Journal of
Health, Medicine and Nursing
(JHMN)

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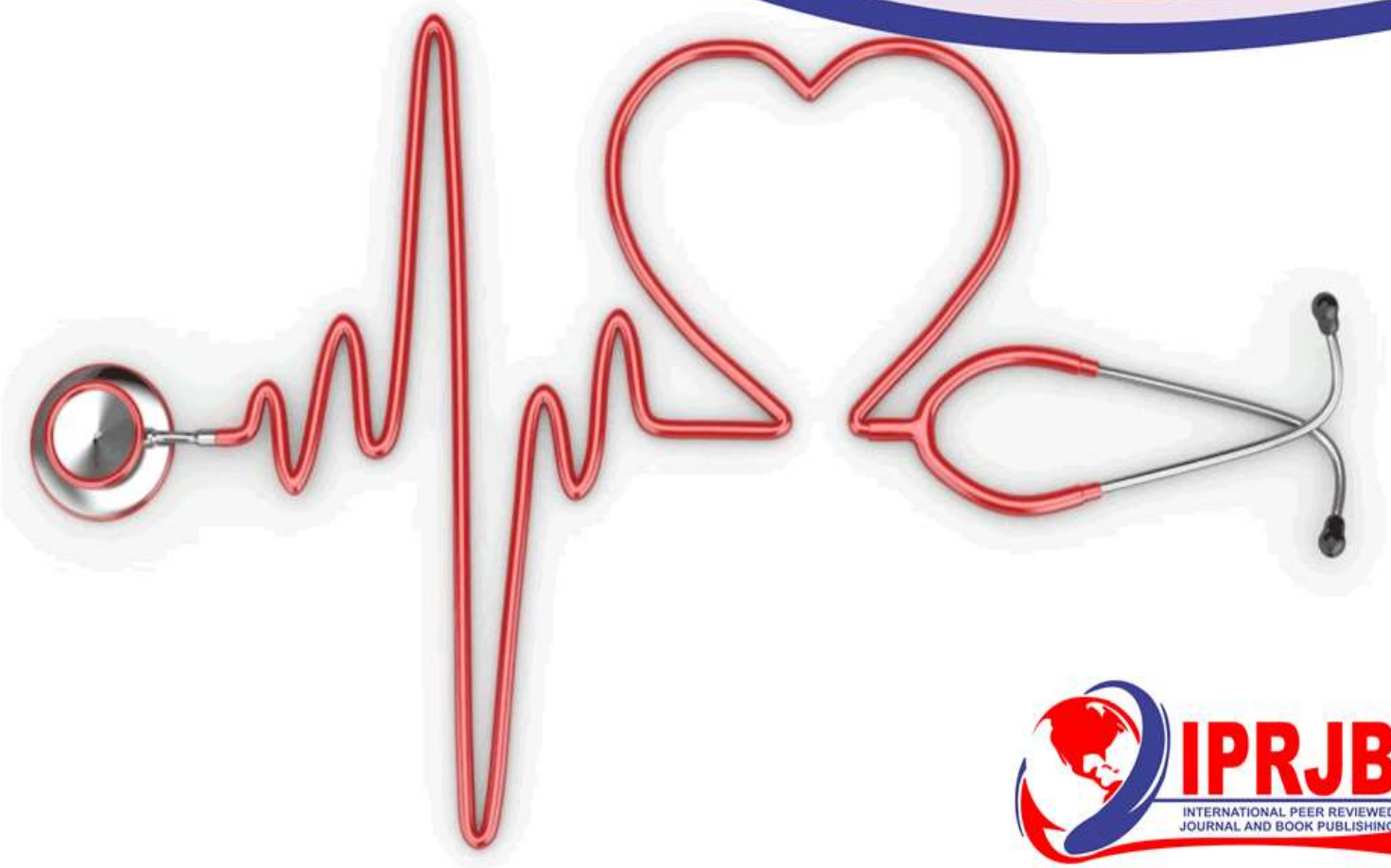

IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

Journal of Health, Medicine and Nursing
ISSN 2520-4025 (Online)
Vol.11, Issue 3. No.1, pp 1 – 16, 2025

www.iprjb.org

Socio-Demographic and Economic Predictors Influencing Immunization Coverage among Under-5 Children of Nomadic Pastoralists in Garissa County, Kenya

