

Mobile Phones Increase Immunization Rates: Evidence from the DHS

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Abstract

Immunization is an efficient and cost-effective intervention for improving child survival. Despite of that, more than 30 million children are unimmunized. In developing countries, the low vaccination rates are mainly due to the demand-side barrier, such as lack of knowledge, forgetfulness and prohibitive transport. The potential impact of mobile phone access on immunization rates is here explored using data from the latest available DHS from 14 Low Middle Income Countries (LMICs) in Africa and Asia. Preliminary results show that children of phone-owning mothers are more likely to be vaccinated vis-à-vis their phone-less counterparts. This study therefore may provide strong empirical support that boosting mobile-phone access and coverage might be a vehicle through which increase immunization in LMICs.

Keywords: Mobile Phones; Technology; Immunization Rates

JEL classification numbers: O33; I12; L82; L86

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Immunization is an efficient and cost-effective intervention for improving child survival [3]. Despite of that, more than 30 million children are unimmunized [13]. While many improvements on the supply side issues (e.g. cold chain, staff training and procurement) have been done, still demand-side barriers such as lack of knowledge, forgetfulness and prohibitive transport costs have been blamed as the leading cause for low vaccine uptake in Low and Middle Income Countries (LMICs) [18].

To increase a more equitable access to immunization, the World Health Organization encouraged member states to take action to incorporate eHealth (electronic health) in their health systems and services, during the 8th World Health Assembly in 2005. Among them, mobile technologies have been applied to a diverse range of initiatives outlined in recent reviews on mHealth (mobile health) interventions globally [6]. Mobile-phone-based health-care interventions have extensively improved health care and the support provided to field health-workers [7] with implications in terms of improved antenatal care attendance [10], reduced perinatal mortality [10], improved clinical outcomes of HIV-positive pregnant women [5], and increased contraceptive use [16, 4] as well as its acceptability [12]. Furthermore, the increased affordability of mobile phones has been shown to be related to enhanced financial inclusion and labor market prospects, especially for women [17], increased food security and dietary quality [15], and better educational outcomes [1].

Although the potential for mobile ownership and, in particular, mHealth interventions to improve vaccination rates seems rather straightforward, the evidence is not, being so far mainly anecdotal and based on a few selected countries. Vaccination reminders SMS were found to increase uptake and reduce delays in receiving immunization in Zimbabwe [11], increase vaccination uptake in Kenya and in India [9]. No effects, however, were found in Pakistan [8].

This paper tries to fill this gap in the literature, by exploiting how the digital revolution might affect immunization in LMICs using data on 14 countries from the Demographic Health Surveys (DHS) covering the period 2014-2017. Digital technologies have changed people’s lives and everyday activities across the globe. With the advent of the “mobile-phone” – a cheap, ubiquitous, and multitasking device, many developing countries have leapfrogged over the landline stage of development and moved straight into the wireless age with immense socio-economic implications [14]. In several developing countries mobile phones nowadays serve a wide range of capabilities spanning from enabling communication to the provision of information and the delivery of services [2]. In so doing, we contribute to the literature in two directions. First, by exploiting the exogenous variation in the mobile coverage, we aim to provide evidence on the causal impact of mobile ownership on immunization rates. Secondly, we intend to shed light on the potential heterogeneity in this relationship across countries and immunization types.

