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Effects of a telehealth programme using mobile data transmission on primary healthcare utilisation among children in Bamako, Mali

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Summary

Pesinet is a non-profit organisation which operates a microinsurance programme combined with a monitoring service in low-income countries to increase primary healthcare utilisation for children. We studied the association between enrolment in the Pesinet programme and changes in utilisation of health services. We conducted a prospective controlled study in Bamako (Mali) in children under five years old. Participants in the Pesinet service were recruited from a neighbourhood of Bamako (n = 91) and participants in the control group (usual care) came from two other neighbouring districts (n = 89). Eight questionnaires were completed at 2-week intervals for each child in the study. We performed logistic regression modelling to assess the effect of the Pesinet programme on health service utilisation, adjusting for confounding variables (age and socio-economic status). During the study, families reported 206 episodes of disease in the intervention group and 168 in the control group. Children from the intervention group had 85 medical consultations and those in the control group had 28. Based on the logistic regression model, there was increased utilisation of health care services among children enrolled in the Pesinet programme, with an adjusted Odds Ratio for medical consultations of 2.2. Membership of the Pesinet telehealth programme increased primary healthcare utilisation among children under five years old in Mali.

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Introduction

Despite important progress, child health remains a serious problem in many countries. In Mali, the situation is exceptionally difficult. In 2010, the infant (0 to 1 year) mortality rate was 99 per 1000 live births and the mortality rate in children under five years was 178 per 1000. Over 120,000 children under five years died in 2010 in Mali. About 70% of these early childhood deaths could be prevented using simple and affordable interventions, such as monitoring basic symptoms, including bodyweight change.[1] One of the main reasons for the high rate of health problems in Mali is the under-utilisation of the medical services available locally.[2]

Mobile health (m-health) is a way of reaching large numbers of people for health purposes. The majority of mobile phone users (64%) are based in low- and middle-income countries (LMICs). Telehealth and m-health have great potential in LMICs, but their value in healthcare still needs to be evaluated.[3]

Pesinet is a non-profit organisation which operates a monitoring service for prevention, early-detection, treatment and follow-up of illnesses in children under five years old. The monitoring service is combined with a simple micro-insurance plan that improves access to healthcare for families with young children in Bamako, Mali.[4] The Pesinet service depends on trained weighing agents (WA) who are responsible for recruiting new subscribers, carrying out weekly health check-ups of children enrolled in the programme, collecting health data on a mobile phone application, and transmitting the data to a database for analysis by physicians. When children at risk are identified, the mobile application sends an alert to the family and an emergency ticket is given to the patient to come to the community health centre the same day.

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The WA also educates families on preventative health practices, informs them about existing medical services and acts as an interface between families and healthcare providers.[4]

There have been several reports about telehealth and m-health programmes in Africa and in other LMICs. However, most of the studies have been descriptive, non-controlled and lacking in scientific rigour.[5] In a recent systematic review of the literature on m-health interventions in LMICs, Gurman *et al.* concluded that the studies were either purely descriptive in nature or lacked evaluation components entirely.[6] Nevertheless, some studies have shown the positive effect of m-health on healthcare in developing countries. For example, a pilot study in Rwanda used mobile technology for data collection, community health management, basic automated remote diagnostics, and tracking pregnancy and newborn life cycles. This study demonstrated an increased number of deliveries in health facilities and a reduction in child deaths.[7] Another pilot study in Malawi found that the use of SMS messaging reduced delays in data transmission, improved data quality, reduced manpower requirements and improved reporting rates in child malnutrition surveillance.[8]

There have been very few reports about programmes combining telehealth and micro health insurance in LMICs. A report about a combined telehealth and micro-insurance intervention in India was purely descriptive.[9] We are not aware of any quantitative study of healthcare utilisation in a paediatric population.

The objective of the present study was to evaluate the relationship between enrolment in the Pesinet telehealth programme and changes in the utilisation of health services among children under five years old in Bamako.

Methods

We conducted a prospective study of children enrolled in the Pesinet telehealth programme who formed the Telehealth group (TG) and children not enrolled in the programme who formed the Control group (CG). The study took place between November 2010 and April 2011 with 16 weeks of follow-up for each participant. Participants were recruited in November-December 2010 in three districts of Bamako.[10] The neighbourhood of Bamako-Coura was the main site covered by the Pesinet programme, so participants in the TG were recruited in this district. Two other neighbouring districts, Bolibana and Dravela, were chosen for the recruitment of CG participants. All potential participants were approached by the WAs who were women from the same districts. Participants for the TG were drawn by a simple random method from about 600 children enrolled in Pesinet at the time.[11]

The enrolment procedure for the CG was as follows: WAs visited homes in a random order to identify potentially eligible families (those with children under five years old). After verifying eligibility, the WA offered the parent of the eligible child the opportunity to participate in the study. Parents who accepted signed a consent form. The WAs tried to balance the TG and CG according to age, sex and socioeconomic status of families throughout the recruitment procedure.[12] As the assignment of participants to intervention or control group was not randomized, the design of the study must be considered quasi-experimental.[13]

Children eligible for the study had no diagnosed chronic diseases and were aged between 0 and 72 months. If there were two children or more in the families enrolled in Pesinet, only one of them was recruited (at the family's discretion).