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Article History

Received 11th April 2025

Received in Revised Form 18th May 2025

Accepted 24th June 2025

How to cite in APA format:

Adan, M., Magu, D., Mburugu, P., & Mwiti, P. (2025). Socio-Demographic and Economic Predictors Influencing Immunization Coverage among Under-5 Children of Nomadic Pastoralists in Garissa County, Kenya. *Journal of Health, Medicine and Nursing*, *11*(3), 1–16. https://doi.org/10.47604/jhmn.3402

Abstract

Purpose: The purpose of the study is to determine socio-demographic and economic predictors influencing immunization coverage among under-5 children of nomadic pastoralists in selected manyattas in Garissa County, Kenya

Methodology: The study was a cross sectional study design on immunization coverage in Balambala Sub County in Garisa County. The population was selected from household residents of Manyattas in Balambala, among families who had children for immunization. The inclusion criteria was the guardians/caretakers of children aged 0-60 months in Manyattas of Balambala Sub County in Garisa County, whose parents/Caregivers gave informed consent to participate in the study. Children must have resided in Balambala Sub County for more than 6 months. Systematic sampling method was used to collect data from the sample. Data collection was done by use of questionnaires on social demographic and economic factors associated with children immunization. SPSS version 12 was used for analysis where Univariate and multivariable analysis was done to determine association between socio-demographic and economic factors and immunization among children under five years. Ethics Review committee approval no ISERC/MSc/015/2024 was obtained.

Findings: The analysis of factors associated with immunization coverage among caregivers reveals significant associations with several socio-demographic characteristics. Caregivers' age emerged as a critical factor, with those aged 35-44 showing the highest rate of fully immunized children at 88.2%, while caregivers aged 45 and above had the lowest full immunization rate at 37.5%. Caregivers from households earning more than KSh 20,000 had the highest rate of fully immunized children (92.9%), while those earning less than KSh 10,000 had the lowest rate (65.2%).

Unique Contribution to Theory Practice and Policy: Enhance education and awareness by implementing community-based education and awareness programs to improve health literacy among caregivers, particularly focusing on the importance of completing the full immunization schedule. health education initiatives should target caregivers with no or low levels of formal education and involve community health volunteers for effective dissemination of information.

Keywords: *Immunization, Pastoralists, Children*

INTRODUCTION

Worldwide, between 1990 and 2018 it was found that children under the age of five ranges ranged from 96 to 41 per 1,000 live births recorded during this period. The World Bank reports have suggested that immunization is one of the cost-saving besides live-saving approach to lower the rates of deaths and diseases among young children in the world (WHO, 2019). Immunization is a process that prompts or stimulates the body's immune system among children through the use of vaccines that is described as either active or passive immunization. Passive immunization is described as a short-term immunity, which is availed through the transfer or pre-created antibody in the body, or particularly sensitized lymphocytes, from the immune person to a non-immune person.The World Health Organisation in its report approximated that immunization among children has the potential to prevent 2-3 million diseases and complications annually, as well as around 1.5 million mortalities may be averted if the worldwide immunization strategies advances (WHO, 2015). Thus, the global immunization has experienced increased coverage to approximately 70% worldwide for the pentavalent vaccine along with measles vaccines by the conclusion of the 1990. Globally, WHO (2019) reported that the process of immunization has experienced stagnation in its coverage, which has resulted in much mortality.

The mainstream of the children reported to miss the vaccines resides in disadvantage and marginalized rural communities; therefore, these children will not access routine immunization service in their respective areas or nations. This warrants urgent interventions to ensure that more children under the age of 2 years are immunized to prevent further deaths due to preventable diseases for which vaccines are accessible. Globally the interventions of vaccine-avertible illnesses and conditions among children are of public health significance. It helps in preparation for potential emergence of pandemic diseases that may lead global health and security (UNICEF, 2015). The immunization along with other associated health measures may lead considerably to the decrease in infant death frequencies and consequently achieve SDGs goals, especially number 3, which aim to end preventable deaths of infants, as well as children below 5 years by 2030. The effective utilization of immunization programs and services will need acceptability besides understanding of the benefits in readiness for adequate measures to overpower access obstacles.There are many caregivers who fail to finish the scheduled immunization doses for their children as prescribed (Cooper *et a*l., 2021).In Sub -Saharan Africa services are offered at health clinics and hospital outpatient facilities where mainstream in nomadic pastoralist communities are not reached.

