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Original Article

Effects of Differential Household Characteristics on Immunization Coverage for Children Aged 12-23 Months in Alego Usonga, Nyakach and Butere Sub Counties, Kenya

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ABSTRACT

Immunisation remains one of the most important public health interventions to reduce child morbidity and mortality. The purpose of this study was to analyse the differential effects of household characteristics on immunisation coverage for children aged 12-23 months in Butere, Nyakach and Alego Usonga Sub Counties in Western Kenya. The specific objectives were: to describe the household characteristics, to determine the level of immunisation coverage by antigens and lastly, to analyse the association of household characteristics with immunisation. The study design was analytical statistics utilising secondary data that was collected during a larger study on community health units' systems strengthening in three Sub Counties with a total number of 11,160 households. The findings established that there existed varied distributions in proportions for the household characteristics within the regions. The study also revealed that there was a high proportion of the different antigens examined. Finally, the study established that there exists a significant association between different household characteristics and immunisation coverage in all three sites. In Alego Usonga significant association between all the five household characteristics (education level of household headship, staple food availability, latrine availability, water treatment, and housing type) and immunisation. Butere recorded a significant association between two household characteristics (education and housing type) and immunisation coverage, and lastly, Nyakach displayed latrine and food availability to be significant associations with immunisation coverage. The study makes four recommendations for; stakeholders, policymakers, health service providers, and researchers regarding the importance of differential household characteristics in relation to improving immunisation coverage in the population.

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INTRODUCTION

Immunisation remains one of the most important public health interventions and a cost-effective strategy to reduce both the morbidity and mortality associated with infectious diseases. Over two million deaths are delayed through immunisation each year worldwide (WHO, 2011).

Immunisation significantly contributed to the achievement of Millennium Development Goal (MDG) number 4, one of the eight elements of primary health care, also addressed in then the current sustainable development goals (SDGs) United Nations Sustainable Development Summit (2015). Effective utilisation of immunisation services is associated with improved child health outcomes. WHO (2011) targets immunisation coverage of 90% for urban areas and 80% for rural. Recent estimates indicate that the global DTP3 immunisation coverage of infants is 82%. Although the recent trend related to global vaccination coverage is positive with 120 countries reaching 90% DTP3 coverage in 2008, despite Kenya and other sub-Saharan countries still continue to experience under-immunisation.

Globally, there have been increases in routine childhood vaccination coverage since the 1990s, resulting in large reductions in measles mortality and progress to the attainment of the African regional goal for diphtheria, pertussis, and tetanus (DPT) vaccine coverage. In 2014, estimated global coverage with three doses of diphtheria-tetanus-pertussis (DTP) containing vaccine increased to 86% compared to 74% in 2000, which resulted in an estimated 115 million infants being immunised. However, an estimated 18.7 million infants worldwide are still not being reached by routine immunisation services and 20.6 million children in the same age group have failed to receive a single dose of DPT (WHO, 2014). Other diseases, such as measles, deaths have drastically reduced; for example, deaths from measles have reduced by 75% from 2000 to 2013 worldwide, meaning 15.6 million deaths were averted (Simons et al., 2012). In addition to lowering child mortality, immunisation programs have improved the primary care infrastructure in developing countries and empowered women to better plan their families, with consequent health, social and economic benefits (Andre et al., 2008).

In 2010, more than six million children in sub-Saharan Africa did not receive the full series of three doses of the diphtheria-tetanus-pertussis vaccine by one year of age. At present, only 71% of African infants receive the full series of three doses of the diphtheria-tetanus-pertussis vaccine (DTP3). There is wide inter-country variation in reported DTP3

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coverage, from 23% in Chad to 99% in Mauritius (UNICEF, 2010). Vaccine efficacy tends to be lower in low-income countries than in higher-income countries (Madhi et al., 2010), emphasising the need to attain and sustain high and equitable childhood immunisation coverage in Sub-Saharan Africa, where most countries are low-income. (Wiysonge et al., 2007)

Despite the aim to vaccinate all children, vaccine-preventable disease outbreaks have been recorded (Ministry of Public Health and Sanitation, 2012), indicating that the targets are still not being achieved. The most recent official estimates support this; according to a WHO report (2013), the national coverage being approximated as BCG 79%; DPT-3 76%; OPV 82%; HBV 83%; HIB 83%; and measles 79%. Variations in immunisation uptake have been documented in different areas in the country, with the highest rates being in Nandi County (93.9%) and the lowest in Mandera (27.7%) (KNBS & ICF MACRO, 2014). Nevertheless, it is acknowledged that there are limitations to the accuracy of all official estimates with possible variations between 8% and 16% (WHO, 2013).

Immunisation coverage tends to vary in the former Western province of Kenya, vaccination coverage has been traditionally high with most districts performing at above 80% fully vaccinated child coverage. However, for instance, Kakamega County is estimated to be at 62.2% with full immunisation coverage (KNBS & ICF MACRO, 2014). However, as is the case with national vaccination uptake estimates, these may not be accurate. The stagnation of progress towards achieving the targets has facilitated roll out of various interventions to improve the situation in western Kenya, both from the National government such as the 'Linda mama' project and the County initiatives such as 'Oparanya Care' an intervention initiated by the County Governor of Kakamega to hospital delivery and post-natal care for the infants. There have been a series of such interventions in place.

Kenya has focused on immunisation in its efforts to reduce child mortality (KNBS, 2010). This was revealed by the Kenya Demographic and Health Survey (KDHS) conducted by the Kenya National Bureau of Statistics (KNBS) with a number of interventions geared towards it. However, one in every 19 children born in Kenya still dies before his or her first birthday, while one in 14 does not survive to age 5.

Western Kenya region exhibits more or less similar characteristics in terms of climate and natural resources. There are differences between sub-counties on aspects of health facility distribution and functionality levels. Implementation of community health strategy (CHS) has been shown to vary by sub-counties (SERAM REPORT, 2014) as well. The region has seen a number of interventions and Community Health Strategy goals are in tandem to address the differentials in immunisation coverage due to differentials in household characteristics.

Immunisation, a major proven effective intervention in improving the health status of children is one such intervention that has remained a key intervention in the region. With community health strategy intervention, it has been assumed that coverage for immunisation should be universal irrespective of differentials in household characteristics. The focus and concentration of interventions are largely due to the HIV epidemic and malaria incidence. Evidence has shown that immunisation coverage is a function of social demographic, economic, and other factors at the household (HH) level (Kruk et al., 2009). Western Kenya comprises populations of diverse social, demographic, economic, and other factors at the household characteristic level.

