

Mobile phone and child mortality: the case of developing countries

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Abstract

Using the Generalized Method of Moments (GMM) methodology on a panel dataset of 43 developing countries covering the period 2000 to 2012, this study provides an econometric evidence that child mortality relates to mobile phone, health expenditure, gross domestic product per capita, female education, and Sanitation. The results imply that mobile phone isn't an important contributor in reducing child mortality. Additionally, higher per capita income, total public expenditure, female education, and access to Sanitation have a statistically significant favorable impact on child mortality. Furthermore, public health expenditure almost has an insignificant impact. The results of this study benefit the policymakers in designing policies aiming to reduce child mortality in developing countries.

1. Introduction

Health is one of the principal dimensions that represent the core of the Millennium Development Goals (MDGs), as it is a pivotal role in reducing poverty, education, and gender equality (WHO, 2005:7). Moreover, the goal of good health and well-being is considered one of the Sustainable Development Goals (SDGs) (ICSU & ISSC, 2015). Bloom et al. (2004) indicate that health capital has a positive impact on economic growth. The study concludes that increasing life expectancy by one year as a result of improving health conditions contributes to increasing economic growth by about 4% per annum. Additionally, the study of Aguayo-Rico et al. (2005) attributes the difference in growth rates among countries to the difference in health level.

As child's health is considered one of the public health components, the fourth goal of the MDGs is represented in reducing under-five mortality by two-thirds over the period from 1990 to 2015. Despite the progress in reducing the under-five mortality rate, the rate announced in the millennium goals has not yet been achieved. Globally, under-five mortality has dropped from 90 deaths per 1,000 live births in 1990 to 43 deaths per 1,000 live births in 2015, with an average decline of more than half. According to these rates, the goal of reducing under-five mortality rate by two-thirds will be achieved by the year 2025 (UN., 2015 A).

The united nation launches the 2030 agenda including 17 SDGs and 169 targets that are built on the MDGs and complete what haven't been achieved. One of the SDGs is to ensure healthy lives for achieving nine targets, one of these targets is to reduce newborn mortality to 12 deaths and under-five mortality to 25 deaths per 1000 live births by 2030 (UN., 2015 B).

As the lack of knowledge, information and health services is considered one of the underlying causes of child mortality (under five and infant mortality) (UNICEF, 2009:15), access to the mobile phone can play an essential role in reducing child mortality. Mobile phone is characterized by being small in size, portable, relatively cheap, and easy to use. Thus, there is broad agreement about the importance of mobile phone as an important factor in improving the usage and quality of health services provided to pregnant women and children (Noordam et al., 2011:623; Modi, 2013:1).

The rapid expansion of mobile phone infrastructure, especially in developing countries, contributes to widening the coverage of most areas (mHealth Alliance, 2012:8). The additional coverage is reflected in the number of mobile subscribers that amount to about 5.5 billion in the developing countries out of 7 billion subscribers worldwide in 2014 (ITU., 2015). Therefore, there are increasing opportunities to access to maternal and child health information and services through the

mobile phone. Using and relying upon mobile phone in the health field is known as m-health (Noordam et al., 2011:622).

Accordingly, the main objective of this study is to answer two main questions: Does the access to mobile phones has a statistically significant role in reducing child mortality in the developing countries? What are the other factors that possibly contribute to reducing child mortality in those countries?

Despite the general agreement about expected favorable impact of using the mobile phone on child mortality, the empirical evidence is still limit. Most of the studies evaluate pilot projects that apply health programs through mobile phones in particular areas or on case study as the study of West (2015). According to our knowledge, the study of Balci and Kucuk (2014) is the only study that focuses on studying the impact of information and communication technology (ICT) components and gender equality on child development using a cross-sectional data set of 136 developed and developing countries in 2006.