In Kenya nomadic lifestyle is associated with factor influencing low immunization coverage among children under 5 years. The study done in Kenya found out that 60% of children from nomadic households had never been vaccinated compared to 72% of the children five years and below from settled pastoralists. (Kiptoo E. 2015).The knowledge of the mothers from nomadic pastoralists have been found to have low knowledge on the importance of children immunization compared to mothers from settled households. The study done in Kenya have found social cultural factors are associated with children immunization, (Gammino . 2016). In Kenya Garissa county is one of nomadic pastoralist communities where it is not well understood whether economic and social demographic challenges facing women are associated with immunization of their children under five year.

Statement of the Problem

The child vaccination is a crucial public health approach towards facilitating besides improving the infant survival rates. Studies estimates that when the vaccines are accessible to populations, especially underserved ones against childhood illnesses and extensively adopted, and countries increase their vaccine coverage worldwide to around 90%, an extra 2 million mortalities annually could be averted in infants below 5 years (Hermann *et al*., 2019). The established barriers towards effective immunization coverage comprise distance covered by affected, as well as health-seeking behavior, the shortage of state public health communication approaches, unexploited prospects, shortage health workers, stock outs, a and economic factors of children care givers. It makes children are prone to preventable illnesses, resulting in greater levels of morbidity and mortalities. According to Kabubo-Mariara (2022), children who received vaccines are more healthy than those who missed vaccines. In Kenya nomadic pastoralist communities face economic and social demographic challenges in achieving immunization of their children under five year leading to low immunization coverage. Immunization coverage in Garisa County was found to be low 60% among children Five years and below. (Ahmed. 2017).

LITERATURE REVIEW

There is need to highlight obstacles to vaccine distribution to guarantee responsibility and improve immunization stagnation occurs. These missed opportunities affect unprotected children and future generations and action is required to improve immunization coverage (Njeumi *et al.*, 2025). It has been shown of the entire low-income birth cohort study studies, 98% of the live births in nations that never received the pneumococcal conjugate vaccines in the immunization plans (WHO, 2019). Based on the reports released by WHO, an infant is completely vaccinated on getting a single dosage of BCG, three doses of DPT, polio, as well as a single dose of measles. BCG vaccine is administered to newborns at birth or during the first clinic against TB control and management. On the other hand, DPT along with polio vaccines needs 3 doses at around 6, 10, and 14 weeks after birth. The measles vaccine is usually administered when the infant is at nine months.The WHO (2019) suggests that infants or children below five years get the full dose of vaccination before they are one year. Certainly, it was reported that around 30 million children under five years globally are unvaccinated. In several nations, the immunization programs are not accessible to the disadvantages and marginalized communities for accessible vaccination programs because caregivers have failed to finish the recommended dose of vaccines (Waisbord *et al.*, 2015).

Approximately 13.5 million children had not been vaccinated, and around19.4 million children has not been vaccinated against diphtheria in the following nations: Angola, Brazil, the Democratic Republic of the Congo (DRC), Ethiopia, India, Indonesia, Nigeria, Pakistan, the Philippines, besides Vietnam according to reports by (WH0, 2019). These vaccines mainly target conditions, like TB, DPT, tetanus, pertussis, hepatitis B, as well as Homophiles Influenza type b. Consequently, pneumococcal pneumonia along with Rotavirus has been lately introduced as diseases affecting children and many children miss immunization. In Kenya services for vaccine preventable diseases are offered freely towards elimination of life - threatening diseases to avert 2 to 3 million mortalities yearly. WHO extended the immunization program designed to eliminate diphtheria, measles, tuberculosis, pertussis, besides poliovirus (WHO, 2015).The KDHS reveal that 79% of newborns aged below two years had received all basic vaccinations. The lowest proportion in North Eastern Province at 55% and 93.3% in

Central Province (KDHS, 2014). The inequality in immunization cover mirrors the difference in the impact of health determinants in various provinces in the region.