Despite the efforts that the region has received to improve immunisation coverage across different regions, there is no adequate information to show changes and how the impact of interventions has been on different households in the different regions. This study therefore sought to describe household characteristics, establish the level of immunisation coverage by antigens and also to analyse the effect of differential household characteristics on immunisation coverage within the respective Sub Counties.

The Expanded Program on Immunization (EPI) was initiated by the World Health Organization in 1974 to control vaccine-preventable diseases worldwide (Keja *et al.*, 1988). Immunisation coverage has ever been a global goal since the 1990s with the development of primary health care, where full

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immunisation coverage was listed to be among the top eight to be given priority. The Millennium Development Goals 2010-2015 prioritised reduction of child mortality with immunisation as a key intervention.

Currently, in resource-poor areas around the globe, inadequate levels of immunisation against childhood diseases remain a significant public health problem. The prioritisation of immunisation related efforts is further demonstrated through the Global Vaccine Action Plan (GVAP), a strategy endorsed in 2012 by the 194 Member States of the World Health Assembly to ensure equitable access to existing vaccines. The strategy stressed that reaching unvaccinated children – typically in poorly-served remote rural areas, deprived urban settings, fragile states, and strife-torn regions – is essential if the goals of the GVAP were to be met (WHO, 2013).

In 2016, during April immunisation week, under the global slogan "Close the immunisation gap", the campaign focused on immunisation for all throughout life. More than 180 countries, territories and areas marked the week with activities including vaccination campaigns, training workshops, round-table discussions, and public information campaigns. It aimed to accelerate action to increase awareness and demand for immunisation and improve vaccination delivery services so that people everywhere can be protected against deadly diseases.

To demonstrate further commitments toward improving immunisation, Kenya has domesticated international treaties and goals into its national policies and targets. For example, from 2011 to 2014, Kenya has done a lot regarding policy on immunisation including drafting a bill covering vaccines and vaccination activities mapping all immunisation-related legislations in Kenya; two draft immunisation-related bills existed: a vaccine procurement bill, which introduced a vaccine procurement trust fund, and the general health bill, which includes a section on vaccinations, immunisation in both public and private hospitals through the division of vaccine and immunisation (MOH, 2013).

In September 2011, the Kenyan Ministry of Health (MOH) highlighted a case in Nyanza Province where a 3-year-old boy was found to have polio (Kirimi, 2011), and to reverse the situation, efforts are further being translated into regional and district level targets as part of the Ministry of Health (MoH's) annual operational plan to inform and guide local priority setting and resource allocation. For instance, the immunisation campaign dubbed 'Kutomaliza Chanjo Ni Kukatiza Ndoto' is based on the concept of aspirations and dreams caregivers have for their children and uses this as an emotional hook for increasing immunisation uptake. Kenya Health News (2014)

The findings from objectives one and two of this study are beneficial to the Sub County Health Management Team (SCHMT) and County Health Management Team (SHMT) in identifying important household characteristics that influence the utilisation of health services, specific antigens which are poorly utilised and as a result hinder the realisation of immunisation coverage in these specific regions. This information will trigger necessary actions towards improvements needed to amend the situation. The third objective of this study will be of importance to other researchers, program implementers and policymakers as to whether household characteristics impact immunisation utilisation. This will be an eye-opener as they will be able to discover critical areas where intensive efforts need to be directed towards the realisation of fully immunised children in rural areas.

MATERIALS AND METHODS

This study was analytical in design utilising independent and dependent variables. It utilised secondary data collected through quasi-experimental design for two years (2014 and 2015) within the respective Community Health Units through the support of Great Lakes University of Kisumu (GLUK) research officers in the larger operational research implemented for Health System Strengthening in the three Counties Kakamega, Kisumu, and Siaya. The study utilised data from three Sub Counties where the Community Health Units Strengthening Program was implemented. They include Butere, Nyakach, and Alego Usonga. The CHUs had also been implementing Community Health Strategy (CHS) with the support of the Ministry of Health in

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partnership with GLUK. The target population for this study were children of ages 12-23 months old in households within Community Health Units in the respective sub-counties. Further, the children belonged to households within CHUs that had maintained household register records in which full information regarding under five immunisation history was comprehensively documented. In total, data from 11 CHUs was used in the analysis of this study's findings.

The selection used the purposive sampling technique to include CHUs that met the following criteria: CHU covered by GLUK in the CHS partnership and supported through the MOH submitted their Community-Based Health Information System (CBHIS) / data consistently for at least two years during the period 2014-2015 and lastly based on the completeness of the data set submitted. Table 3.1 below illustrates the CHUs per Sub County totalling 11, with a total number of 11,160 Households being full CHU coverage on household registration.

Table 1: Number of CHUs per Sub County used in the study

County	Sub-county	No.	CHU Name	Household numbers
Kakamega	Butere	1	Bubala	1200
		2	Mutoma	1100
		3	Ituti	1010
		4	Bukhoko	1200
Kisumu	Nyakach	1	Gem Rae	1100
		2	Andigo Opanga	1200
		3	Jimo West	1150
		4	Kajimbo	1100
Siaya	Alego Usonga	1	Sigoma Uranga	700
		2	Mahola Ulawe	750
		3	Kabura Uhui	650
Total	**3**	**11**		**11,160**

Data for analysis for this study was collected by the Community Health Volunteers (CHVs) within the three Sub Counties following the implementation of the Community Health Units Strengthening program in 2010. Data for CHU household registration and for updates were collected every six months as required under the CHS guideline (MOH, 2013). Before data collection, training and refresher training were provided to the CHVs. A 10% validation sample was conducted by experienced research assistants to ensure the quality of data collected by the CHVs. It was on this basis that this study retrieved data and extracted relevant information to draw the findings of this study's main objective, which was to document trends in immunisation coverage within the respective Sub Counties in Western Kenya. Further, the data quality control checks were performed to ensure completeness and consistency before the final data set that was used in this study. Descriptive statistics were used to answer the first and second objectives. Frequencies were run to determine the level of immunisation coverage by a specific antigen. The analytic method was used to obtain the analysis for objective three, where cross-tabulations were used to determine the effect of differential household socioeconomic and demographic characteristics on differentials in full immunisation coverage. The data were analysed using STATA version 14. A Chi-square test at a 95 % confidence interval was used to test the association between differential household socioeconomic and demographic characteristics on immunisation coverage. The strength of association between immunisation coverage prevalence and differential household characteristics was further tested using a logistics odds ratio.

