareness among pregnant women about importance of regular antenatal visits. The women in the rural area are dependent on the male counterpart for attending antenatal clinic. The telephonic message or a phone call from a hospital regarding the antenatal visit helped in creating awareness among the other members of the family, ultimately improving the attendance at the antenatal clinic. The less educated women need to convince the family persons, especially the male folk for taking them to antenatal clinic. Women's health is in general is not a priority agenda for men, especially in villages.

The phone call was found to be more effective mode of communication as compared to the text messages in the present study. The study subjects when interviewed about it, replied in majority (92%) that they received the phone call from the hospital about their visit. Thirty percent subjects said that they had forgotten the exact day and date of visit, and phone call just two days before, reminded them about it and helped them to arrange for travel and accompaniment to antenatal clinic. Eighty six percent of women from intervention group could follow the exact days and dates of their visit. This helped them to receive attention from their regular doctor. This helped to built rapport with a particular doctor. This helped women to build trust and confidence about the services of the hospital. As against, the women from control group, either missed their antenatal visits as they forgot about it or they reported on wrong days, thus not meeting their regular doctor. At times, they were sent back by the doctors and asked them to report on their respective days. This resulted in inconvenience, mistrust and lack of confidence about the services rendered by the hospital. In the present study, it was observed that the women in intervention group had higher consumption of oral haematinic tablets than women from control group. Significantly higher number of women from intervention group (81%) had consumed iron and calcium tablets for more than three months, after enrolment in the study, as compared to women in control group (69%). Women in the rural area are dependent on the family members for purchasing iron tablets for them. Telephonic reminders

by doctors or nurses were responsible for higher percentage of injection tetanus toxoid immunization coverage in intervention group as compared to control group. Lund et al reported that there was a trend towards favourable intervention association across all secondary outcome measures, although not statistically significant.<sup>7</sup> In the intervention group 72% of nullipara women received two doses of tetanus vaccination versus 56% in the control group (OR, 1.62; 95% CI, 0.81-3.26). The perinatal deaths are the deaths that occur during intrauterine life after 28 weeks of pregnancy till seven days after birth, thus it consists of intrauterine deaths (macerated still births), intrapartum deaths (fresh Still births) and early neonatal deaths. The perinatal deaths mainly occur in high risk pregnancies. Unbooked status, poor supervision during pregnancy, poor quality of natal care and absence of neonatal care facilities. The perinatal mortality among babies born at Pravara Rural Hospital was lower in intervention group (2.94%) as compared to control group (3.82%). This could be attributed to optimum antenatal care, institutional deliveries, timely deliveries by appropriate route, good quality natal care and neonatal care .

In the present study, it was observed that the need for blood transfusion for correction of anaemia was significantly higher in control group (3.00%) as compared to intervention group (0.00%). Similarly, the need for parenteral iron therapy for correction of iron deficiency anaemia was higher in control group (5.00%) as compared to intervention group (2.00%). Overall, 8.00% women required either parenteral iron therapy or blood transfusion for treatment of anaemia in control group as against 2.00% in intervention group. This difference was significant. The possible reasons for less number of women requiring anaemia treatment in intervention group could be related to better antenatal care, more frequent visits, better nutrition following dietary advice received through mobile phone calls and text messages and due to direct contact with specialists at the antenatal clinic. Similar observations were noted by other authors in their studies.<sup>7</sup> Postnatal visit is also useful in providing contraceptive advice to woman or the couple. It is a good opportunity to counsel the couple about the importance of spacing between the issues and adoption of small family norms. The couple can be educated about various options available for contraception or sterilization. In the present study, the pregnant woman and or her husband was educated through text messages about the importance of postnatal visits. Majority of women from intervention group (85.00%) visited Pravara Rural Hospital, for postnatal check up, as compared to the women from the control group (21.00%). This was one of the most significant finding and achievement of the present study. This has helped in many ways. The male participation in child rearing has increased. Husband of the woman or the close family members visited the hospital during child immunization. The Ghana health Service-Policy planning monitoring and evaluation division, reported in the pilot

district, the average time to follow with a defaulting client had dropped from over 20 days to just over a week for antenatal care visits and from 2 days to just over half a day for postnatal care visits.<sup>16</sup>

## CONCLUSION

In the present study, the mobile phone intervention significantly increased the proportion of women receiving the recommended four antenatal care visits during pregnancy and there was a trend towards more women receiving preventive health services and more women with ante-partum complications being identified and referred. Mobile phone intervention in the form of calls and messages have positively influenced the rate of institutional deliveries and health behaviour of the women and the community. The study gathered good evidence that m-Health tools present an opportunity to influence behaviour change and ensure that women access prevention services, including antenatal, natal and postnatal care. Pregnant women proactively participated and optimally utilized and appreciated the m- health initiation in the present study.

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