Impact Evaluation of Vaccination Against Eight-Child-Killer Diseases on Under-Five Children Mortality at Mbale District, Uganda

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Abstract

This study examines the impact evaluation of vaccination against eight-child-killer diseases on under-five children mortality at Mbale District. It was driven by three specific objectives which are to determine the proportion of under-five children mortality due to the eight-child-killer diseases to the total under-five children mortality; establish the cause-effect relationship between the eight-child-killer diseases and under-five children mortality; as well as establish the dependence of under-five children mortality in the location at Mbale District. A community based cross-sectional and longitudinal (panel) study design involving both quantitative and qualitative (focus group discussion and in-depth interview) approaches was employed over a period of 36 months. Multi-stage cluster design involving Health Sub-District (HSD), Forms of Ownership (FOO) and Health Facilities Centres (HFC) as the first, second and third stages respectively was used. Data was collected regarding the eight-child-killer diseases namely: measles, pneumonia, pertussis (whooping cough), diphtheria, poliomyelitis (polio), tetanus, haemophilus influenza, rotavirus gastroenteritis and mortality regarding immunized and non-immunized children aged 0-59 months. We monitored the children over a period of 24 months. The study used a sample of 384 children out of all the registered children for each year at Mbale Referral Hospital and other Primary Health Care Centres (HCIV, HCIII and HCII) at Mbale District between 2015 and 2019. These children were followed from birth to their current state (living or dead). The data collected in this study was analysed using cross tabulation and the chi-square test. The study concluded that majority of mothers at Mbale district took their children for immunization and thus reducing the occurrence of under-five children mortality. Overall, 2.3%, 4.6%, 3.1%, 5.4%, 1.5%, 3.8%, 0.0% and 0.0% of under-five children had polio, tetanus, diphtheria, measles, pertussis, pneumonia, haemophilus influenzae and rotavirus gastroenteritis respectively across all the sub counties at Mbale district during the period considered. Also, different locations (sub counties) do not have significant influence on the occurrence of these eight-child-killer diseases among the under-five children at Mbale district. Therefore, the study recommended that government and agencies should continue to work together to implement measures of vaccination programs and increasing access to basic health care with a continuous improvement on the social interventions to progress child survival.

Keywords: Vaccination; mortality; eight-child-killer diseases; under-five children.

Introduction

In order to increase child immunisation coverage, the underlying reasons for parents not immunising their children should be known. In the chosen study area (Mbale Municipality), so far, no community-based immunisation coverage impact assessment or evaluation study was conducted. Therefore, this study tried to fill this gap by identifying the child immunisation coverage and impact on under- five mortalities.

Child mortality is a core indicator for child health and well-being. In 2000, world leaders agreed on the Millennium Development Goals (MDGs) and called for reducing the under-five mortality rate by two thirds between 1990 and 2015 – known as the MDG 4 target (Forder, 2002; WHO, 2006; Odusanya *et al.*, 2008 and Nafiu and Hamidu, 2017). Universal immunization of children against preventable diseases (measles, pneumonia, pertussis, diphtheria, poliomyelitis (polio), tetanus etc.) is vital to reduce childhood mortality. So, it is one of the indicators of development in most developing countries. The Expanded Program on Immunization (EPI) was launched in 1974 as a global program for controlling and reducing death from Vaccine Preventable Diseases (VPSs). Thus, vaccination coverage is estimated by convention

with Diphtheria, Pertussis and Tetanus-3 (DPT-3) achieved among children aged 12 to 23 months (Forder, 2002; WHO, 2006; Odusanya *et al.*, 2008 and Nafiu and Hamidu, 2017).

The major hindering factors from achieving universal immunization include low access to services, low number of trained manpower, high staff turnover, lack of fund donors, lack of information, lack of transportation, distance from health facilities, inadequate awareness of mothers/caregivers, others such as missed opportunities and high dropout rates especially through routine approaches (Barreto and Rodrigues, 1982; Binka *et al.,* 2007; and Sanou *et al.,* 2009).