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Table 2: Analysis Plan Summary

Objectives	Variables	Statistical tools
Household characteristics	• Education level of HH • Availability of latrine • Availability of stable food • Water treatment mechanisms • House type	Descriptive statistics ▪ Frequency ▪ Proportions
Level of immunisation coverage by antigens	• Pentavalent 1 • Pentavalent 3 • Measles	Descriptive statistics ▪ Frequency ▪ Proportions
Effect of differential HH characteristics on immunisation coverage	• Education level of HH • Availability of latrine • Availability of stable food • Water treatment mechanisms • House type	Analytical statistics ▪ Chi-square ▪ Logistics odds ratio

RESULTS

Household Characteristics

This data was meant to describe household characteristics that relate to health service utilisation in the findings. The household characteristics data comprised; the educational level of the household head, availability of stable food, availability of latrine, house type, and water treatment.

Education Level of Household Head & House type

From the findings of 2014, the highest level of education attained by the majority of households was primary education with Butere at 71% and Nyakach at 63%; however, in the same year, Alego Usonga posted to have the majority of household heads with no education at 53%.

In the subsequent year, 2015, the trend was maintained in Butere and Nyakach with primary education remaining highest at 73% and 63%, respectively. On the other hand, Alego Usonga showed a shift in proportion where primary education was highest at 72%, as displayed.

Table 3: Level of education for household head and proportions for house types

	2014 [n (%)]			2015 [n (%)]		
	Nyakach	**Butere**	**Alego Usonga**	**Nyakach**	**Butere**	**Alego Usonga**
Level of education						
None	94(5)	135(8.44)	295(53.53)	30(10.49)	68(5.75)	48(7.45)
Primary	921(63)	1141(71.35)	233(42.87)	181(63.29)	865(73.24)	466(72.36)
Secondary and above	453(32)	323(20.20)	23(4.17)	75(26.22)	248(20.99)	130(20.19)
House Type						
Temporary	254(17.30)	457(29.11)	299(54.59)	216(17.73)	340(29.23)	266(41.82)
Semi-permanent	1123(76.50)	1040(66.24)	243(44.34)	932(76.52)	764(65.70)	299(47.02)
Permanent	91(6.20)	73(4.65)	6(1.10%)	70(5.75)	59(5.07)	71(11.16)

In the two years (2014 & 2015), in all the regions, the highest proportions of HHs had semi-permanent houses with a constant lead in Nyakach at 76% within the two years, Butere was 2nd at 66% and lastly Alego Usonga at 44% and 47% for the two years respectively as illustrated in *Table 3* above.

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Availability of Latrine and Stable Food

In 2014 the region that posted to have the highest number of HHs with latrines was Butere at 98%, followed by Alego Usonga at 87%, while Nyakach had 84% of its HHs with latrines. In the following year (2015), Butere maintained the highest proportion of HHs with latrines, followed by Alego Usonga and lastly Nyakach at 99%, 93%, and 84%, respectively. This means that Nyakach led in terms of HHs with no latrine, followed by Alego Usonga, and the lowest proportion in Butere, as shown in *Table 4* below.

Table 4: Proportions for latrine and stable food availability

	2014 [n (%)]			**2015 [n (%)]**		
	Nyakach	**Butere**	**Alego Usonga**	**Nyakach**	**Butere**	**Alego Usonga**
Availability of latrine						
Yes	1239(84.40)	1538(98.27)	481(87.14)	1027(84.3)	1171(99.15)	604(93.79)
No	229(15.59)	27(1.73)	71(12.86)	191(15.68)	10(0.85)	40(6.21)
Availability of stable food						
Yes	1149(78.27)	941(60.17)	463(83.88)	881(72.33)	420(35.56)	568(88.20)
No	319(21.73)	623(39.83)	89(16.12)	377(27.67)	761(64.44)	76(11.80)

In 2014, the Sub County that posted to have the highest number of HHs with stable food was Alego Usonga, followed by Nyakach, and last Butere at 83%, 78%, and 60%, respectively. This sequence was maintained in the subsequent year of 2015 with Alego Usonga at 88%, Nyakach at 72% and Butere at 35%. This implied that in the two years (2014 and 2015), Butere led in terms of HHs who had no stable food, followed by Nyakach and the lowest proportion in Alego Usonga as shown in *Table 4* below.

Water Treatment

In 2014, the region that posted the highest proportion of HHs treating water was Alego Usonga (93%), closely followed by Nyakach (90%), while Butere had (87%) of its HHs treating water. This means that Butere led in terms of HHs not treating water, followed by Nyakach and the lowest proportion in Alego Usonga.

In the following year (2015), Alego Usonga maintained the highest proportion of treated water (99%). However, Butere and Nyakach had a swop in positions where Butere was 2nd with (92%) and Nyakach (90%). Implying that Nyakach had the highest proportion of HHs not treating water at 9%, followed by Butere at 7%, and Alego had the lowest number at 0.9% as shown in *Table 5*.

Table 5: Proportions for water treatment in HHs

	2014[n (%)]			**2015[n (%)]**		
	Nyakach	**Butere**	**Alego Usonga**	**Nyakach**	**Butere**	**Alego Usonga**
Yes	1324(90.19)	1369(87.53)	512(92.75)	1102(90.48)	1091(92.38)	638(99.07)
No	144(9.81)	195(12.47)	40(7.25)	116(9.52)	90(7.62)	6(0.93)

Level of Immunization Coverage Rates by Antigens

The antigens in focus for this study included; Pentavalent 1, Pentavalent 3, and Measles as these are the major antigens covered in the MOH household registration tool. Additionally, they are considered to be the main antigens of focus when determining full immunisation coverage. Description of findings: (individual antigens performance by years). Pentavalent 1 displayed high uptake in both 2014 and 2015 at (96% & 95%) respectively as shown in *Figure 1*.