Conceptual Framework

A conceptual framework is an exemplification of the relationships between different study variables to describe an extensive concept. Adedokun *et al.*, (2013) in their study on various determinants of infant vaccinations in Nigeria used the educational level along knowledge as the main determinant. They used knowledge, socio-demographic, as well as and economic characteristicsand perception as major independent variables of the study. Social demographic factors of nomadic pastoralists have unique barriers that affects their mobility, seosonal movement as they take their livestock responsibility. The research embraced caregiver knowledge, perception, as well as practices besides access to healthcare services as independent variables of the study, with adherence with complete, partial or incomplete level to childhood immunization schedule as the dependent variable.

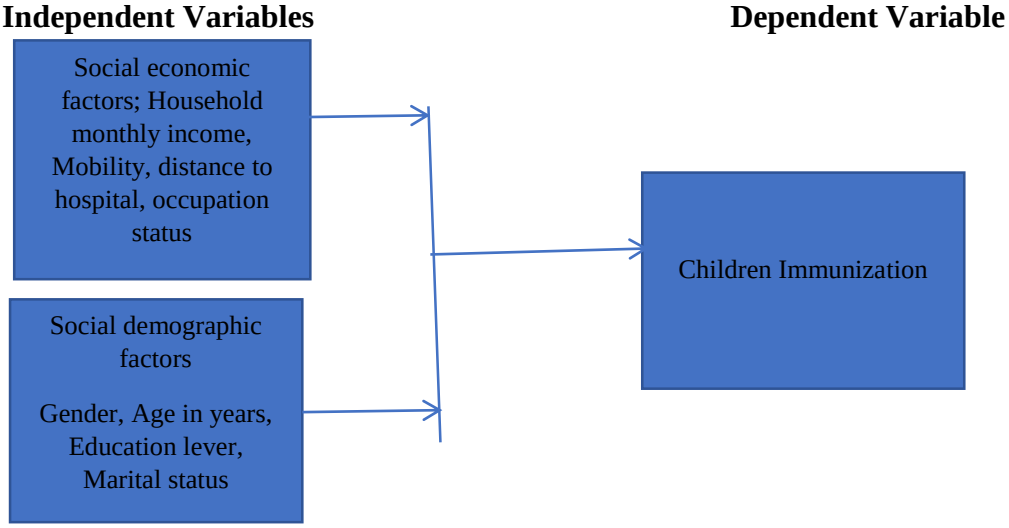

Figure 1: Conceptual Framework

The conceptual framework demonstrate the relationship between independent variable: Social demographic factors, Gender, Age in years, Education lever, Marital status and Social economic factors; Household monthly income, distance to hospital, occupation status and dependent variable children immunization

Research Gaps

The child vaccination is a crucial public health approach towards improving the infant survival rates. Immunization coverage in Garissa county is low compared to nationally Kenya. The socio-demographic and economic factors influencing immunization coverage among under-5 children of nomadic pastoralists in Garissa County, Kenya is not well established.

METHODOLOGY

Study Design

The study was a cross sectional study design on immunization coverage in Balambala Sub County in Garissa County.

Study Population

The population selected for the study constituted household residents of Manyattas in Balambala, especially families who had children for immunization.

Inclusion Criteria

Guardians/caretakers of children aged 0-60 months in Manyattas of Balambala Sub County in Garisa County, whose parents/Caregivers gave informed consent to participate in the study. Children must have resided in Balambala Sub County for more than 6 months.

Exclusion Criteria

Guardians/caretakers of children aged 0- 60 months, whose parents and/or guardian did not give study's informed consent. Children who will not have resided in Balambala Sub County for more than 6 months.

Sampling

Sampling Procedure

The primary sampling units was Manyattas where 189 families who were selected using systematic sampling method from a list of 560 families sampled. With minimum sample size of 295 calculated using Fishers et al formula.

Data Collection

The data on inoculation status of the child was gathered employing WHO vaccination questionnaires that were configured for usage in this research. Caretakers or custodians of the youngsters were cross-examined in addition to the data recorded. The information on socio-demographic features besides immunization history of the infant was obtained. Data on vaccination position of the youngster was either be recorded straight from the child vaccination card and if no card was accessible, the data was be gathered from the caretaker. In cases where the child did not have established any vaccination, the mother and/or caretaker was requested to provide grounds for vaccination failures.