Based on the previous background and due to the lack of evidence of wide-scale impact, there is a necessity for an empirical study to test the impact of mobile phone on child mortality. Therefore, the present study aims to estimate this impact in 43 developing countries over the period 2000 till 2012. The 43 developing countries was selected according to the availability of data out of 75 developing and less developed countries representing 98% of all maternal and child deaths at the global level, and of interest to 'The Commission on Information and Accountability for Women's and Children's Health (COIA)'. The United Nations founded COIA in 2011 aiming to help these countries in fulfilling the fourth and fifth goals of the MDGs; reducing under-five mortality and maternal death. It proposes ten recommendations to strengthen ICT role in these countries to achieve the MDGs (ITU., 2013).

This study includes five sections. The introduction represents the first section. The second section includes the existing literature. The third section contains the econometric model and data set. The fourth section deals with the estimation results of the study. Finally, the fifth section presents the findings and provides policy recommendations.

2. Literature review

2.1. Mobile phone and child mortality

Since the year 2000, many development initiatives have been offered to overcome the information challenges facing developing countries and to close the technological, social, and economic gap. For instance in the year 2000, the G-8 provided the 'Digital Opportunity Task Force' with the main objective was to provide the advice to governments and international organizations to close the digital gap (WB., 2003). Also, a pair of important initiatives was taken by the International Telecommunication Union and United Nations represented by the World Summit on the Information Society in Geneva (December 2003) and in Tunisia (November 2005) (ITU. & UN., 2003). The primary aim of these two initiatives is to urge and spread the use of information and communication technology in developing countries seeking to close the digital gap between the developed and the developing countries and accordingly achieving the development goals included in the Millennium Declaration. Furthermore, the UN Global Strategy for Maternal and Child Health stresses the importance of mobile phone and broadband internet access in health care services in improving women and children's health (UN., 2010:10).

Mobile phone, like any ICT device, allows the exchange and transfer of information worldwide without spatial or temporal barriers (Shade et al., 2012:157), with high efficiency and low costs (Chen, 2004:9). Although it is common in recent years to have access to health information depending on computers especially after widening the Internet infrastructure, relying on the mobile phone in the field of health care is now more important. Mobile phone outperforms the computer and is favored by users because of the capability of using by all groups of society in all regions at any time (Riley et al., 2011:53), especially because smartphones allow the ability of connection to the

Internet. A survey conducted by AUSAID and USAID (2012) on 2500 women in Egypt, India, Uganda, and Papua New Guinea found that 84% of these women desired to get better health care information, and 39% of them wished to have access to health information through their mobile phones.

Although many developing countries depend on local radio to provide some information concerning mothers and infants in local dialect or language, the radio can be replaced by the mobile phone. A project based on radio technology in delivering health care to pregnant women applied in Tororo district of Uganda in 1996 and resulted in reducing the rate of maternal mortality by nearly 50% by the year 1999 (Musoke, 2001). Lately, it was displaced by mobile phone as it is a cheaper and more applicable solution (Noordam, et al., 2011:2). However, this kind of projects can still be applied, and information can still be obtained from local radio through the mobile phone as the radio application is available on mobile phone.

As for the visual media through which some health information for pregnant women and infant are broadcasted and can change some views concerning the use of modern medical means (Navaneetham & Dharmalingam, 2002), it can be watched through smartphones. Based on above, the importance of mobile phone is apparent as a tool for providing health services and information.

The expected positive impacts of using the mobile phone on child and maternal health flow through two channels: users and medical service providers in the health sector. In many developing countries, especially in Africa, the majority of the population lives in rural areas that lack proper health care. This situation leads many of them to go cities to receive health care, bearing high cost (McNamara, 2007:20). Accordingly, the mobile phone is considered one of the important tools in this respect as it provides the possibility of receiving health information and facilitating the arrival of medical services that were not available, in addition to reducing medical care cost (ITU., 2003:84; Hjelm, 2005:60). Doctors being geographically distant from patients is not an obstacle anymore to diagnose diseases and determine treatment in due time (West, 2015:13). In Bangladesh, mobile birth notification system "mobiles for health" was launched for the purpose of contacting health units to call for midwives in case working ladies need them. Applying this system resulted in the fact that the number of births under the supervision of specialists reached about 89%. Beforehand, about 90% of births used to take place outside hospitals (Brownlee, 2012). There is no doubt that the increase in using smartphones and its applications will help in widening the scope of medical services either for users or service providers (Riley et al., 2010:54). Smartphones that are linked to the internet allow for browsing medical reliable websites which help in obtaining medical information. Users can search for a treatment and get all the health knowledge needed. Moreover, doctors can search for medical information for the purpose of learning or conducting researches. For example, site as www.mamaye.org benefits stakeholders as it updates information on a daily basis which finally be reflected in a better child and maternal health (Nyamawe and Seif, 2014:40).

