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What factors influence the up-take of tuberculosis vaccine for children in Ghana?

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ABSTRACT

Background: Tuberculosis (TB) is one of the most dangerous communicable diseases in the world. However, with regard to children, the problem is exacerbated by the fact that there is a challenge in diagnosing childhood TB (World Health Organisation, 2013). This therefore strengthens the need for adopting preventive means such as immunisation in order to avoid childhood TB.
Methods: This paper used data from the 2014 Ghana Demographic and Health Survey which was conducted from early September to mid-December 2014 and the binary probit model to investigate the factors which influence the up-take of TB vaccine for children in Ghana.
Results: The study revealed that children from the Eastern region, children from the traditional/no religion/spiritualist faith, male children, children with younger, unemployed, and uninsured (no health insurance) mothers as well as those whose mothers had big monetary challenges in seeking medical care, were less likely to have received or utilised the TB vaccine.
Conclusion: This study therefore concludes that mother's employment, religion, region of residence, mother's insurance, and challenges with finances in seeking medical care for mother, mother's age and the sex of the child are the factors that determine the up-take of TB vaccine among children in Ghana.

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Background

Tuberculosis (TB) is a bacterial disease that mostly affects the lungs. Even though it is preventable and curable, it is regarded as a major killer of people globally with more than 95% of these deaths happening in middle and low income countries. Also, TB is reported to have affected 9.6 million people in 2014 out of which 1.5 million died. Further, it is estimated that, 1 million children were attacked by TB in 2014 out of which 140,000 died [1].

In the case of children, the burden of TB is likely to be higher given that it is very difficult to *diagnose* TB *in children* [2] and hence making it very worrying as well as the need to adopt *preventive measures such as vaccination*.

Given the deadly nature of TB, it was not surprising that eradicating TB was part of the Millennium Development Goals and currently part of the Sustainable Development Goal (SDG) 3. These have necessitated programmes in various nations toward the eradication of TB.

TB is one of the most common communicable diseases in Ghana [3] and hence it is not surprising that Ghana has in place a TB control programme and also according to the Expanded Immunization Programme in Ghana, children are supposed to receive the Bacille-Calmette-Guérin (BCG) vaccine to prevent TB.

Therefore since the burden of childhood TB shows a continuous transmission within a particular population [2], it was necessary to investigate the factors that influence the uptake of the BCG vaccine for children in Ghana, given that TB is a communicable disease and hence if some people are affected, the whole population stands at a risk. This would help in at large attaining the SDG 3.2 of

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reducing the mortality of children less than 5 years of age to 25 deaths per thousand live births by 2030 and hence contribute to the overall SDG 3 of healthy lives and well-being for all.

On the theoretical literature, the work of Grossman [4] tells us that there is a derived demand for health and hence the BCG vaccine would be utilised for children in order to produce good health.

On the empirical front, Russo et al. [5], Cockcroft et al. [6], Lakew et al. [7], Ibnouf et al. [8], and Otieno et al. [9] have conducted studies on the factors that influence the utilisation of immunisation for children in Cameroon, Nigeria, Ethiopia, Sudan, and Kenya, respectively. In Ghana, Immurana and Urma [10], Immurana and Urma [11], Dwumoh et al. [12], Matthews and Diamond [13], Bosu et al. [14], McGlynn [15], and Duah-Owusu [16] have also conducted studies on factors that influence immunization utilisation.

However, among all these works, none of them precisely investigated the factors that influence the up-take of the BCG vaccine for children in Ghana and hence making this paper to the best of the authors' knowledge, the first to study this.