At the end of 2011, immunization was reported to have saved 2 to 3 million lives; nonetheless, in the same year 1.5 million children were estimated to have died (more than 70% live in ten African and Asian countries) from VPDs is a reflection of the incomplete coverage with existing vaccines that persists in many parts of the world (Torun and Barkirci, 2006). Goal of Global Immunization Vision and Strategy (GIVS) was to reduce global measles deaths by 90% by the year 2010 or earlier (Ryman *et al.*, 2008 and Shehu *et al.,* 2017).

Africa region and the Global Alliance for Vaccines and Immunization (GAVI) in 2000 set a goal of reaching less than 80% DPT-3 coverage in every district is greater than 80% of developing countries by 2005. This goal is referred as the "80/80 goal". To achieve this goal, the Global Alliance for Vaccines and Immunisations (GAVI) proposed a new approach, Reaching Every District (RED) in 2002 (WHO, 2006; WHO, 2009 and WHO, 2015).

Measles immunization coverage is one of the indicators for progress towards MDG-4. IN 2008 there were an estimated 164,000 measles deaths globally. It was estimated that during 2000 to 2007, measles caused deaths declined by 89% in Africa. However, measles outbreaks continue to occur throughout the region (Kidane and Tekie, 2003, WHO, 2006; Uganda Bureau of Statistics, 2007; Ibnouf *et al.,* 2007; Kaldewei and Pitterle, 2011; and Nafiu *et al.*, 2016b, 2016c).

In 1980, the Government of Uganda initiated the implementation of Expanded Program on Immunisation (EPI) with goal of increasing vaccination coverage against the eight-childhood-killer diseases by 10% each year to reach 100% coverage in 1990. This program goal has largely remained unrealised even using different efforts (Ministry of health, 2015). Despite the high prevalence of VPDs in the country, immunization coverage rates stagnated and remained very low for many years. Health Sector Development Program IV (HSD-IV) goal of the ministry of health EPI strategy is to achieve 96% DPT-3coverage in all regions.

The Uganda Bureau of Statistics (2017) showed coverage level of DPT-3 and the percentage of fully immunised children are reportedly 36.5% and 24.3% respectively. According to this report, DPT-3 coverage in many of the districts was below 80% and infant mortality rate (IMR) stood at 59 per 1000 live births nationally.

Materials and Methods

The study was conducted at Mbale district, Eastern Region of Uganda in a period of 36 months. The district is located at a distance of 250 kilometers to Kampala, Uganda Capital City. According to Uganda Bureau of Statistics (2017), Mbale district is made up of 25.2% Urban and 74.8% Rural; 48.2% Male and 51.8% Female; and a total number of 56 Health Facilities Centres (HFC) with 3 Forms of Ownership (FOO) found in 3 Health Sub-Districts (HSD). There are 1 Referral Hospital, 2 Hospitals, 3 health centres IV, 30 health centres III and 20 health centres II. EPI is provided by both governmental health centers and private health centres. According to Mbale District Health Report (2016), 79% and 85% of children were fully vaccinated in 2015 and 2016 respectively.

The sample size required for quantitative survey was computed using a formula of calculating single population proportions with the assumption of 5% margin of error, 95% confidence level. Sample size was calculated by considering the estimated proportion of mothers knowledgeable on immunization using table of Krejcie and Morgan (1970). The estimate of the sample size which yields the highest number was considered as a final sample size.

Sampling Technique

The research sampling technique is multi-stage cluster design involving Health Sub-District (HSD), Forms of Ownership (FOO) and Health Facilities Centres (HFC) as the first, second and third stages respectively. The total Health Facilities Centres (HFC) of 56 in the district was clustered into 13, 24 and 18 for Bungokho North HSD, Bungokho South HSD and Municipality HSD respectively. Then, 12, 21 and 16 health centres will be selected by cluster sample. Thereafter, from each HSD, children ling method from each of the HSD respectively in the district were selected by simple random sampling method. The modified 2005 WHO-EPI cluster sampling method was employed to select study children with consideration of each HSD as one cluster (Nafiu*et al.*, 2012). Then, the selection of the required number of children were from the selected households with proportional allocation of study subjects. The first child in each zone was selected randomly from the centre of the zone and the rest of them were selected from the subsequent household till the required number of children have been attained.