However, many people lack abilities and skills to search for the needed information by using the mobile phone on their own. Thus, workers in the health sector can share medical information concerning the health of children and pregnant women using sending text messages to mobile phones (Lund et al. 2014:2), as maternal health is strongly linked to children's health and their survival. Relying on text messages returns to the ability to be sent easily, at a low cost for a high number of beneficiaries, within a short period, and is also suitable for all kinds of mobile phones (Riley et al. 2011:54).

In Zanzibar, the project "wired-mother" was adopted in twenty-four health units covering six districts to increase the percentage of mothers receiving medical care during pregnancy and after delivery. This project depended on text messages to spread medical information, and it provided the possibility of direct contact between mothers and health units through a system on the mobile phone (Lund et al., 2014:2). In Rwanda, the rapid short message services (SMS) application was applied in 2012 in four districts for the purpose of supporting and helping pregnant women and newborns.

Using this program helped workers in the health field to follow up pregnant women and urged them to obtain health care during pregnancy. It also helped them to improve communication in case of emergency (World Vision International). In China, appointment attendance has been enhanced by 7% as a result of sending reminder text messages to women through mobile phones. As for Malaysia, health care increased by 40% among mothers who received reminder messages (West 2015:5).

Furthermore, mobile phones allow the possibility of protecting mother and child from some diseases through sending text messages that announce launching of different vaccination campaigns, and clarify how to take precautionary measures to control or prevent the spread of a particular disease (WB., 2003:22-23). Phukan et al. (2009) prove that parents' lack of information is one of the essential factors that lead to vaccination leak.

On the other hand side, Mobile phone contributes in gathering and providing workers in health care sector with information about patients. In Rwanda "Rapid Short Message Services application" that was applied to support pregnant women and infants helped in determining the causes of maternal and child death on the local basis (World Vision International). Moreover, Mobile phone contributes in providing the opportunity of exchanging medical expertise and providing workers in remote regions with information and medical consultancy from their colleagues who have a greater opportunity to obtain information (McNamara 2007:12). In Ghana, nurse midwives depend on the mobile phone to discuss complicated cases with their colleagues and superiors (UN., 2010:10). In Islands of Gambia, workers in health sector send photos of patient's symptoms to doctors in near cities to diagnose the disease without any transportation costs (WB., 2003:23).

Based on the above, it is apparent that access to mobile phone technology can contribute to the effectiveness and efficiency of health services provided to mother and child which, naturally, will be reflected in child mortality reduction. West (2015) finds that the use of mobile phone has a favorable effect on a group of African countries under study, as the mobile phone technology provides the opportunity to improve doctors' abilities and increase the quality of services rendered to critical cases for both mother and infant in due time. Fedha (2014) concludes a positive relation between women who have mobile phones and the number of attending clinics during pregnancy period, as they were reminded of their appointments by the mobile phone. Nyamawe and Seif (2014:41) return the reduction of maternal and child mortality in Tanzania during the period from 1996 till 2010 to several projects that connected mothers to both health centers and midwives using text messages and mobile phone calls. The projects provided mothers with information related to their health condition in addition to some advises and warnings regarding critical cases. Moreover, the project linked health units with hospitals that allowed workers in local units to obtain medical consultancies and recommends for critical cases.