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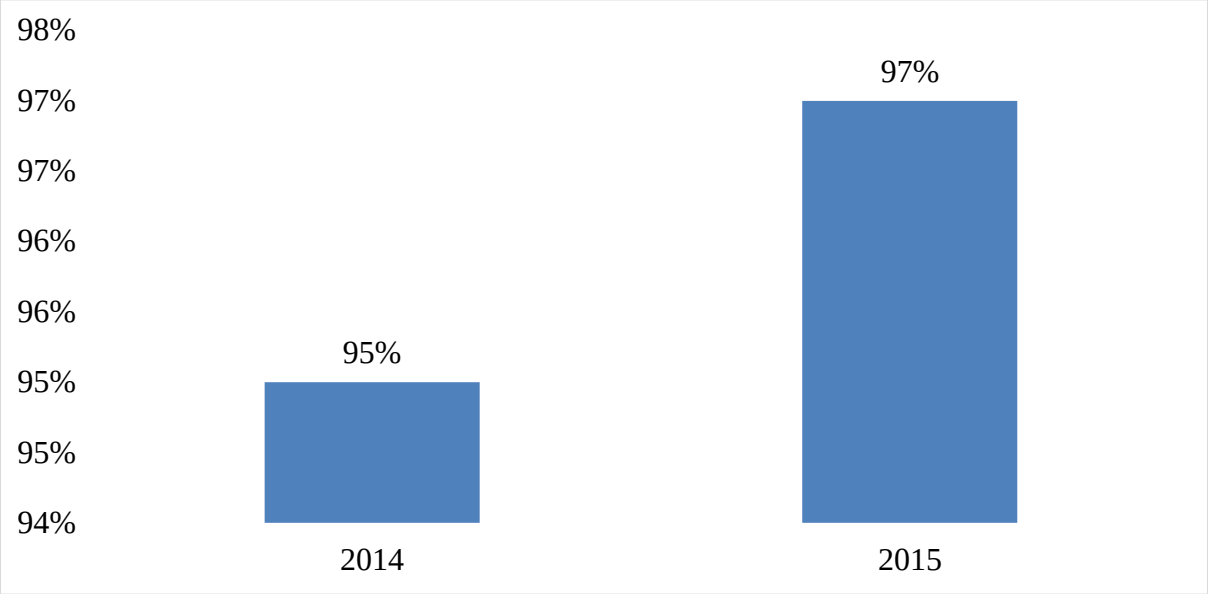
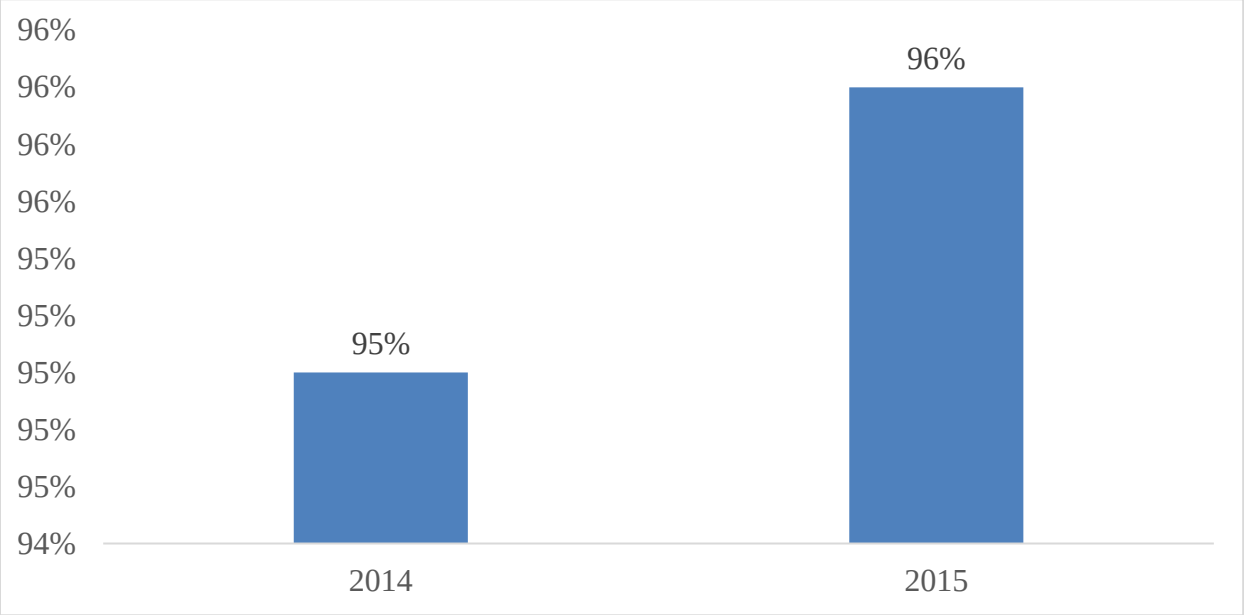
Figure 1: Pentavalent 1 coverage by years



Pentavalent 3 exhibited a steady high uptake across the two years period at (95% & 96%) for 2014 and 2015, respectively (see *Figure 2*).

Figure 2: Pentavalent 3 coverage by years.



Measles uptake was at (93% and 95%) for 2014 and 2015, respectively, as shown in *Figure 3*.