Data and Methods

The study utilised data from the 2014 Ghana Demographic and Health survey (GDHS) which was a cross-sectional survey carried out from early September to mid-December 2014 in Ghana by the Ghana Statistical Service, the Ghana Health Service and other partners. During the survey, information on women and their children who were less than 5 years old were recorded. The information included household, socio-economic information of women as well as the immunisation status of children which included whether a child had received the BCG vaccine or not. Therefore, the BCG utilisation status was verified by looking at whether the BCG portion of the child's immunisation card has been ticked, or whether the date the vaccine was given has been shown on the card or whether mother was able to confirm that is being given to a child. In this study, all uncertain/unknown responses were regarded as missing values. Therefore this study coded as 1 (BCG utilised for the child) if any of the above was established and 0 if not established or otherwise (BCG not utilised for the child). Given that BCG utilisation was dichotomous, the study adopted the binary *probit* model as the empirical model of estimation whiles subjecting wealth status, marital status and religion to some form of recoding different from how they were coded originally in the data. Also all categorical dependent variables were treated as dummy variables. In order to give much more intuitive meanings to the results as Williams [17] contends, the study reported the average marginal effects of the regressors. All the analyses of data in this study were done using stata 11.2.

Results and Discussion

Descriptive and chi square analyses

The study employed the Pearson chi square test as shown in Table 1 before the Probit regression (multivariate analysis), in order to find out whether there were significant relationships between BCG vaccine utilisation for children and the various categorical independent (explanatory) variables. The results revealed significant relationships between BCG utilisation and mother's employment, marital status, mother's health insurance, residence (urban/rural), region of residence, ethnicity, religion, mother's education, money, and distance to seek medical care by mother, partner's education, household wealth status and the sex of the child. Also, 96.41% and 94.15% of urban and rural children respectively were revealed to have received the BCG vaccine. In addition 96.55%, 95.52%, and 87.66% of Muslim, Christian and traditional/spiritualist/no religion faiths children were revealed to have received the BCG vaccine respectively. Also 94.51% and 95.64% of male and female children respectively were found to have received the BCG vaccine whiles 92.74% and 97.22% of children with mothers who felt money to seek medical care for themselves was a big problem and not a big problem respectively, were revealed to have received the BCG vaccine. Moreover, 92.34% and 96.24% of children whose mothers had no health insurance and those whose mothers had health insurance were found to have received the BCG vaccine.

Regression results

Given that TB is one of the most common communicable diseases in Ghana [3], and the BCG vaccine is effective in preventing TB, this section tackled the multivariate analysis of the factors that influence the utilisation of TB vaccine for children in Ghana using the binary probit regression model as shown in Table 2.

The results showed that on average, children in the Eastern, Upper East, and Brong Ahafo regions were 3% less probable, 3% and 2% more probable

Table 1. Descriptive and Pearson chi square analyses of BCG vaccine utilisation among children in Ghana.

Variable	BCG (%)		Chi-square	Variable	BCG (%)		Chi-square
	No	Yes			No	Yes	
Region			141.4851***	Mother's education			35.6570***
Western	5.67	94.33		Uneducated	7.27	92.73	
Central	6.12	93.88		Primary	4.51	95.49	
Greater Accra	1.34	98.66		Secondary	3.39	96.61	
Volta	3.05	96.95		Higher	3.30	96.70	
Eastern	7.41	92.59		Mother's insurance			38.1203***
Ashanti	3.57	96.43		Uninsured	7.66	92.34	
Brong Ahafo	1.43	98.57		Insured	3.76	96.24	
Northern	11.70	88.30		Marital status			3.7629*
Upper East	1.12	98.88		Single	5.74	94.26	
Upper West	4.00	96.00		Married	4.55	95.45	
Residence			14.4777***	Mother's employment			3.7006*
Urban	3.59	96.41		Unemployed	6.04	93.96	
Rural	5.85	94.15		Employed	4.66	95.34	
Religion			62.8255***	Permission to seek medical care/ help by mother			2.6221
Christian	4.48	95.52		Big problem	6.70	93.30	
Islam	3.45	96.55		Not a big problem	4.82	95.18	
Traditional	12.34	87.66		Money to seek medical care/help by mother			59.7195***
Ethnicity			135.6554***	Big problem	7.26	92.74	
Akan	4.43	95.57		Not a big problem	2.78	97.22	
Ga/Dangme	3.61	96.39		Distance to seek medical care/help by mother			47.8455***
Ewe	3.38	96.62		Big problem	7.91	92.09	
Guan	4.69	95.31		Not a big problem	3.58	96.42	
Mole-Dagbani	3.67	96.33		Partner's education			39.2276***
Grusi	1.27	98.73		Uneducated	7.62	92.38	
Gurma	14.97	85.03		Primary	4.15	95.85	
Mande	1.18	98.82		Secondary	3.47	96.53	
Other	5.71	94.29		Higher	3.43	96.57	
Sex of household head			0.6636	Wealth status			16.1234***
Male	5.08	94.92		Non-rich	5.66	94.34	
Female	4.52	95.48		Rich	3.06	96.94	
Sex of child			3.8033*				
Male	5.49	94.51					
Female	4.36	95.64					