2.2. Other determinants of child mortality

The Gross Domestic Product (GDP) per capita, a proxy for standard of living, is considered one of the well-known determinants of child mortality. Anyanwu And Erhijakpor (2007: 16) emphasize that high per capita income leads to an increase in the demand for health care, assuming that it is a normal good. High income leads to the adoption of modern health technology that is reflected in the reduction of mortality rate (Houweling et al., 2005:1258). Moreover, it allows the possibility of providing essential public infrastructures such as water, sanitation, nutrition, and better houses (Cutler et. al. 2006:110). Income has a tangible impact on health especially in low-income countries due to the prevalence of absolute deprivation that includes lack of food and clean water (Anyanwu And Erhijakpor 2007:16). O'Hare et. al. (2013:413) show that the increase in average GDP per capita by 10% leads to a reduction in infant mortality rate by 10% in case of the prevailing infant mortality rate in the country is 50 per 1000 live births. The empirical study of Fayissaa and Gutema (2005:126) on 31 Sub-Saharan African countries over the period from 1990 till 2000, finds that the increase in income per capita, food availability, urbanization, and the decrease of illiteracy and carbon dioxide emission rate improve life expectancy at birth. Additionally, Hanmer et al. (2003)

find that per capita income, health indicators, education and gender inequality are statistically significant determinants of infant and under-five mortality.

It is also argued that health expenditure is an important determinant of under-five and infant as it affects child health status. Therefore, WHO (2007: 14) has designed a framework including six essential foundations for the sake of strengthening the health system. Health expenditure is considered a proxy for the health system. Bokhari et. al. (2007:257) conclude that public health expenditure has a significant impact on maternal and under-five mortality reduction. Anyanwu And Erhijakpor (2007:28) find that public and total health expenditure have a remarkable effect on under-five and infant mortality in 47 African countries. Gottret and Schieber (2006:4) conclude that public health expenditure in 81 medium and low-income countries has a greater impact on reducing maternal and under-five mortality than the impact of public investment in roads, education, and sanitation. Houweling et al., (2005:1261) conclude that public health expenditure has a significant effect on reducing child mortality rate among poor groups as compared to rich groups. Issa and Ouattara (2012:28) find that public health expenditure is more efficient in lower development stages while private health expenditure is more efficient in reducing infant mortality in higher development stages.

Despite the importance of public sector in providing health services especially in developing countries and despite the fact that the existence of positive externalities or market failures justify the existence of public health sector, this does not mean that increasing public health expenditure guarantees achieving positive health outcomes (Anyanwu And Erhijakpor 2007:8). Lewis (2006:44) confirms the importance of having good governance to achieve efficient public health expenditure and increase health investment returns. Kamiya (2010:10) proves that public health expenditure will not pay off in the case of lack of complementary services such as pure water, sanitation, and communication infrastructure. In a panel study on 44 Sub-Saharan African countries during the years from 1995 till 2010, Novignon et al. (2012:6) conclude that total health expenditure leads to an improvement of life expectancy at birth and reduction of child mortality. The study, however, shows that the misallocation of resources and weak management in public health sector lead to an increase in child mortality in case of increasing public health expenditure.

On the other hand, female's education is considered one of the main determinants of under-five and infant survival and health. Women are the first and principal sponsors for children so their education will be reflected in their behaviors concerning the best health-care for children (Cutler et al. 2006:110). Educated women have greater ability to interact efficiently with health service providers, respond to treatment recommendations, most committed to childcare, and provide a clean living environment (Smith and Haddad 1999:16). The study of Rowe et al. (2005) conducts a survey on a sample of ladies have children under five years in Nepal in 2000. It concludes that educated women and dealing with media positively and strongly correlate with mother's health information and behavior which reflect on her health as well as her children's health. In a study conducted in 22 countries of Latin America and the Caribbean during the nineties, Moore, et al. (2003) conclude that the impact of female literacy and vaccination rates have a more significant impact on reducing under-five mortality as compared to the impact of the increase in Gross National Product per capita. Despite the multiple benefits of educated women to their children, women's education increases their chances for outdoor work and this will be at the expense of children's care (Smith and Lawrence 1999:16). Nevertheless, it is expected that the advantages of female's education on child mortality reduction exceed the negative impact of her going out to work.