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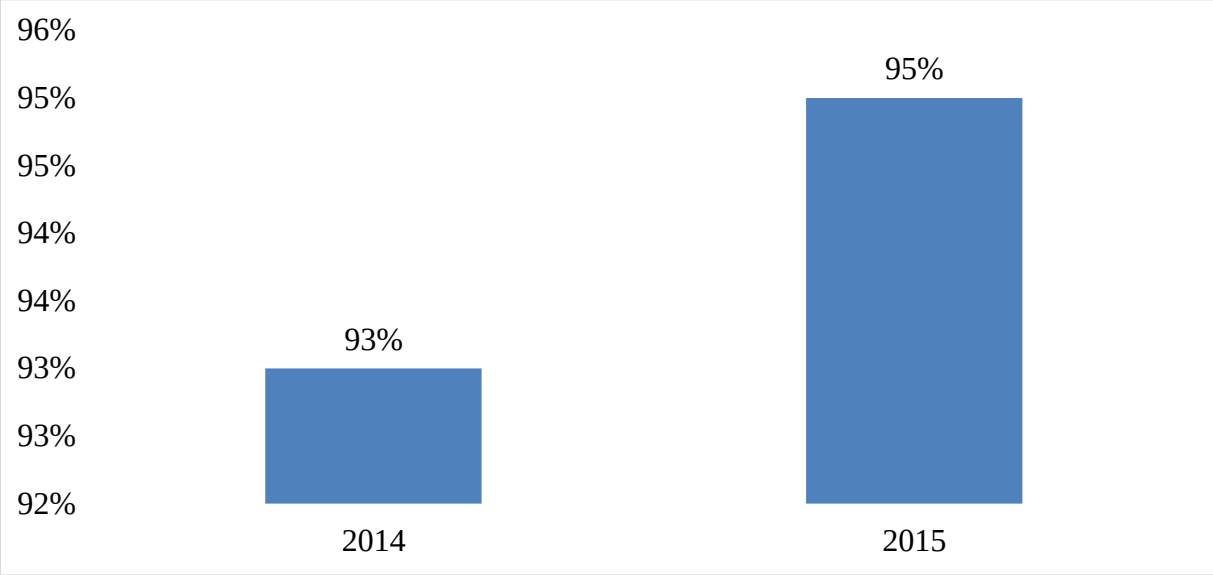
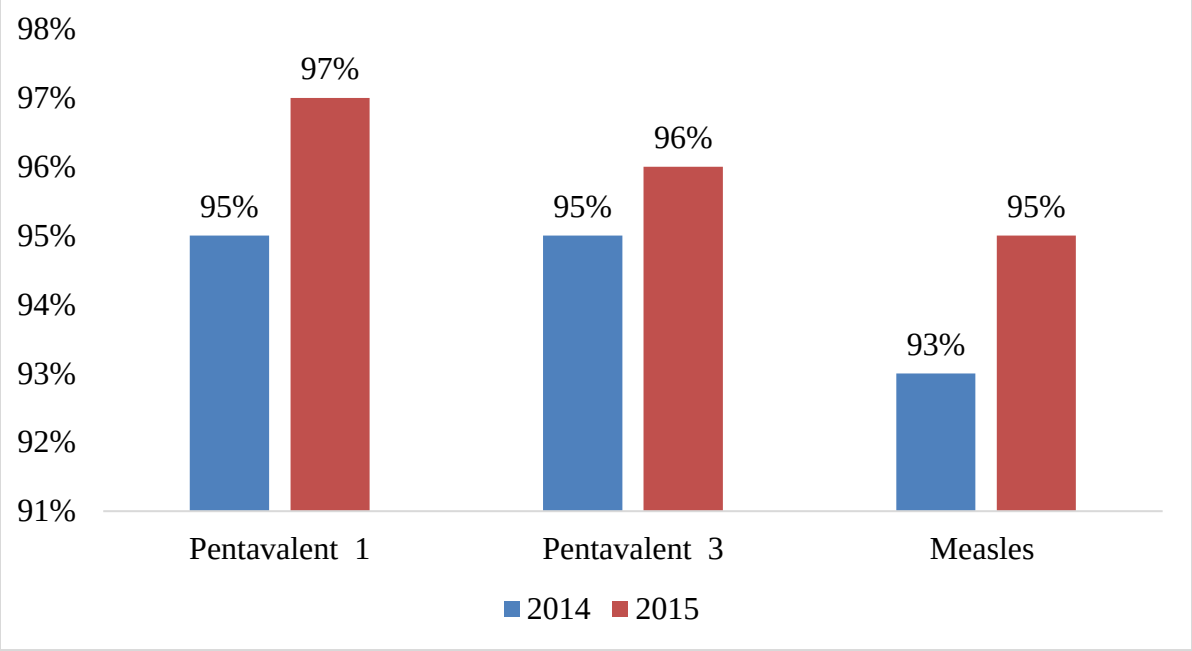
Figure 3: measles coverage by years.



Comparison of the Antigens

Comparatively, the trend for all the three antigens remained the same, with Pentavalent 1 recording (95% & 97%) for 2014 and 2015, respectively; Pentavalent 3 was at (95% and 96%) while measles recorded the lowest proportion at 93% in 2014 and a slight increase in 2015 to 95% (see *Figure 4*).

Figure 4: Antigens coverage by years



Immunisation Coverage by Sites

In the two-year period in Butere Sub County, Pentavalent 1 and measles showed a constant uptake at 96% and 93%, respectively, whereas Pentavalent 3 indicated a slight increase from 95% to 97% in 2014 and 2015, respectively, as shown in *Figure 5*.

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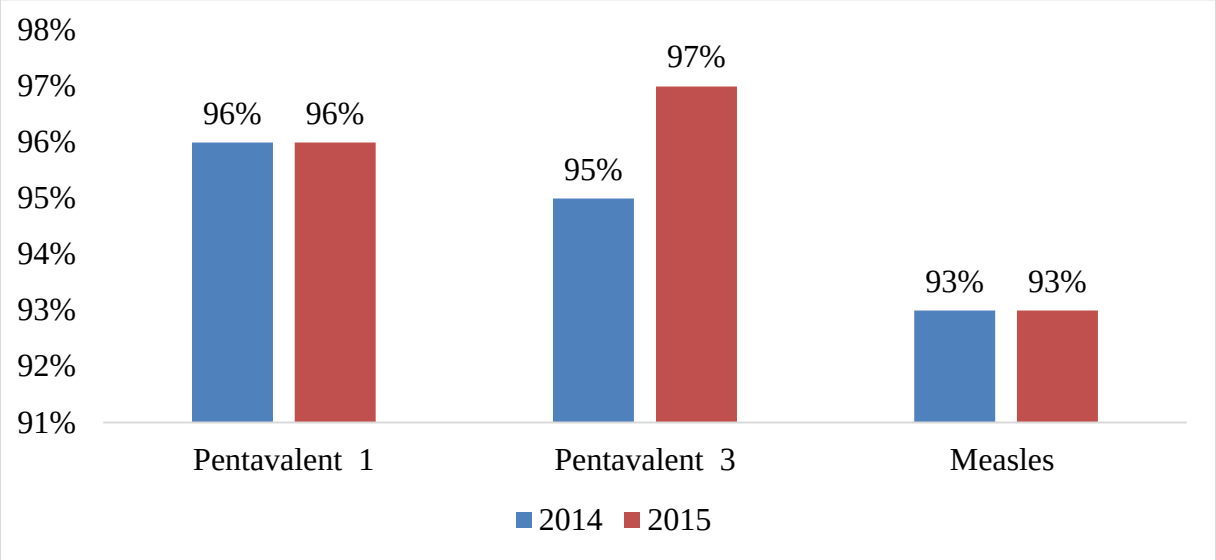
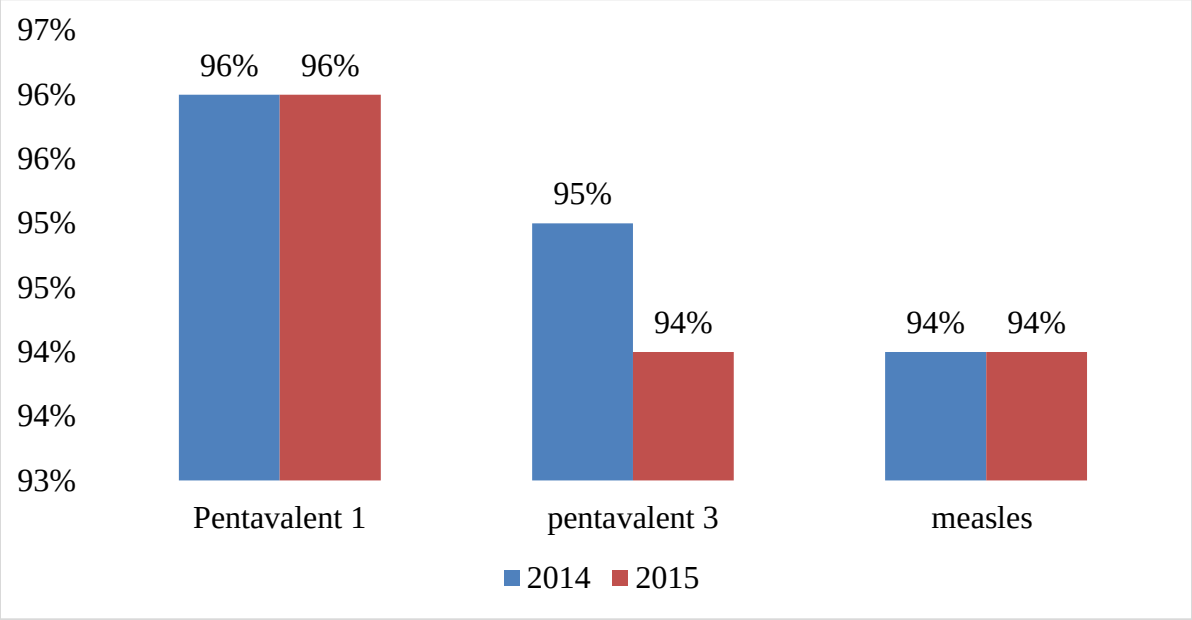
Figure 5: immunisation coverage in Butere