Data Collection

It is an interviewer-administered structured questionnaire to obtain information from mother(s) or caregiver(s) of the child(ren) by trained interviewers. The instrument was constructed from a review of available literature on immunization coverage, WHO questionnaire, and EDHS for immunization coverage and translated into local language(s). Mothers or caregivers were asked to show immunization cards and the dates of immunization will be extracted from the cards. For those whose immunization cards are not available or lost, the mothers or caregivers were asked on immunization status of their children. In order to reduce recall bias, different recalling techniques such as routes of administration (checking injection sites and presence of the scar on the upper arm, whether the child has taken vaccine orally) was used.

Results

The following results were generated from the data collected

Table 1: Crosstabulation between sub counties and child ever suffered from polio

	CHILD EVER SUFFERED FROM POLIO		
SUBCOUNTIES	YES	NO	Total
INDUSTRIAL DIVISION	1	8	9
NORTHERN DIVISION	0	15	15
WANALE DIVISION	1	8	9
NAKALOKE	0	4	4
BUMASIKYE	0	6	6
BUSIU	1	86	87
Total	3 (2.3%)	127 (97.7%)	130

Source: Results of the Analysis (2019)

Results in Table 1 reveal that industrial division, Wanale division and Busiu have one (1) case each of polio while Northern division, Nakalole, and Bumasikye have zero (0) case of polio. Overall, 2.3% of under-five children had polio in Mbale district during the period considered.

Table 2: Chi-Square Test of Association between sub counties and child ever suffered from polio

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.296[a]	5	.200
Likelihood Ratio	5.066	5	.408
Linear-by-Linear Association	2.357	1	.125
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 2 reveals that there is no significant difference along location (sub counties) with respect to under-five children having suffered from polio (P-value of 0.200>0.05). This indicates that location (sub counties) does not have a significant influence on the number of under-five children suffering from polio.

Table 3: Crosstabulation between sub counties and child ever suffered from tetanus

	CHILD EVER SUFFERED FROM TETANUS		
	YES	NO	Total
INDUSTRIAL DIVISION	0	9	9
NORTHERN DIVISION	1	14	15
WANALE DIVISION	1	8	9
NAKALOKE	1	3	4
BUMASIKYE	0	6	6
BUSIU	3	84	87
Total	6(4.6%)	124(95.4%)	130

Source: Results of the Analysis (2019)

Results in Table 3 indicate that Northern division, Wanale division, Nakaloke and Busiu have six (6) cases of tetanus while Industrial division and Bumasikye had zero (0) case of tetanus among the under-five children. Overall, 4.6% of under-five children had tetanus in Mbale district during the period under study.

Table 4: Chi-Square Test of Association between sub counties and child ever suffered from tetanus

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.777[a]	5	.329
Likelihood Ratio	4.403	5	.493
Linear-by-Linear Association	.656	1	.418
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 4 reveals that there is no significant difference along sub counties with respect to under-five children having suffered from tetanus (P-value of 0.329>0.05). This indicates that location (sub counties) does not have a significant influence on the number of under-five children suffering from polio at Mbale district.

Table 5: Crosstabulation between sub counties and child ever suffered from diphtheria

SUBCOUNTIES	CHILD EVER SUFFERED FROM TUBERCULOSIS		Total
	YES	NO	
INDUSTRIAL DIVISION	0	9	9
NORTHERN DIVISION	1	14	15
WANALE DIVISION	1	8	9
NAKALOKE	0	4	4
BUMASIKYE	0	6	6
BUSIU	2	85	87
Total	4(3.1%)	126(96.9%)	130

Source: Results of the Analysis (2019)

Results in Table 5 reveal that Northern division and Wanale division had four (4) cases of diphtheria while Industrial division, Nakaloke and Bumasikye had zero (0) case of diphtheria. Overall, 3.1% of under-five children had diphtheria at Mbale district during the period considered.