Data Entry and analysis

The data was entered in Microsoft access where a data base was designed exported in SPSS version 12 for analysis. Socio-demographic factors were analyzed employing descriptive statistics. The data on vaccination status, as well as coverage was presented as proportions of the total sample size. Chi-square tests was employed to identify any significant relationships between the immunization and their socio-demographic and economic factors. Univariate and multivariable analysis was done determine association between socio-demographic and economic factors and immunization among children under five years.

Ethical Considerations

The research was approved by the PWANI Ethical Review Committee (ERC Number ISERC/MSc/015/2024.There after clearance obtained from National Commission for Science Technology and Innovation and relevant County Health Departments. Informed consent was sought from the caretakers and/or guardians of the children in the study. Data from questionnaires was kept under lock and key and was secured by ensuring high level of privacy and confidentiality. Data was entered in computers and protected by use of passwords.

RESULTS

Social Demographic and Economic Characteristics of Children Caregivers

The demographic characteristics of caretakers reveal several important patterns. A total of 295 caretakers participated in the study. A significant majority of the caretakers were female (66.1%), suggesting a gendered division of caregiving responsibilities, with women more likely to assume these roles than men (33.9%). In terms of age, most caretakers fell within the young to middle-aged category, with 39.7% aged between 25-34 years and 28.8% between 35-44 years. The younger group, aged 18-24 years, made up 23.4%, while only 8.1% were aged 45 years and above, indicating a smaller proportion of older individuals in caregiving roles. Education levels were notably low, with over half (57.3%) of caretakers having no formal education. A smaller percentage had completed primary education (22.0%), and even fewer had secondary (16.6%) or tertiary education (4.1%). This low level of education could have significant implications for health literacy and informed decision-making. Marital status was predominantly characterized by monogamous marriages (55.9%), with polygamous marriages also being common (32.9%). Only a small fraction of caretakers were single (4.1%), widowed (5.1%), or divorced (2.0%), suggesting relatively stable family structures. Occupationally, nearly half of the caretakers were pastoralists (44.8%), indicating a reliance on rural, agricultural-based livelihoods. Others were engaged in business (31.5%), while a smaller proportion were involved in casual employment (13.9%) or formal employment (5.1%), with 4.7% being unemployed. Financially, most households had modest incomes, with 39.0% earning less than KSh 10,000 per month, 37.3% earning between KSh 10,000-20,000, and 23.7% earning more than KSh 20,000. In terms of household size, a significant proportion of households were large, with 53.9% having seven or more members. Households with 4-6 members made up 32.5%, while only 13.6% had 1-3 members. Table 1:

Journal of Health, Medicine and Nursing
ISSN 2520-4025 (Online)
Vol.11, Issue 3. No.1, pp 1 – 16, 2025
www.iprjb.org

Table 1: Social Demographic and Economic Characteristics of Children Caregivers

Characteristics	Frequency (n)	Percentage (%)
Demographic Characteristics		
Gender		
Male	100	33.9
Female	195	66.1
Age in years		
18-24	69	23.4
25-34	117	39.7
35-44	85	28.8
≥45	24	8.1
Education Level		
No formal education	169	57.3
Primary	65	22.0
Secondary	49	16.6
Tertiary	12	4.1
Marital status		
Single	12	4.1
Married polygamous	97	32.9
Married monogamous	165	55.9
Windowed	15	5.1
divorced	6	2.0
Occupation		
Pastoralist	132	44.8
Business	93	31.5
Formal Employment	15	5.1
Casual employment	41	13.9
Unemployed	14	4.7
Household monthly Income		
<KSh 10,000	115	39.0
KSh 10,000-20,000	110	37.3
>KSh 20,000	70	23.7
Household Size		
1-3	40	13.6
4-6	96	32.5
≥7	159	53.9
Migration pattern		
Frequently (monthly)	30	10.2
Infrequently (bi-annually)	123	41.7
Rare (annually or less)	142	48.1.9
Religion		
Christianity	74	25.1
Muslim	221	74.9
Healthcare Access Factors		
Distance to Hospital in Km		
<30 Km	57	19.3
30-60 Km	91	30.9
>60 Km	147	49.8
Time to the nearest hospital		
Less than 30 minutes	54	18.3
30mins-1 hour	49	16.6
1 hour-2 hours	95	32.2
More than 2 hours	98	32.9
Means to hospital		
Motorbike	86	29.2
Donkey	7	2.4
Walking	57	19.3
Public means	124	42.0
Private vehicle	21	7.1