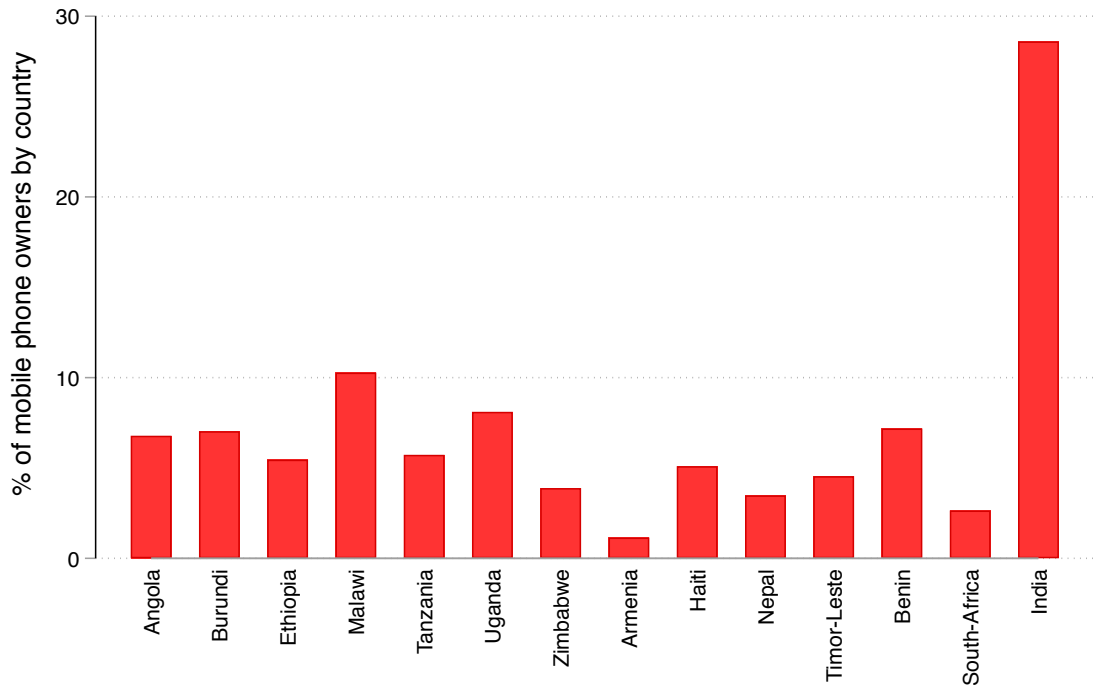


Figure 1: % of mobile phone owners by country Source: Author’s elaboration on DHS data.

1 The Data and Methods

To assess the association between mobile phone penetration and immunization coverage we use the women dataset for 14 LMICs from the DHS. More precisely our data cover nine African countries, namely Angola, Benin, Burundi, Ethiopia, Malawi, South-Africa, Tanzania, Uganda and Zimbabwe and six Asian countries, namely Armenia, Haiti, India, Nepal and Timor-Leste. The data cover the latest waves of the DHS for the period 2014-2017.

Figure 1 shows the percentage of mobile users in our dataset. Stark evident is the cross-country heterogeneity with respect to mobile phone ownership, with India playing the lion’s share and Armenia having the lowest penetration rate among women.

From the survey, we create a dummy equal to at least one child has received any kind of immunization (e.g. BGC, Diphtheria-Pertossius DPT3, Polio, Measles-Mumps and Rubella-MMR, or any other) by the age of three. Unfortunately only the six youngest children living in the household were included. To estimate the association between the two we used model 1

explained in what follows

$$IMM_{ic} = \alpha + \beta \cdot Mobile_{ic} + \gamma \cdot Mother_i + \eta \cdot Country_c + \epsilon_{ic} \quad (1)$$

Where IMM_{ic} represents the probability for a mother i living in country c to get at least one of her children immunized. $Mobile$ is a dummy variable equal to 1 whether she own a mobile phone and 0 otherwise. $Mother$ are some mother specific effects such as her education and her marital status, $country$ are some country fixed effect. ϵ represents a random error term. We are interested in the β coefficients which represent the change in the probability to have a child immunized associated with a mobile phone ownership.

2 Results

As a preliminary assessment of our results, the models depicted from Table 1 to Table 5 show that children from phone-owing mothers have a higher chance, by about 3%, to be vaccinated with respect to their phone-less counterparts. This study therefore may provide strong empirical support that boosting mobile-phone access and coverage might be an important vehicle through which increasing immunization in LMIC. In additional regressions (reported in the full paper) we deal with the endogeneity issue in the relationship vaccination-mobile phone ownership by exploiting the impact according to the degree of mobile penetration.