Installing sanitation in houses is an another determinates of child mortality. The lack of sanitation in developing countries causes a recurrence of diarrheal disease, which is considered one of the leading causes of infant and under-five mortality (Günther and Fink 2010:2).

3. Model Specification & data

3.1. The model

The Arellano-Bond (1991) estimation methodology is used to overcome the endogeneity problem that might arise from child mortality rate to one or more of the determinants and vice versa, as this problem leads to a possible correlation between the set of determinants and the error term of the model. The mentioned methodology is applied to test the impact of mobile cellular subscriptions and other important determinants of infant and under-five mortality rate, as presented in Equation (1) as follows:

$$MR_{i,t} = B_0 + B_1 MR_{i,t-1} + B_2 Ph_{i,t} + B_3 \ln GDPPC_{i,t} + B_4 Hexp_{i,t} + B_5 Fedu_{i,t} + B_6 Sans_{i,t} + u_{i,t} \quad (1)$$

Where $MR_{i,t}$ represents child mortality rate: under-five and infant mortality. $MR_{i,t-1}$ represents the lag of the child mortality rate. $Ph_{i,t}$ represents Mobile cellular subscriptions or internet users. $\ln GDPPC_{i,t}$ is a natural log of Gross Domestic Product per capita. $Hexp_{i,t}$ refers to public or total health expenditure, $Fedu_{i,t}$ represents female education, $Sans_{i,t}$ denotes to sanitation facilities, and $u_{i,t}$ refers to the error term, with the subscript i for countries ($i = 1, \dots, n$) and t for years ($t = 1, \dots, T$).

It is necessary to note that Equation (1) is estimated twice; once by using the under-five mortality rate as a dependent variable in the model and the other by using the infant mortality rate as another dependent variable. Also, to check the robustness of the model other explanatory variables were used. The indicator of internet users and total health expenditure replaced Mobile cellular subscriptions and public health expenditure respectively.

To estimate the model using Dynamic Panel System GMM, first the correct group of instruments must be valid, or in other words, it must be relevant and exogenous. First, to test for the relevance of the instruments, the F-statistic of the first stage regression of every endogenous variable on the group of instruments must exceed ten to ensure that the bias is smaller than the OLS estimation. Secondly, to test for overidentification the J-statistic test is used to test the hypothesis that the group of instruments are exogenous to the error term of the original model. If the null hypothesis is not rejected, then the group of instruments are exogenous.

This method is characterized by its ability to tackle Endogeneity problem that emerges from the omitted variables or measurement errors. The basic idea of GMM method is to put slope equation in the form of a dynamic panel data model previously referred to, then take the first differences of the equation variables, and use the lagged values for the levels of explanatory variables as instrumental variables (Arellano and Bond 1991).

Based on the literature reviewed earlier, Mobile cellular subscription is expected to have an adverse impact on child mortality rate. Thus, an increase in mobile phone subscriptions implies a broader access to health care and services, which helps to decrease under-five and infant mortality rate. Additionally, it is expected that GDP per capita, female's education, and sanitation will have a favorable impact on child mortality rate. Moreover, it is clear that the impact of public and total health expenditure on child mortality is somewhat ambiguous; consequently, the sign of the indicator can't be predicted in advance.

3.2. Descriptive data

The present study use unbalanced panel data for 43 developing countries over the period 2000-2012 sourced from the world development indicators data set and listed in Appendix A. Table (1) gives the description of variables.