Table 6: Association between sub counties and child ever suffered from diphtheria

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.376[a]	5	.642
Likelihood Ratio	3.054	5	.692
Linear-by-Linear Association	.878	1	.349
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 6 reveals that there is no significant difference along sub counties with respect to under-five children having suffered from diphtheria (P-value of 0.642>0.05). This indicates that location (sub counties) does not have a significant influence on the number of under-five children suffering from diphtheria at Mbale district.

Table 7: Crosstabulation between sub counties and child ever suffered from measles

	CHILD EVER SUFFERED FROM MEASLES		Total
	YES	NO	
INDUSTRIAL DIVISION	0	9	9
NORTHERN DIVISION	1	14	15
WANALE DIVISION	1	8	9
NAKALOKE	0	4	4
BUMASIKYE	1	5	6

BUSIU	4	83	87
Total	7(5.4%)	123(94.6%)	130

Source: Results of the Analysis (2019)

Results in Table 7 indicates that Northern division, Wanale division, Bumasikye and Busiu had seven (7) cases of measles while industrial division and Nakaloke had zero (0) case of measles. Overall, 5.4% of under-five children had measles at Mbale district during the period considered.

Table 8: Chi-Square Test of Association between sub counties and child ever suffered from measles

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.972[a]	5	.704
Likelihood Ratio	3.035	5	.695
Linear-by-Linear Association	.040	1	.841
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 8 reveals that there is no significant difference along sub counties with respect to under-five children having suffered from polio (P-value of 0.704>0.05). This indicates that location (sub counties) does not have a significant influence on the number of under-five children suffering from measles in different sub counties at Mbale district.

Table 9: Crosstabulation between sub counties and child ever suffered from pertussis (whooping cough)

	CHILD EVER SUFFERED FROM WHOOPING COUGH		
SUB COUNTIES	YES	NO	Total
INDUSTRIAL DIVISION	0	9	9
NORTHERN DIVISION	0	15	15
WANALE DIVISION	0	9	9
NAKALOKE	0	4	4
BUMASIKYE	0	6	6
BUSIU	2	85	87
Total	2(1.5%)	128(98.5%)	130

Source: Results of the Analysis

Results in Table 9 indicate that Busiu had two (2) cases of pertussis while Northern division, Industrial division, Wanale division, Nakaloke and Bumasikye had zero (0) case of pertussis. Overall, 1.5% of under-five children had pertussis at Mbale district during the period considered.

Table 10: Chi-Square Test of Association between sub counties and child ever suffered from pertussis (whooping cough)

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.004[a]	5	.962
Likelihood Ratio	1.622	5	.899
Linear-by-Linear Association	.875	1	.350
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 10 reveals that there is no significant difference along sub counties with respect to under-five children having suffered from pertussis (P-value of 0.962>0.05). This indicates that location (sub counties) does not have a significant influence on the number of under-five children suffering from pertussis.

Table 11: Crosstabulation between sub counties and child ever suffered from pneumonia

	CHILD EVER SUFFERED FROM PNEUMONIA		
SUB COUNTIES	YES	NO	Total
INDUSTRIAL DIVISION	0	9	9
NORTHERN DIVISION	1	14	15
WANALE DIVISION	1	8	9
NAKALOKE	0	4	4
BUMASIKYE	1	5	6
BUSIU	2	85	87
Total	5(3.8%)	125(96.2%)	130

Source: Results of the Analysis (2019)

Results in Table 11 indicate that Northern division, Wanale division, Bumasikye and Busiu had five (5) cases of pneumonia while industrial division and Nakalole had zero (0) case of pneumonia. Overall, 3.8% had pneumonia in the area of Mbale district studied.