Nyakach Sub County showed steady performance in the two years at 96% for Pentavalent 1 both in 2014 and 2015, Pentavalent 3 was at 95% & 94% respectively, a slight decrease seen in the year 2015. The performance of measles was constant at 94% in both the years 2014 and 2015 (*See Figure 6*).

Figure 6: Immunisation coverage in Nyakach



Between 2014 and 2015, CHUs in Alego Usonga Sub County recorded a steady increase in coverage for all the three antigens starting with the lowest of 93% for measles and averaging at 98% across the three antigens as shown in *Figure 7*.

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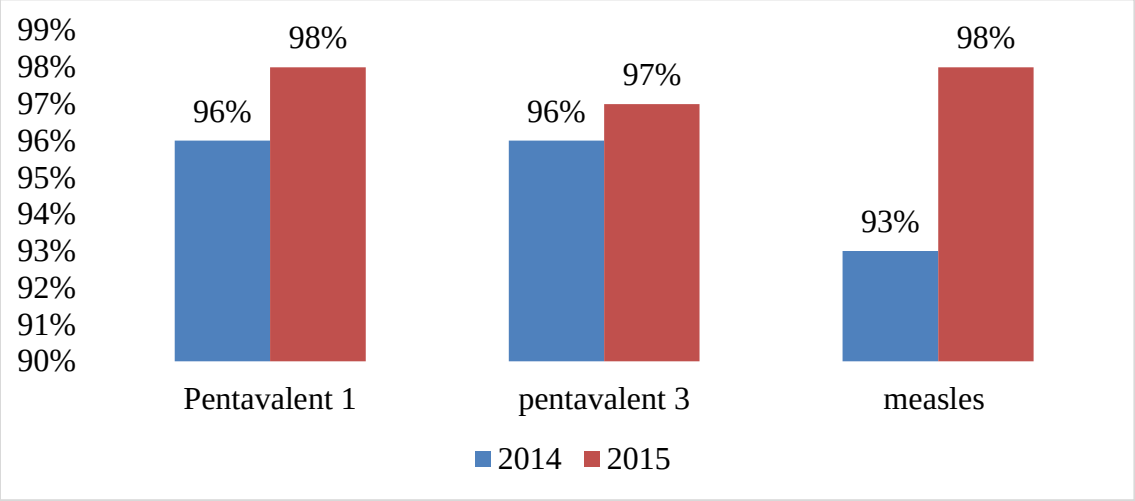
Figure 7: immunisation coverage in Alego Usonga