Social Demographic and Economic Factors Associated With Immunization Coverage

The results from Table 2, present a bivariate analysis of factors associated with immunization coverage among caregivers of children. This analysis examined several socio-demographic factors, including age, education level, household income, migration patterns, distance to the hospital, and time taken to reach healthcare facilities. The Chi-square test and corresponding p-values were used to determine the statistical significance of these associations.

The analysis of factors associated with immunization coverage among caregivers reveals significant associations with several socio-demographic characteristics. Caregivers' age emerged as a critical factor, with those aged 35-44 showing the highest rate of fully immunized children at 88.2%, while caregivers aged 45 and above had the lowest full immunization rate at 37.5%. This finding suggests that older caregivers may face more challenges in ensuring their children receive full immunization compared to younger caregivers. Additionally, education level played an essential role in immunization coverage. Caregivers with tertiary education recorded the highest percentage of fully immunized children at 83.3%, followed closely by those with secondary (81.6%) and primary education (81.2%). In contrast, caregivers with no formal education had the lowest full immunization rate at 66.3%, highlighting the positive impact of education on immunization outcomes.

Similarly, household income was significantly associated with immunization coverage. Caregivers from households earning more than KSh 20,000 had the highest rate of fully immunized children (92.9%), while those earning less than KSh 10,000 had the lowest rate (65.2%). This underscores the link between higher household income and better immunization outcomes, likely due to improved access to healthcare resources. Migration patterns also had a strong association with immunization coverage. Caregivers who migrated infrequently or rarely (annually or less) had the highest rate of fully immunized children (90.8%), while those who migrated frequently (monthly) had a much lower rate (29.8%). This suggests that frequent migration disrupts access to healthcare services, making it more difficult for children in such households to complete their immunization schedules.

Moreover, the distance from caregivers' residences to the hospital significantly influenced immunization coverage. Those living within 30 km of a hospital had the highest rate of fully immunized children (91.2%), while those living more than 60 km away had a lower rate (69.4%). This indicates that proximity to healthcare facilities plays a crucial role in enhancing immunization rates. Finally, the time taken to reach the hospital was also an important factor. Caregivers who took less than 30 minutes to reach the hospital had the highest full immunization rate (90.7%), while those who took more than 2 hours had the lowest rate (69.4%), suggesting that longer travel times pose a barrier to completing immunization schedules.

Table 2: Bivariate Analysis of Social Demographic and Economic Factors Associated With Immunization Coverage

Variable	Fully Immunized n (%)	Partially Immunized n (%)	χ2	p-value
Age in years			28.09	<0.001
18-24	54(78.3)	15(63.8)		
25-34	90(76.9)	27(23.1)		
35-44	75(88.2)	10(11.8)		
≥45	9(37.5)	15(62.5)		
Education level			9.411	0.024
No formal education	112(66.3)	57(33.7)		
Primary education	53(81.2)	12(18.8)		
Secondary education	40(81.6)	9(18.4)		
Tertiary education	10(83.3)	2(16.7)		
Household income			12.249	0.002
<KSh 10,000	75(65.2)	40(34.8)		
KSh 10,000-20,000	92(83.6)	18(16.4)		
>KSh 20,000	65(92.9)	5(7.1)		
Migration pattern			30.489	<0.001
Frequently (monthly)	20(29.8)	47(70.2)		
Infrequently (bi-annually)	60(69.8)	26(30.2)		
Rare (annually or less)	129(90.8)	13(9.2)		
Distance to Hospital			9.345	0.009
<30 Km	52(91.2)	6(8.8)		
30-60 Km	70(76.9)	21(23.1)		
>60 Km	102(69.4)	45(30.6)		
Time to the hospital			9.931	0.019
Less than 30 minutes	49(90.7)	5(9.3)		
30mins-1 hour	40(81.6)	9(18.4)		
1 hour-2 hours	75(78.9)	20(21.1)		
More than 2 hours	68(69.4)	30(30.6)		