Table(1). Variables Description

| Variable | Description |
|---|--|
| Under-five mortality rate (UFMR) | Probability of deaths per 1,000 live births under age five |
| Infant mortality rate (IMR) | Deaths per 1,000 live births under age one |
| Gross Domestic Product Per Capita (GDPPC) | Gross Domestic Product per capita in constant 2011 international dollars |
| Mobile cellular subscriptions (MOBSC) | Mobile cellular subscriptions per 100 people |
| Internet users (NETU) | Internet users per 100 people |
| Public health expenditure (HPUB) | Percentage of public health expenditure of total health expenditure |
| Total health expenditure (HGDP) | Percentage of total health expenditure of GDP |
| Female education rate (FEDU) | Primary completion rate for female (% of relevant age group) |
| Improved sanitation facilities (SANS) | Percentage of population using improved sanitation facilities |

Table (2) represents descriptive summary statistics of the variables used in the empirical analyses. It shows that, on average, under-five mortality stands at 94.9 deaths per 1,000 live births while infant mortality stands at 62.2 deaths per 1,000 live births. Mean Mobile subscription is 29.9 per 100 while mean internet users stand at 6.1.

Table (2). Descriptive statistics

| Variable | Mean | Maximum | Minimum | Std. Dev. |
|----------|----------|----------|----------|-----------|
| UFMR | 94.91109 | 226.9000 | 15.30000 | 46.21539 |
| IMR | 62.15975 | 116.2000 | 13.10000 | 25.05832 |
| GDPPC | 3622.618 | 16320.14 | 506.3607 | 3398.348 |
| MOBSC | 29.89708 | 153.7856 | 0.000000 | 32.19621 |
| NETU | 6.131681 | 55.41605 | 0.005902 | 9.229181 |
| HPUB | 44.29253 | 79.22261 | 3.091015 | 14.25339 |
| HGDP | 5.440302 | 12.27262 | 1.446244 | 1.854190 |
| FEDU | 65.53471 | 119.6577 | 12.47971 | 25.04949 |
| SANS | 40.01896 | 100.0000 | 6.600000 | 25.91217 |

Source: Authors' estimations

4. Empirical results

Table (3) and (4) present estimation results for under-five mortality rates (UFMR) and infant mortality rates (IMR) respectively. The coefficients of the lagged under-five and infant mortality are positive and statistically significant, and they indicate that child mortality is persistent over time as the estimated values are close to one. The coefficients of Mobile cellular subscriptions and Internet users are unexpectedly statistically insignificant throughout the models. Our results are in line with the study of Balcilar and Kucuk (2014) where they conclude that in the case of including control variables, the indicators of ICT lost their significance impact on child development indicators including under-five mortality rate, and percentage of children under-five of low weight.

Although the pilot studies in the developing countries prove the significance of the mobile phone with respect to child mortality reduction, our insignificant results suggest that; first, our study is based on panel data, so any obstacle facing the mobile phone technology in the child health field is difficult to overcome rapidly and consequently translated in the insignificance of this variable. On the other side, the pilot studies are conducted on the micro level, as they examine pilot projects depending on the mobile phone in the child health field applied in a particular district or town. Accordingly there exist a direct and immediate tackle of any problem facing the project, which is reflected in the significance of mobile phone. Secondly, Most of the developing countries'

populations live in rural regions, and they suffer from a low standard of living. Furthermore, most educated people in these countries are not familiar with the English language that is used to display most of the health information on the Internet (Omary et. al. 2010:44). While, the pilot projects that connect mothers with health units launch their application in the native language, and sometimes provide mobile phones at low prices or for free (Lund et al. 2014:2). Moreover, the workers in the pilot project deal mothers and help them to understand the programs so as to ensure the success of the pilot project and its significant impact of the mobile phone. Finally, lack of electricity and the limited coverage of mobile networks in some regions are considered obstacles to the spread of this technology that limits the expected benefits of the mobile phone in developing countries (Noordam et. al. 2011: 3). Whereas, the pilot projects create appropriate circumstances that ensure the success before the implementation, for instance, the project utilizes electricity generators in the regions that suffer from lack of electricity.

Next, as the results of Table (3) and (4) show the variable log GDP per capita has a favorable statistical significant impact on under-five and mortality rates. A result that is consistent with Kamiya (2010); Wang (2002); Anand and Barnighausen (2004); Issa and Ouattara (2012); and Novignon et al. (2012). In contrast to Anyanwu And Erhijakpor (2007) that show weak effect, as they refer to the fact that the weak impact of per capita income on mortality rate is an indicator of little effect in poor countries compared to rich countries.