Based on data concerning the healthcare utilisation for children 0–5 years in Bamako, a sample size of 160 children (80 in each group) was considered sufficient to detect, with a power of 80%, a difference between groups of at least 10% in the rates of consultation.[12]

Intervention

Children received a weekly (or twice weekly for children of 0–1 years old) routine home visit by a WA. The WAs collected information on the child's health status (bodyweight, body temperature, breast-feeding, vomiting, stools, coughs, health complaints and any emergency indicators) and recorded the data in their mobile phones via a JAVA applet. The phone kept track of each subscriber so that the WA could easily access and update recorded information on a patient. The health data were transferred through the mobile network to a central server and presented to the general practitioner (GP) of the nearest Community Health Centre through a website that flagged any abnormalities automatically. The GP analysed the data and if a health problem was identified, the WA gave an emergency ticket to the patient for a same-day consultation with the GP. Children enrolled in Pesinet received free consultations and a reduction on the price of prescribed medications.

Control

Children in the CG received no weekly home visits by a WA and no particular monitoring by a GP, nor any discounts on care or medicine. Thus the comparison arm was usual care.

Data collection

We developed a structured questionnaire to collect information on diseases, medical consultations and associated costs. The WA conducted follow-up visits every two weeks for TG and CG families. Eight questionnaires were completed at 2-week intervals for each child in the study. During each visit, the WA asked the respondent about the previous two-week period. The first question was: "Over the last two weeks, has your child been ill? Yes/No" and the second question was: "Have you consulted to

treat your child's illness? Yes/No''. In most cases, the respondent was the mother of the participating child. The same person in the family answered the questions for every WA visit. During the first visit, a questionnaire was completed by all participating families to assess their socioeconomic level using the Progress out of Poverty Index (PPI).[14] All families were grouped according to the four categories of socioeconomic status (1 = lowest to 4 = highest).

Statistical analysis

We first conducted chi-squared homogeneity tests to compare the groups' characteristics. Then a logistic regression was used to estimate the effect of enrolment in the Pesinet telehealth programme on healthcare utilisation. Each child participating in the study typically contributed eight observations to the analysis. Regression models were estimated using the Generalized Estimating Equations (GEE) approach with an independent working correlation structure. This structure was chosen by the quasi-likelihood information criterion (QIC) and confirmed by the Wald-Wolfowitz runs test.[15] The initial model included the group as a variable of interest, as well as age at follow-up times, gender and PPI as potentially confounding variables. We used a backward algorithm and the QIC to select the best model.[15] We did not identify multicollinearity problems. We used a standard package (SAS 9.3) for all analyses.

The study was approved by the appropriate ethics committees.

Results

In total, out of 188 children eligible to participate in the study, four families (2%) refused to participate and four (2%) who were enrolled were excluded due to lack of adequate follow-up after the first visit, see Figure 1. Out of 180 children included (91 in TG, 89 in CG), complete data were obtained for 176 (97%). Three participants were lost due to failed follow-up at the last visit (2 in TG; 1 in CG) and one was lost due to failed follow-up for the last three visits (TG). Data from all participants with no lost visits were used in the analyses.

The median age of children in the TG was 1.4 years (range 0.2 to 4.6), and 2.9 years (range 0.1 to 5.9) in the CG. There was a significant difference in the distribution of age groups between the TG and CG (Table 1). However, there was no significant difference regarding gender distribution. The socioeconomic level of families according to the PPI was significantly higher in the TG (Table 1). Despite the efforts of the WA during recruitment, the two study groups were not balanced regarding the age of the children and the socioeconomic status of the families (Tables 1). Thus, the sociodemographic variables (age, gender and PPI) were considered as potential confounding factors and were taken into account in subsequent analyses.

During the 16-week follow-up period, 236 episodes of disease were reported for 82 children in the TG, and 168 episodes of disease for 71 children in the CG. Among these 404 episodes, there were 113 associated primary healthcare consultations: 85 in the TG and 28 in the CG, see Table 2. There was no significant difference regarding the distribution of reported symptoms between the two study groups.