Table 12: Association between sub counties and child ever suffered from pneumonia

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.357[a]	5	.374
Likelihood Ratio	4.308	5	.506
Linear-by-Linear Association	.694	1	.405
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 12 reveals that there is no significant difference along sub counties with respect to under-five children having suffered from pneumonia (P-value of 0.374>0.05). This indicates that location (sub counties) does not have a significant influence on the number of under-five children suffering from pneumonia across the various sub counties at Mbale district.

Table 13: Crosstabulation between sub counties and child ever suffered from haemophilus influenzae

	CHILD EVER SUFFERED HAEMOPHILUS INFLUENZAE		
SUB COUNTIES	YES	NO	Total
INDUSTRIAL DIVISION	0	9	9
NORTHERN DIVISION	0	14	14
WANALE DIVISION	0	8	8
NAKALOKE	0	4	4
BUMASIKYE	0	5	5
BUSIU	0	85	85
Total	0(0.0%)	100(100%)	130

Source: Results of the Analysis (2019)

Results in Table 13 indicate that there was zero (0) case of haemophilus influenzae registered in all the sub counties (Industrial division, Northern division, Wanale division, Nakaloke, Bumasikye and Busiu) of Mbale district. This means that there was no any case of haemophilus influenzae in the area studied.

Table 14: Association between sub counties and child ever suffered from haemophilus influenzae

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.762	5	.246
Likelihood Ratio	10.417	5	.179
Linear-by-Linear Association	10.620	1	.191
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 14 reveals that there is no significant difference along sub counties with respect to under-five children having suffered from pneumonia (P-value of 0.246>0.05). This indicates that location (sub counties) does not have a significant influence on the occurrence of haemophilus influenza among under-five children.

Table 15: Crosstabulation between sub counties and child ever suffered from rotavirus gastroenteritis

SUB COUNTIES	CHILD EVER SUFFERED HAEMOPHILUS INFLUENZAE		Total
	YES	NO	
INDUSTRIAL DIVISION	0	9	9
NORTHERN DIVISION	0	15	15
WANALE DIVISION	0	9	9
NAKALOKE	0	4	4
BUMASIKYE	0	6	6
BUSIU	0	87	87
Total	0(0.0%)	100(100%)	130

Source: Results of the Analysis (2019)

Results in Table 15 indicates there was no any case of rotavirus gastroenteritis registered across the sub counties (Industrial division, Northern division, Wanale division, Nakaloke, Bumasikye and Busiu). This means that there was no any case of rotavirus gastroenteritis during the period considered at Mbale district.

Table 16: Association between sub counties and child ever suffered from rotavirus gastroenteritis

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.129	5	.991
Likelihood Ratio	14.799	5	.640
Linear-by-Linear Association	17.150	1	.471
N of Valid Cases	130		

Source: Results of the Analysis (2019)

Result in Table 16 reveals that there is no significant difference along sub counties with respect to under-five children having suffered from rotavirus gastroenteritis (P-value of 0.991>0.05). This indicates that location (sub counties) does not have a significant influence on the occurrence of rotavirus gastroenteritis among under-five children in Mbale district.

Conclusions

The study concluded that majority of mothers at Mbale district took their children for immunization and thus reducing the occurrence of under-five children mortality. Overall, 2.3%, 4.6%, 3.1%, 5.4%, 1.5%, 3.8%, 0.0% and 0.0% of under-five children had polio, tetanus, diphtheria, measles, pertussis, pneumonia, haemophilus influenzae and rotavirus gastroenteritis respectively across all the sub counties at Mbale district during the period considered. Also, different locations (sub counties) do not have significant influence on the occurrence of these eight-child-killer diseases among the under-five children at Mbale district.

Recommendations

Government and agencies should continue to work together to implement measures of vaccination programs and increasing access to basic health care.

There should be a continuous improvement on the social interventions to progress child survival.

The government should continue to monitor progress and mobilize grassroots action and advocacy aimed at ending preventable deaths among under-five children mortality.

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