Source: Authors computation from the 2014 GDHS. Notes: 1) *, **, and *** showing significant difference at 10%, 5%, and 1% respectively, within the predictor and BCG vaccine utilisation among children in Ghana. 2) Traditional in this study means traditional/ spiritualist/no religion.

respectively, to have been given the BCG vaccine relative to those in the Upper West region (base or reference region) and hence pointing out the essence of the region of residence in the utilisation of child health inputs. The result on the Brong Ahafo region is similar to the findings of Immurana and Urma [10] with regard to demand for Pneumococcal vaccine for children in Ghana. Also similar result in the case of the Eastern region was found by Immurana and Urma [11] on the less likelihood of children in the Western region of Ghana to have been given both the Yellow fever and Measles 1 vaccine. However, the findings above conflict those of Logullo et al. [18] who found region not to be linked with adequate up-take of Measles vaccine in Sao Paulo city (Brazil).

Also on the average, children with Islamic backgrounds were 2% more probable to be given the BCG vaccine relative to those from traditional/spiritualist/no religion background (reference category). Similar result was revealed by Immurana and Urma [11] on the less likelihood of demanding the Yellow fever vaccine for children from traditional/ spiritualist/no religion background. This could be due to the unwillingness of some traditional faith believers with regard to adopting modern medicine, believing that traditional form of medication is an important traditional value or legacy and hence need not be substituted for modern medicine.

Table 2. Probit regression on Factors which influence the up-take of BCG vaccine for children in Ghana.

Dependent variable	BCG	Standard errors
Independent variable	Average marginal effect	
Religion (Ref: Traditional)		
Christian	0.0129753	0.0110293
Islam	0.0223337*	0.0130755
Region (Ref: Upper West)		
Western	−0.0300652	0.0193918
Central	−0.0113364	0.01817
Greater Accra	0.0182785	0.0165133
Volta	0.0122037	0.015887
Eastern	−0.034702*	0.0201761
Ashanti	0.0015452	0.0161188
Brong Ahafo	0.0230722*	0.0133311
Northern	−0.0229526	0.0156149
Upper East	0.0283821**	0.0119676
Ethnicity (Ref: other)		
Akan	0.0264777	0.0299269
Ga/Dangme	0.0487228	0.0308367
Ewe	0.0331963	0.0303827
Guan	0.0394374	0.033109
Mole-Dagbani	0.0307225	0.0299156
Grusi	0.0488542	0.0311582
Gurma	−0.0074173	0.0341986
Mande	0.0496056	0.035089
Residence (Ref: Rural)		
Urban	0.0001966	0.0082809
Wealth (Ref: Non-rich)		
Rich	0.001036	0.0104522
Sex of household head (Ref: Female head)		
Male head	0.0009401	0.0081444
Age of household head	−0.0001538	0.000254
Sex of child (Ref: Female)		
Male child	−0.0120196**	0.0057692
Childs age	0.0015701	0.002137
Birth order of child	−0.0034465	0.002197
Mother's employment (Ref: Unemployed)		
Employed	0.0158967*	0.0083117
Marital status (Ref: Single mothers)		
Married	0.0014962	0.0070939
Mother's education (Ref: Uneducated)		
Primary	0.0063124	0.009444
Secondary	0.0124845	0.0092816
Higher	−0.0117856	0.0265231
Permission to seek medical care by mother (Ref: Not a big problem)		
Big problem	0.0033341	0.010159
Mother's insurance (Ref: Uninsured)		
Insured	0.023168***	0.0071469
Distance to seek medical care by mother (Ref: Not a big problem)		
Big problem	0.0110267	0.0072529
Mother's age	0.0017238**	0.0007204
Money to seek medical care by mother (Ref: Not a big problem)		
Big problem	0.0181863***	0.0068808
Partner's education (Ref: Uneducated)		
Primary	0.0104442	0.0107541
Secondary	0.0127336	0.0093017
Higher	0.0029511	0.0161225
	N = 5132	
	Prob > chi^2 = 0.0000	