As the results of Table (2) and (3) show, the estimated coefficients on public health expenditure is almost statistically insignificant while the estimated coefficient on total health expenditure is negatively significant. The significance of total health expenditure may return to the efficiency of the private health expenditure whereas the insignificance of public health expenditure outcome can be justified by the misallocation of resources and weak management that lead to the waste of the resources directed to public health expenditure. The results are consistent with Kamiya' result (2010) which clarifies that public health expenditure has no impact on child mortality. Issa and Ouattara (2012) conclude that the increase in total health expenditure has an insignificant impact on infant mortality reduction while public health expenditure has a significant one. On the other side, Anyanwu and Erhijakpor (2007) conclude that there is an inverse relationship between public health expenditure and child mortality rate. Accordingly they highlight the importance of increasing public health expenditure in African countries for achieving the fourth goal of the MDGs. Also, on a sample of 60 low-income countries, the study of Wang (2002) reaches the same conclusion. Finally, the study of Berger and Messer (2002) finds that increasing the share of government expenditure on health is positively correlated with mortality rate.

Regarding the variable of female education (FEDU), the results of Table (3) and (4) show a statistically significant favorable impact on both under-five and infant mortality rates. These results highlight the importance of including the female education in any policy option concerning to child mortality. These results conform to the findings of Anyanwu And Erhijakpor (2007); Anand and Barnighausen (2004); and Issa and Ouattara (2012). On the other hand, Wang (2002) finds a significant positive relation between female education (primary and secondary) and mortality rate (infant and under-five mortality). Also, using the share of female students in education, Kamiya (2010) reaches the same conclusion.

Finally, as for the improved sanitation facilities, the results show a favorable impact on both infant and under-five mortality. These results consist with those of Wang (2002); Kamiya (2010); and Anyanwu And Erhijakpor (2007). They find that improved sanitation has a statistically significant effect on reducing child mortality. The study of Günther and Fink (2010) concludes that improving sanitation has a good impact on under-five health and confirms the importance of increasing governmental intervention in the field of improving sanitation.

**Table 3. Results of the GMM estimations
Dependent variable: Under-five mortality rate(UMFR)**

| Variables | Model (1) | Model (2) | Model (3) | Model (4) |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| Constant | 42.15908 (0.0106)** | 28.40710 (0.0031)*** | 50.06086 (0.0029)*** | 28.96694 (0.0961)* |
| UMFR ₋₁ | 0.881548 (0.0000)*** | 0.905793 (0.0000)*** | 0.907104 (0.0000)*** | 0.918609 (0.0000)*** |
| Ln(GDPPC) | -4.739706 (0.0140)** | -3.157307 (0.0116)*** | -5.806779 (0.0069)*** | -5.935482 (0.0019)*** |
| MOSCB | -0.000695 (0.8958) | -0.007370 (0.1321) | | |
| NETU | | | -0.017672 (0.1603) | -0.021099 (0.1635) |
| HPUB | -0.025125 (0.3737) | | -0.047546 (0.0156)** | |
| HGDP | | -0.448782 (0.0016)*** | | -0.883789 (0.0001)*** |
| FEDU | -0.119617 (0.0128)** | -0.066190 (0.0029)*** | -0.067318 (0.0145)** | -0.042069 (0.0744)* |
| SANS | -0.252280 (0.0066)*** | -0.191119 (0.0123)** | -0.160681 (0.0559)* | -0.050161 (0.0501)* |
| Number of Observations | 203 | 281 | 250 | 280 |
| J-Statistic/P-value for J-statistic Overidentify test | 9.401946 [0.152203] | 7.336819 [0.196771] | 9.852666 [0.275520] | 8.692411 [0.275500] |

Notes: p-value are reported in parentheses, where * p<0.1; ** p<0.05; *** p<0.01

Values in square parentheses [.] are the Arellano-Bond autocorrelation test p-values