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Table 1: Correlations between mob. phone ownership and BGC vaccination

	(1)	(2)	(3)	(4)
	At least one child received BGC			
	b/se	b/se	b/se	b/se
owns a mobile telephone	0.078*** (0.004)	0.074*** (0.004)	0.043*** (0.005)	0.032*** (0.005)
Ref: Angola				
Burundi		0.256*** (0.011)	0.275*** (0.012)	0.303*** (0.013)
Ethiopia		-0.054** (0.021)	-0.027 (0.022)	0.001 (0.022)
Malawi		0.248*** (0.012)	0.240*** (0.013)	0.269*** (0.013)
Tanzania		0.209*** (0.012)	0.215*** (0.014)	0.237*** (0.014)
Uganda		0.223*** (0.011)	0.213*** (0.012)	0.238*** (0.013)
Zimbabwe		0.149*** (0.015)	0.126*** (0.016)	0.154*** (0.016)
Armenia		0.220*** (0.011)	0.198*** (0.013)	0.202*** (0.013)
Haiti		0.045* (0.019)	0.036 (0.020)	0.065** (0.020)
Nepal		0.187*** (0.016)	0.198*** (0.018)	0.216*** (0.018)
Timor-Leste		0.056** (0.017)	0.054** (0.018)	0.074*** (0.018)
Benin		0.146*** (0.014)	0.182*** (0.015)	0.195*** (0.015)
South-Africa		0.202*** (0.012)	0.182*** (0.014)	0.184*** (0.014)
India		0.190*** (0.011)	0.184*** (0.013)	0.195*** (0.013)
Ref: no education				
primary			0.071*** (0.006)	0.064*** (0.006)
secondary			0.105*** (0.006)	0.082*** (0.006)
higher			0.104*** (0.009)	0.068*** (0.009)
respondent's current age			0.000 (0.000)	0.000 (0.000)
respondent currently working			-0.004 (0.005)	-0.003 (0.005)
Ref: Currently married				
Currently in a union			0.006 (0.007)	0.006 (0.007)
Formerly married/union			-0.008 (0.009)	-0.003 (0.009)
household has: radio				0.015** (0.005)
household has: television				0.065*** (0.005)
R-squared	0.015	0.098	0.110	0.118
N	51167	51167	48987	48585
F	319.113	99.593	71.322	70.407

OLS. Standard errors robust to heteroskedasticity in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 2: Correlations between mob. phone ownership and DPT vaccination

	(1)	(2)	(3)	(4)
	At least one child received DPT			
	b/se	b/se	b/se	b/se
owns a mobile telephone	0.073*** (0.005)	0.073*** (0.005)	0.038*** (0.005)	0.029*** (0.005)
Ref: Angola				
Burundi		0.303*** (0.012)	0.321*** (0.014)	0.349*** (0.014)
Ethiopia		0.031 (0.022)	0.067** (0.023)	0.095*** (0.023)
Malawi		0.278*** (0.014)	0.267*** (0.015)	0.295*** (0.016)
Tanzania		0.256*** (0.013)	0.261*** (0.015)	0.286*** (0.015)
Uganda		0.243*** (0.013)	0.235*** (0.014)	0.261*** (0.014)
Zimbabwe		0.189*** (0.016)	0.165*** (0.018)	0.192*** (0.018)
Armenia		0.226*** (0.017)	0.206*** (0.019)	0.210*** (0.020)
Haiti		0.072*** (0.020)	0.064** (0.022)	0.090*** (0.022)
Nepal		0.221*** (0.018)	0.237*** (0.020)	0.257*** (0.020)
Timor-Leste		0.080*** (0.019)	0.079*** (0.020)	0.097*** (0.020)
Benin		0.147*** (0.016)	0.185*** (0.017)	0.198*** (0.017)
South-Africa		0.222*** (0.016)	0.191*** (0.020)	0.192*** (0.020)
India		0.201*** (0.012)	0.201*** (0.014)	0.213*** (0.015)
Ref: no education				
primary			0.078*** (0.007)	0.071*** (0.007)
secondary			0.123*** (0.007)	0.101*** (0.007)
higher			0.117*** (0.011)	0.082*** (0.011)
respondent's current age			0.002*** (0.000)	0.001*** (0.000)
respondent currently working			0.010 (0.006)	0.011 (0.006)
Ref: Currently married				
Currently in a union			0.007 (0.007)	0.007 (0.007)
Formerly married/union			0.005 (0.010)	0.011 (0.010)
household has: radio				0.017** (0.006)
household has: television		6		0.063*** (0.006)
R-squared	0.010	0.078	0.089	0.097
N	51041	51041	48874	48475
F	222.116	86.481	65.717	64.050