Source: Authors computation from the 2014 GDHS. Notes: 1) ****P*-value < 0.01, ***P*-value < 0.05, and **P*-value < 0.1. 2) Traditional in this study means traditional/spiritualist/no religion.

Also as expected on the average, employed mothers were 2% more likely to have utilised the BCG vaccine for their children relative to unemployed mothers. Similar findings were revealed by Immurana and Urma [10] and Immurana and Urma [11] who found employed mothers to be more probable to demand for both the Pneumococcal and Rotavirus vaccines and both the Measles and Yellow fever vaccines for children in Ghana respectively. This is because employed mothers are better empowered to afford indirect costs of vaccine utilisation such as transportation cost and therefore would be more probable to utilise it for their children relative to unemployed mothers. Also, it could be that, mothers who are employed are conscious of the time and money they will lose for abandoning their job in order to seek treatment for their children when they are sick and hence would be more prepared to embrace preventive measures.

Further as expected, mothers with health insurance, were 2% more probable to have utilised the BCG vaccine for their children relative to mothers without health insurance. Thus insurance makes easier access to health facilities (where immunization drives could take place) for mothers and children. This becomes more reasonable under the national health insurance scheme in Ghana where there is a free maternal and child health insurance registration. Also with mother's health insurance giving easy access to health facilities, it means they could benefit from information on the importance of child immunization from these health facilities and hence would be more willing to utilise for their children as compared to their counterparts without health insurance. This is similar to the results

of Dwumoh et al. [12] who revealed that health insurance of children influenced full immunization of children in Ghana and those of Immurana and Urma [11] with regard to demand for the Measles 2 vaccine for children in Ghana.

In addition as expected, mothers with big monetary problems in seeking medical care were found to be 2% less probable to utilise the BCG vaccine for their children relative to mothers without big monetary problems in seeking medical care. This could be that mothers with big monetary problems in seeking medical care, are likely not to be able to afford for instance, transportation cost to immunization centres or are less likely to visit health facilities and hence the less probability of utilising (for their children) these vaccines which are normally offered at health facilities or other immunisation centres free of charge.

Moreover on average, male children were found to be 1% less probable to have received the BCG vaccine relative to female children. This could be due to the notion of some people/mothers/caregivers that male children are naturally stronger as compared to their female counterparts and therefore would be unwilling to utilise such vaccines for male children.

Lastly on the results, a yearly rise in mother's age was found to increase the probability of a child receiving the BCG vaccine by 0.2%. Thus aging mothers might have gained enough experience from past births concerning the importance of such vaccines to the survival of children and therefore would be more inclined to utilise them for children. This concurs with the findings of Russo et al. [5] in Cameroon who found younger mother's age to affect incomplete immunization for children as well as Otieno et al. [9] who found older maternal age to be linked with the likelihood that a child was given Influenza vaccination in Kenya.

Conclusion

Based on the findings, it can be concluded that mother's employment, religion, region of residence, mother's health insurance, money as a big problem in seeking medical care for mother, mother's age and sex of the child are the factors that determine the up-take of the BCG vaccine among children in Ghana.

Therefore intensifying regional health utilisation drives, encouraging mothers/women to enroll on the free maternal health insurance scheme, targeting and aiding unemployed, poor, and younger mothers with regard to the health needs of their children, opening up job opportunities for women, and public education on the need for all children to be immunised against major diseases irrespective of their sex, could be effective tools in bettering child health utilisation such as immunisation and hence reducing child mortality for a better human capital base in future.

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