**Table 4. Results of the GMM estimations
Dependent variable: Infant mortality rate (IMR)**

| Variables | Model (1) | Model (2) | Model (3) | Model (4) |
|---|-----------------------------|-----------------------------|-----------------------------|--------------------------|
| Constant | 29.24067 (0.0497) ** | 16.43987 (0.0168) ** | 21.28598 (0.0600) ** | 21.18519 (0.0345) *** |
| INF ₋₁ | 0.891655 (0.0000) *** | 0.900789 (0.0000) *** | 0.906012 (0.0000) *** | 0.901275 (0.0000) *** |
| Ln(GDPPC) | -3.398869 (0.0572) * | -1.545429 (0.0416) ** | -2.374347 (0.0701) * | -2.143294 (0.0784)* |
| MOBSC | -0.001058 (0.8698) | -0.003190 (0.2020) | | |
| NETU | | | -0.000226 (0.9765) | -0.001141 (0.8861) |
| HPUB | -0.012447 (0.2442) | | -0.015509 (0.2247) | |
| HGDP | | -0.188312 (0.0721)* | | -0.270010 (0.0414)*** |
| FEDU | -0.031913 (0.0731)* | -0.037854 (0.0029)*** | -0.027684 (0.0847) * | -0.031100 (0.0548)** |
| SANS | -0.109516 (0.0666)* | -0.075189 (0.0410)** | -0.080862 (0.0307)*** | -0.070996 (0.0672)* |
| Number of Observations | 249 | 309 | 250 | 251 |
| J-Statistic/P-value for J-statistic Overidentify test | 14.18894 [0.164547] | 6.569335 [0.254689] | 10.23965 [0.248607] | 6.391605 [0.380781] |

Notes: p-value are reported in parentheses, where * p<0.1; ** p<0.05; *** p<0.01

Values in square parentheses [.] are the Arellano-Bond autocorrelation test p-values

5. Conclusion and Policy implication

The present study uses Generalized Method of Moments methodology on a panel data set of 43 developing countries (COIA countries) over the period from 2000 till 2012 to estimate the impact of the mobile phone on child mortality. The estimation results show that mobile phone isn't a significant factor in reducing child mortality. Additionally, the results imply that GDP per capita, total health expenditure, female education, and access to sanitation have a statistically significant favorable impact on child mortality. Furthermore, the results show that public health expenditure almost has an insignificant impact on child mortality rate, which possibly arises from misallocation of the resources in the public health system.

Nevertheless, to depend on a mobile phone, as one of the tools to reduce child mortality, policies and government interventions are needed to overcome obstacles in this respect. It is important to provide the infrastructure for mobile phone services network such that it covers the country as a whole including rural and remote regions that lack health care. As many countries depend on the private sector, which seeks profit, in providing mobile phone services, the government intervention is required to achieve the comprehensive coverage for mobile phone networks either by supporting, cooperating, or coordinating with private sector companies. The interest in infrastructure is not limited to mobile phone networks only, but it should include also providing the infrastructure needed for electricity and sanitation enhancement and widening. Additionally, at the country level, it is necessary to launch health information system cares about child and mother health in the native language, and applicable on the mobile phone. Moreover, policymakers should adopt policies that increase GDP per capita. It is also important to increase female education in countries under study. Finally, allocating total and public health expenditure must be efficiently achieved to reach fruitful results regarding under-five and infant health.

6. References

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APPENDIX A

Countries used in the analysis are classified by regional groups according to that used by World Health Organization. Available at: <http://www.who.int/countries/en/> [Accessed January 2016]

African Region: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Congo, Dem. Rep., Côte d'Ivoire, Gambia, Ghana, Guinea, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Swaziland, Senegal, Tanzania, Togo, Uganda, Zambia; **Regions of the Americas:** Mexico, Peru, Bolivia, Guatemala; **Eastern Mediterranean Region:** Pakistan, Yemen, Egypt, Morocco; **European Region:** Azerbaijan, Kyrgyzstan, Uzbekistan; **South-East Asia Region:** Indonesia, Nepal; **Western Pacific Region:** Philippines