OLS. Standard errors robust to heteroskedasticity in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 3: Correlations between mob. phone ownership and polio vaccination

	(1)	(2)	(3)	(4)
	At least one child received polio			
	b/se	b/se	b/se	b/se
owns a mobile telephone	0.046*** (0.005)	0.052*** (0.005)	0.025*** (0.005)	0.020*** (0.005)
Ref: Angola				
Burundi		0.316*** (0.012)	0.327*** (0.013)	0.346*** (0.013)
Ethiopia		0.120*** (0.019)	0.147*** (0.021)	0.162*** (0.021)
Malawi		0.287*** (0.013)	0.275*** (0.015)	0.294*** (0.015)
Tanzania		0.265*** (0.013)	0.266*** (0.014)	0.284*** (0.014)
Uganda		0.240*** (0.013)	0.232*** (0.014)	0.248*** (0.014)
Zimbabwe		0.210*** (0.016)	0.185*** (0.018)	0.204*** (0.018)
Armenia		0.265*** (0.016)	0.253*** (0.019)	0.251*** (0.019)
Haiti		0.095*** (0.021)	0.086*** (0.022)	0.105*** (0.022)
Nepal		0.237*** (0.018)	0.247*** (0.020)	0.258*** (0.020)
Timor-Leste		0.052* (0.020)	0.048* (0.022)	0.058** (0.022)
Benin		0.147*** (0.016)	0.177*** (0.017)	0.187*** (0.017)
South-Africa		0.141*** (0.026)	0.122*** (0.034)	0.122*** (0.034)
India		0.236*** (0.012)	0.234*** (0.014)	0.241*** (0.015)
Ref: no education				
primary			0.070*** (0.006)	0.065*** (0.006)
secondary			0.107*** (0.007)	0.092*** (0.007)
higher			0.082*** (0.012)	0.059*** (0.012)
respondent's current age			0.001** (0.000)	0.001* (0.000)
respondent currently working			0.012* (0.006)	0.012* (0.006)
Ref: Currently married				
Currently in a union			-0.006 (0.007)	-0.006 (0.007)
Formerly married/union			0.005 (0.010)	0.009 (0.010)
household has: radio				0.008 (0.006)
household has: television				0.044*** (0.006)
R-squared	0.004	0.076	0.085	0.090
N	51175	51175	48996	48593
F	85.456	86.720	65.217	63.227

OLS. Standard errors robust to heteroskedasticity in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 4: Correlations between mob. phone ownership and measles vaccination