Univariate Logistic Regression Analysis of Social Demographic and Economic Factors Associated With Full Immunization

The univariate logistic regression analysis presented in Table 3. Identifies several significant predictors of full immunization among children based on caregiver characteristics. The analysis yielded an odds ratio (OR) of 1.87 for caregivers with primary education, with a 95% confidence interval [CI) of (1.09, 3.19), $p = 0.021$]. This indicates that caregivers with primary education have 87% higher odds of fully immunizing their children compared to those with no formal education. Similarly, caregivers with secondary education [OR=1.90, 95% CI (1.07, 3.38), $p = 0.019$], suggesting that higher educational attainment correlates with increased odds of full immunization. Caregivers with tertiary education [OR=2.25, 95% CI (0.92, 5.50), $p < 0.001$], indicating that children of caregivers who had attained tertiary level of education were about 2.25 times more likely to have their children fully immunized compared to those without any form of education. This implies that as the level of education of caregivers increases the chances of of their children getting full immunization increases.

Household income was another critical factor; caregivers earning between KSh 10,000 and 20,000 had 2.49 times the odds [95% CI (1.41, 4.40), $p = 0.002$] of having fully immunized children compared to those earning less than KSh 10,000. Furthermore, households with an income greater than KSh 20,000 exhibited even higher odds, [OR=4.28, 95% CI (1.55, 11.91), $p = 0.003$]. Similarly, age of caregivers played a significant role as well; caregivers aged 25-

34 [OR=2.53, 95% CI (1.10, 5.83), $p = 0.029$], indicating a strong positive association with full immunization, while those aged 45 and above had much lower odds [OR = 0.21, 95% CI (0.09, 0.49), $p = 0.002$].This implies that children whose caregivers were aged either 45years or above were 79% less likely to be fully immunized.

In terms of migration patterns, caregivers who migrated infrequently had an [OR=5.66, 95% CI (2.85-11.22), $p < 0.001$], and those who migrated rarely had an [OR=18.86, 95% CI (8.94, 39.80), $p < 0.001$], indicating significantly higher odds of fully immunizing their children compared to those who migrated frequently. On the other hand, travel-related factors also affected immunization rates; caregivers who took more than 2 hours to reach a hospital had significantly lower odds of full immunization [OR = 0.27, 95% CI (0.10, 0.73), $p = 0.011$]. This means that these caregivers are 73% less likely to have fully immunized children compared to those who can access healthcare more quickly. Similarly, caregivers living more than 60 km from a hospital [OR=0.25 95% CI ([0.09, 0.66], $p = 0.006$], indicating that greater distances hinder access to immunization services. This suggesting that caregivers living more than 60 kilometers from a hospital they were 75% less likely to have fully immunized children compared to those living closer to healthcare facilities.These findings underscore the importance of socio-economic and logistical factors in influencing immunization coverage, highlighting the need for targeted interventions to improve healthcare access for vulnerable populations.

Table 3: Univariate Logistic Regression Analysis of Social Demographic and Economic Factors Associated With Full Immunization

Variable	Odds Ratio (OR)	95% CI	p-value
Age in years			
18-24	1.00(ref)	-	-
25-34	2.53	1.10-5.79	0.029
35-44	0.94	0.48-1.86	0.864
≥45	0.21	0.08-0.56	0.002
Education Level			
No formal education	1.00(ref)	-	-
Primary education	2.13	1.13-4.02	0.021
Secondary education	2.18	1.13-4.20	0.019
Tertiary education	2.40	0.88-6.56	<0.001
Household Income			
<KSh 10,000	1.00(ref)	-	-
KSh 10,000-20,000	2.49	1.40-4.42	0.002
>KSh 20,000	4.28	1.65-11.10	0.003
Migration pattern			
Frequently	1.00(ref)	-	-
Infrequently	5.66	2.85-11.22	<0.001
None	18.86	8.94-39.80	<0.001
Time to the nearest hospital			
Less than 30 minutes	1.00(ref)	-	-
30mins-1 hour	0.45	0.15-1.38	0.162
1 hour-2 hours	0.41	0.15-1.17	0.095
More than 2 hours	0.27	0.10-0.74	0.011
Distance to Hospital in Km			
<30 Km	1.00(ref)	-	-
30-60 Km	0.40	0.15-1.10	0.075
>60 Km	0.25	0.09-0.66	0.006