During model selection, gender was removed from the model as a non-significant and non-confounding variable. The final logistic model included study group as a significant predictor, and age and PPI as confounding variables. The last two variables were not significant at the 5% level, but we retained them in the model. In the final model, a greater proportion of medical consultations was associated with enrolment in the Pesinet telehealth

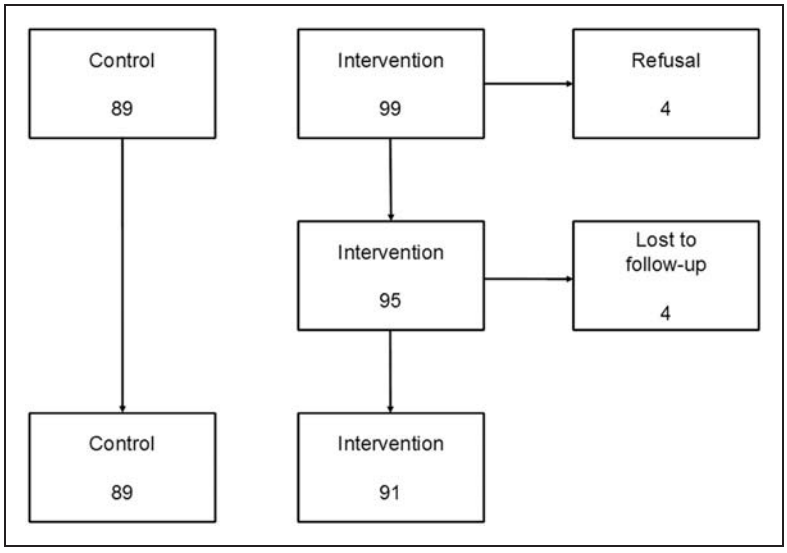

Figure 1. Study flow chart.

Table 1. Characteristics of the participants.

	Intervention (n = 91)	Control (n = 89)	*P*-value (chi-squared test)
Age group (%)			<0.008
0–0.99 y	34	15	
1–1.99 y	27	25	
2–2.99 y	16	21	
3–3.99 y	14	16	
4–4.99 y	8	20	
5–5.99 y	0	3	
Males (%)	46	60	<0.072
PPI index (%)			<0.001
1	1	22	
2	27	38	
3	49	23	
4	23	16	

Table 2. Primary symptoms.

	Intervention No (%)	Control No (%)	Total
Cold	96 (41)	62 (37)	158
Cough	21 (9)	10 (6)	31
Diarrhoea	17 (7)	20 (12)	37
Fever	24 (10)	23 (14)	47
Infection	19 (8)	7 (4)	26
Pain	9 (4)	8 (5)	17
Teething	4 (2)	2 (1)	6
Vomiting	2 (1)	2 (1)	4
Wounds	4 (2)	7 (4)	11
Others	40 (17)	27 (16)	67
Total	236 (100)	168 (100)	404

programme. The adjusted OR for medical consultations of TG vs. CG was 2.20 (95% confidence interval, CI 1.26–3.85), i.e. the odds of medical consultation for a health problem in the TG were 2.2 times higher than the odds of medical consultation in the CG, see Table 3. The unadjusted OR (2.86, 95% CI 1.79–4.57) was 30% greater than adjusted OR. However, the unadjusted OR did not take into account the confounding factors, and might have been biased. Although non-significant, the OR for the variable age was <1 and the OR for the variable PPI was >1 (Table 3). So, younger children and children from well-to-do families tended to consult more frequently in our sample.

Discussion

In the present study utilisation of healthcare services was significantly greater for children in the Pesinet telehealth programme. A systematic review by Jeffrey and Newacheck showed a significant and positive effect of health insurance on access and utilisation of healthcare in a paediatric population with special needs.[16] In another systematic review, Buchmueller *et al.* analysed 58 studies conducted in North America and found that health insurance coverage increased medical care utilisation from 30 to 50% among children.[17] This increase was significant and affected all types of medical services: ambulatory and hospital, curative and preventive. In addition, this review also showed that medical insurance had a lesser effect for children from poor families compared to those from families with higher incomes.[17] The effect of socioeconomic status on healthcare utilisation was also presented in a UNICEF report.[18] The opposite effect of age on healthcare utilisation found in our study has also been confirmed in the literature.[19]

Table 3. Odds ratio of healthcare utilisation, adjusted by age and PPI.

	Odds ratio	95% confidence limits	
Intervention vs. control	2.20	1.26	3.85
PPI 2 vs PPI 1	1.52	0.55	4.20
PPI 3 vs PPI 1	2.09	0.77	5.66
PPI 4 vs PPI 1	2.10	0.74	5.97
Age	0.99	0.98	1.01

The present study suffered certain limitations that impede the generalisation of the results. The first major limitation relates to the recruitment process: TG and CG participants were recruited from different neighbourhoods and followed by different WAs, and parents decided which child would participate in families with more than one eligible child. Thus, the two study groups were unbalanced with respect to the age of the children and the family's socioeconomic status. In order to minimise the possible effect on the results, age and PPI were kept as confounding variables in the model. There may also have been information bias related to the presence of social desirability and recall biases. However, this bias would not be differential and would not artificially increase the OR.

In conclusion, the present study showed that membership of the Pesinet telehealth programme increased primary healthcare utilisation among children under five years old in Mali.

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