	(1)	(2)	(3)	(4)
	At least one child received measles			
	b/se	b/se	b/se	b/se
owns a mobile telephone	0.074*** (0.006)	0.072*** (0.007)	0.038*** (0.007)	0.026*** (0.007)
Ref: Angola				
Burundi		0.272*** (0.014)	0.267*** (0.015)	0.296*** (0.015)
Ethiopia		-0.050* (0.022)	-0.021 (0.024)	0.008 (0.024)
Malawi		0.217*** (0.017)	0.210*** (0.019)	0.240*** (0.019)
Tanzania		0.194*** (0.016)	0.189*** (0.017)	0.212*** (0.017)
Uganda		0.167*** (0.015)	0.150*** (0.016)	0.175*** (0.016)
Zimbabwe		0.126*** (0.018)	0.106*** (0.020)	0.133*** (0.020)
Armenia		0.131*** (0.023)	0.115*** (0.026)	0.120*** (0.026)
Haiti		-0.001 (0.021)	-0.017 (0.022)	0.010 (0.022)
Nepal		0.232*** (0.022)	0.252*** (0.024)	0.276*** (0.023)
Timor-Leste		0.077*** (0.020)	0.071*** (0.021)	0.093*** (0.021)
Benin		0.036* (0.017)	0.056** (0.019)	0.070*** (0.019)
South-Africa		0.238*** (0.022)	0.204*** (0.029)	0.205*** (0.029)
India		0.188*** (0.013)	0.199*** (0.016)	0.213*** (0.016)
Ref: no education				
primary			0.079*** (0.008)	0.072*** (0.008)
secondary			0.117*** (0.009)	0.095*** (0.009)
higher			0.112*** (0.015)	0.081*** (0.016)
respondent's current age			0.006*** (0.001)	0.005*** (0.001)
respondent currently working			0.033*** (0.008)	0.035*** (0.008)
Ref: Currently married				
Currently in a union			-0.008 (0.010)	-0.007 (0.010)
Formerly married/union			0.019 (0.014)	0.025 (0.014)
household has: radio				0.019* (0.007)
household has: television				0.062*** (0.009)
	8			
R-squared	0.006	0.043	0.053	0.056
N	51016	51016	48857	48456
F	142.957	66.675	58.452	57.819

OLS. Standard errors robust to heteroskedasticity in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 5: Correlations between mob. phone ownership and any vaccination

	(1)	(2)	(3)	(4)
	At least one child received any vacc.			
	b/se	b/se	b/se	b/se
owns a mobile telephone	0.050*** (0.003)	0.051*** (0.003)	0.030*** (0.003)	0.022*** (0.003)
Ref: Angola				
Burundi		0.162*** (0.008)	0.172*** (0.009)	0.192*** (0.010)
Ethiopia		-0.056*** (0.016)	-0.037* (0.017)	-0.020 (0.017)
Malawi		0.148*** (0.009)	0.138*** (0.010)	0.159*** (0.011)
Tanzania		0.122*** (0.009)	0.123*** (0.010)	0.138*** (0.010)
Uganda		0.137*** (0.009)	0.125*** (0.009)	0.143*** (0.010)
Zimbabwe		0.059*** (0.013)	0.036* (0.014)	0.057*** (0.014)
Armenia		0.128*** (0.008)	0.109*** (0.009)	0.111*** (0.010)
Haiti		0.029 (0.016)	0.020 (0.016)	0.040* (0.016)
Nepal		0.096*** (0.014)	0.101*** (0.015)	0.114*** (0.016)
Timor-Leste		-0.029 (0.016)	-0.033* (0.016)	-0.019 (0.016)
Benin		0.086*** (0.011)	0.111*** (0.012)	0.120*** (0.012)
South-Africa		0.125*** (0.008)	0.104*** (0.009)	0.106*** (0.009)
India		0.109*** (0.008)	0.102*** (0.010)	0.110*** (0.010)
Ref: no education				
primary			0.055*** (0.005)	0.050*** (0.005)
secondary			0.080*** (0.005)	0.064*** (0.005)
higher			0.076*** (0.007)	0.050*** (0.007)
respondent's current age			0.000 (0.000)	0.000 (0.000)
respondent currently working			-0.002 (0.004)	-0.001 (0.004)
Ref: Currently married				
Currently in a union			0.005 (0.005)	0.006 (0.005)
Formerly married/union			0.004 (0.007)	0.008 (0.007)
household has: radio				0.010* (0.004)
household has: television				0.047*** (0.004)
R-squared	0.090	0.065	0.076	0.083
N	51016	51016	48857	48456
F	216.656	78.994	53.407	50.250

OLS. Standard errors robust to heteroskedasticity in parentheses. * p<0.05, ** p<0.01, *** p<0.001

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