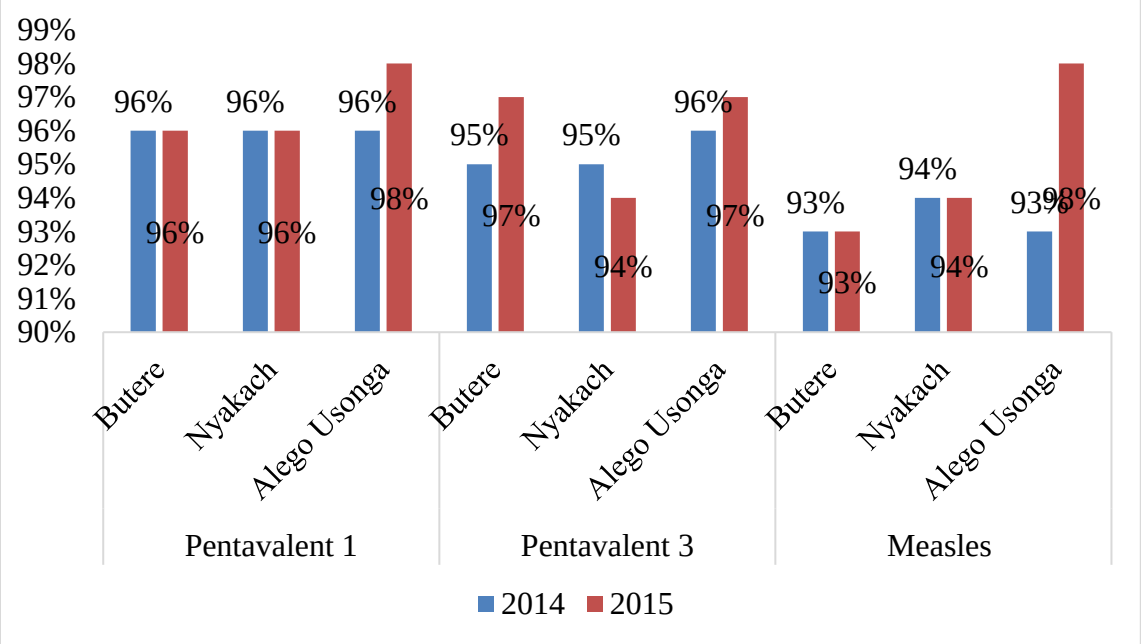


Comparison of Coverage by Sites

From the data, Pentavalent 1 uptake in all the three Sub County was at the same level (96%) in the year 2014; this figure was constant in the year 2015, whereas Alego Usonga Sub County indicated an increase in the same year at 98%. Pentavalent 3 uptake in the three Sub Counties was presented to be at the closely same level with Butere and Nyakach at (95%) and Alego Usonga at 96% in 2014. In 2015, the figures increased slightly in all the sites with Butere and Alego Usonga recording 97%, but Nyakach showed a slight drop to 94%.

Findings also indicate that there was a relatively similar indication of measles uptake in the three Sub Counties across the two years, where Butere recorded 93% for 2014 and 2015. A similar look was also observed in Nyakach, wherein the two years it recorded a constant proportion at 94%; however, Alego Usonga indicated 93% and 98% in 2014 and 2015, respectively. This stood to be the only site with an increase as shown in *Figure 8.*

Figure 8: Immunisation coverage by sites.



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Effect of Differential Household Characteristics on Immunization Coverage

Education Level of Household Head

A significant association was observed between different levels of education and full immunisation coverage in Alego Usonga (p-value = 0.003) and Butere (p-value = 0.253) in 2014. Consistency and absence of association are also observed in 2015 for the sites as shown in *Table 6*.

Table 6: Effect of Household Head Characteristics on Immunization Coverage

		Nyakach			Butere			Alego Usonga		
		N	**P**	**S**	**N**	**P**	**S**	**N**	**P**	**S**
2014										
Immunization	Yes	74%	79%	81%	12%	82%	87%	65%	77%	70%
	No	26%	21%	19%	81%	18%	13%	35%	23%	30%
Chi square; p value		2.7493; 0.253.			12.2607;0.002			11.7261;0.003		
2015										
Immunization	Yes	76%	81%	93%	78%	88%	87%	64%	80%	91%
	No	24%	19%	17%	22%	12%	13%	34%	20%	9%
Chi square; p value		3.4456;0.179			6.2895;0.043			20.1628;0.000		

Key: ***N*** *= none,* ***P*** *= primary,* ***S*** *= secondary and above*

Availability of Latrine

The results showed that there was a significant relationship between latrine availability and immunisation uptake in Alego Usonga across the two years and Nyakach in 2015. In Butere consistency over the two years, there was no association observed as shown in Table 7 below.

Table 7: Availability of Latrine and Immunisation Coverage

		Nyakach		Butere		Alego Usonga	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**
2014							
Immunization	Yes	80%	77%	84%	93%	72%	59%
	No	20%	23%	16%	7%	28%	41%
Chi square; p-value		1.7162;0.190		1.7324;0.188		8.2110;0.004	
2015							
Immunization	Yes	82%	77%	87%	83%	71%	97%
	No	18%	23%	13%	17%	29%	3%
Chi square; p-value		4.0914;0.043		0.1301;0.718		45.3919;0.000	

Availability of Staple Food

Findings revealed that there was a significant relationship between the availability of stable food and immunisation coverage in Alego Usonga in 2014 and Nyakach in 2015, while Butere recorded no differential significance across the years, as shown in *Table 8* below.

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Table 8: Availability of Stable Food and Immunization Coverage

		Nyakach		Butere		Alego Usonga	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**
2014							
Immunization	Yes	79%	80%	86%	82%	72%	59%
	No	21%	20%	14%	18%	28%	41%
Chi-square; p-value		0.2838;0.594		3.3281;0.068		10.2210;0.001	
2015							
Immunization	Yes	80%	85%	89%	86%	80%	80%
	No	20%	15%	11%	14%	20%	20%
Chi-square; p-value		4.7836;0.029		3.4335;0.064		0.0205;0.886	

Water Treatment

The results also showed that there was a significant association between water treatment and immunisation uptake in Alego Usonga in 2014, as other Sub Counties had no statistical significance throughout the two years, as shown in *Table 9.*

Table 9: Water Treatment and Immunization Coverage

		Nyakach		Butere		Alego Usonga	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**
2014							
Immunization	Yes	80%	80%	84%	87%	73%	44%
	No	20%	20%	16%	13%	27%	56%
Chi-square; p-value		0.1342;0.714		1.1119;0.292		32.2550;0.000	
2015							
Immunization	Yes	80%	82%	87%	90%	80%	67%
	No	20%	18%	13%	10%	20%	33%
Chi-square; p-value		0.1669;0.683		0.4922;0.483		1.0693;0.301	

House Type

Findings showed a significant association between differential housing types and full immunisation coverage in Alego Usonga for both years and in 2015 for Butere, while none was recorded for Nyakach in any of the two years, as shown in *Table 10.*

Table 10: House Type and Immunisation Coverage

		Nyakach			Butere			Alego Usonga		
		T	**S-P**	**P**	**T**	**S-P**	**P**	**T**	**S-P**	**P**
2014										
Immunization	Yes	78%	80%	85%	88%	83%	74%	74%	65%	70%
	No	22%	20%	15%	12%	17%	26%	26%	35%	30%
Chi-square; p-value		2.6807;0.262			2.6807;0.292			7.5378;0.023		
2015										
Immunization	Yes	79%	82%	81%	94%	85%	91%	71%	87%	97%
	No	21%	18%	19%	6%	15%	9%	29%	13%	3%
Chi-square; p-value		1.6617;0.436			18.1452;0.000			45.3919;0.000		
Key: T = Temporary, S-P = Semi- permanent, P = Permanent										

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Summary of the Effect of HH Characteristics on Immunisation

From the findings, all the five examined household characteristics showed a significant differential in immunisation coverage rates for differential Sub Counties' households at least in a year or both and in one or two sites.

Education is the only characteristic that depicted a significant association for two sites (Butere and Alego Usonga) across the two years. Latrine and stable food availability showed significant association in 2014 for Alego Usonga as it did in 2015 for Nyakach. Water treating showed significance only in 2014 for Alego Usonga.

Alego Usonga is the only site among the three studied sites where differentials in all the five household characteristics demonstrated significant association rates across the two years except for stable food availability and treating water in 2015. Both Nyakach and Butere each had two important differential characteristics including education and housing type (Butere) and latrine and stable food availability (Nyakach).

Table 11: summary of HH characteristics and their association with immunisation

Household characteristics	Nyakach		Butere		Alego Usonga	
	2014	2015	2014	2015	2014	2015
Education level of household head			✓	✓	✓	✓
Latrine availability		✓			✓	✓
Food availability		✓			✓	
Water treatment					✓	
House Type				✓	✓	✓
Key: ✓: indicates significant association (p value < 0.05)						

DISCUSSION

The study findings indicated that there were differences in household characteristics across the three Sub Counties. Education showed a constant proportion where the majority of the household heads had attained a primary level of education. In all the sites, secondary and above levels registered the lowest proportions. These findings are consistent with (KDHS 2014) results which indicated that the majority of Kenyans 86% had attained primary education and it also acknowledged the fact that there are differentials in regions with regard to education with females recording high proportions than the males.

Based on issues regarding healthy practices at the household level, the findings revealed that in all the sites the proportion of households with latrines was high. Additionally, the findings also indicated that most households treated water in the regions. These elements are usually considered as health practices at the household level and could also display the level at which the household is enlightened with regards to health service utilisation including taking care of the children through preventing care such as immunisation uptake.

Considering aspects of economics in households, the study findings showed that in all the regions, the majority of the household had semi-permanent types of houses. The type of house was normally used to measure the economic status of the household, and this implied that the household members were in a better position to utilise health services including immunisation for the children. Additionally, the findings indicated that stable food availability in households was high in Alego Usonga and Nyakach as opposed to Butere, where the proportion who had stable food was (35.56%). This parameter is also used to determine the level of income in a household if they are able to demonstrate the fact that at least there is a presence of some stable food in the household.

The findings also indicated that the level of utilisation of immunisation services varies from one Sub Counties to the other and also within the various antigens. Pentavalent 1 recorded the highest in all the regions, followed by Pentavalent 3 and the lowest antigen measles. These findings are

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consistent with the results of a study conducted by (Dustin *et al.,* 2015) which revealed that immunisation coverage for Pentavalent 1 was highest at (94%) followed by pentavalent 3 at (83%) and lastly measles (80%). This implies that children with delayed receipt of pentavalent 1 were at risk for not receiving Pentavalent 3 and measles vaccine and as a result, not achieving full immunisation coverage compared with children who received Pentavalent 1.

All three sites maintained a level of coverage above (90%) over the years of study. Indeed, consecutive KDHS (2008/9, 2014) have confirmed differential immunisation coverage rates by different regions.

Lastly, the findings of the study indicated that there was a differential in immunisation coverage due to differential household characteristics in the respective Sub Counties. In Alego Usonga, the study indicated that there was a significant relationship between all the described household characteristics and immunisation coverage; these included the educational level of the household head, availability of latrine, availability of stable food and water treatment, and housing type. These findings are similar to a number of studies conducted in different regions by different authors while looking at other household indicators, including income, that depicted a significant association between household income or occupation and immunisation coverage (Rainey *et al.,* 2011; Abdulraheem *et al.,* 2011; Omole & Owodunni, 2012). In addition, studies have also documented that there is a significant effect between education and health service practices (Wiradnyani *et al.,* 2016).

Comparatively, in Nyakach, there was a significant association documented in two household characteristics with immunisation coverage. The household characteristics which showed this relationship was latrine availability and availability of staple food. These two can be classified as economic and health behaviour factors that can affect the utilisation of immunisation services within a household. The association between economic status and immunisation coverage observed in this study concurs with the results of Babalola and Fatusi (2009); Ndiritu et al., 2006), which indicated that there is a relationship between wealth and vaccination status. Children from wealthy households could be more likely to have their vaccination status checked and to receive missing doses of vaccines when attending a healthcare facility than children from poor households.

Findings from Butere showed that there was an association between education and house type on immunisation coverage. Consistent with this, also empirical results from other studies indicated that education was significantly associated with immunisation utilisation (Bhattacharya, 2002). Lastly, in all the regions, there was a significant association between house type and immunisation coverage. House type is usually classified under parameters in measuring the economic status of the household; thus, economic status greatly affects the level of immunisation utilisation.

CONCLUSION

Among the five variables examined, three variables recorded fairly similar proportions in distributions among households, which included; latrine availability, water treatment, and housing type, while both education and stable food have each site stand out differently. For instance, the analysis on the level of education where Nyakach had an outstandingly higher proportion of households with no education as compared to the other two sites, while Butere recorded very low proportions for a household with staple food availability as compared to its counterparts.

Of the three antigens studied, all of them recorded a high proportion in uptake across the two years; however, measles recorded the least in both years.

In the five household characteristics examined to determine the association on immunisation coverage, all the variables showed a significant association rate across the two years. Alego Usonga was outstanding where it depicted a significant association between the five household characteristics and immunisation coverage across the two years except for food availability and water treatment in 2015. Butere indicated a significant association between two household characteristics and immunisation (education and housing type), whereas Nyakach depicted a significant association

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between two household characteristics and immunisation coverage (latrine and food availability).

This implies that despite the efforts through interventions that have been going on in the areas, there still exist vulnerable groups that would need to be targeted specifically to elevate the achievement of immunisation targets consistent with the Global Sustainable Development Goals. Both the health service providers and policymakers will need to be cognizant of this fact in their programming and health policy formulations

Recommendation

Based on the study findings and conclusion, the following recommendations are highlighted:

- All stakeholders involved in improving child health indicators should focus on interventions which address the economic status of households; strengthen and give those priorities as this is the most important part of the solution. Improvement in economic status improves wealth, educational quality, and finally, health; hence very vital approach.

- Policymakers will still need to come up with policies that specially target households that are made vulnerable through household characteristics of low education for household headship, lack of staple food, absence of latrine and poor housing types such as temporary and below in structure development.

- The health service providers need to also target particular areas with households that exhibit characteristics that are negatively associated with immunisation through health education and promotion interventions.

- Further research needs to be done to clearly describe the interaction between lack and or absence of these associated household characteristics with immunisation so as to provide evidence-based information on programming to tackle root causes.

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