Multivariate Logistic Regression Analysis of Predictors of Full Immunization

The multivariate logistic regression analysis presented in Table 4. Identifies several significant predictors of full immunization among children based on caregiver characteristics. The analysis provides odds ratios (OR), 95% confidence intervals (CI), and p-values for each predictor**.**Caregiver education level significantly influenced full immunization rates. Compared to caregivers with no formal education, those with primary education had 80% higher odds of fully immunizing their children [OR = 1.80, 95% CI (1.05, 3.06), p = 0.031]. Caregivers with secondary education showed a 100% increase in odds of full immunization [OR = 2.00, 95% CI (1.10, 3.60), p = 0.022], while those with tertiary education had 140% higher odds compared to the reference group, although this result was marginally non-significant [OR = 2.40, 95% CI (1.00, 5.70), p = 0.051]. Household income was another critical factor. Caregivers earning between KSh 10,000 and 20,000 had 120% higher odds of full immunization compared to those earning less than KSh 10,000 [OR = 2.20, 95% CI (1.20, 4.10), p = 0.010]. Furthermore, households with an income greater than KSh 20,000 exhibited a 300% increase in the odds of fully immunizing their children [OR = 4.00, 95%CI (1.20, 13.00), p = 0.025. Age also played a significant role, with caregivers aged 25-34 having 120% higher odds of full immunization compared to those aged 18-24 [OR = 2.20, 95% CI (1.00, 4.70), p = 0.050]. Conversely, caregivers aged 45 and older were 70% less likely to fully immunize their children compared to the youngest age group [OR = 0.30, 95% CI (0.10, 0.70), p = 0.002]. Migration patterns revealed substantial effects on immunization likelihood. Caregivers who migrated infrequently had nearly five times the odds of full immunization compared to those who migrated frequently [OR = 4.80, 95% CI (2.00, 11.500, $p < 0.001$). Additionally, caregivers who did not migrate at all exhibited a staggering 1400% increase in odds of full immunization [OR = 15.00, 95% CI (6.00, 38.00), $p < 0.001$].

Access to healthcare services was influenced by both time to the nearest hospital and distance. Caregivers taking more than two hours to reach a hospital had 70% lower odds of full immunization compared to those with less than 30 minutes travel time [OR = 0.30, 95% CI (0.10, 0.70), p = 0.010]. Additionally, caregivers living more than 60 kilometers from a hospital had 80% lower odds of full immunization compared to those living within 30 kilometers [OR = 0.20, 95% CI (0.08, 0.50), p = 0.002]. These findings highlight the multifaceted barriers to achieving full immunization, emphasizing the importance of caregiver education, socioeconomic status, migration stability, and accessibility to healthcare services in enhancing immunization coverage.

Table 4: Multivariate Logistic Regression Analysis of Predictors of Full Immunization

Variable	Odds Ratio (OR)	95% CI	p-value
Education Level			
No formal education	1.00(ref)	-	-
Primary education	1.80	1.05-3.06	0.031
Secondary education	2.00	1.10-3.71	0.022
Tertiary education	2.140	1.00-5.70	0.050
Household Income			
<KSh 10,000	1.00(ref)	-	-
KSh 10,000-20,000	2.20	1.20-4.10	0.010
>KSh 20,000	4.00	1.41-13.00	0.025
Age in years			
18-24	1.00(ref)	-	-
25-34	2.20	1.00-4.70	0.050
35-44	1.30	0.60-2.80	0.500
≥45	0.30	0.10-0.70	0.002
Migration pattern			
Frequently	1.00(ref)	-	-
Infrequently	4.80	2.00-11.50	<0.001
None	15.00	6.00-38.00	<0.001
Time to the nearest hospital			
Less than 30 minutes	1.00(ref)	-	-
30mins-1 hour	0.90	0.40-1.90	0.650
1 hour-2 hours	0.50	0.20-1.20	0.100
More than 2 hours	0.30	0.10-0.70	0.010
Distance to Hospital in Km			
<30 Km	1.00(ref)	-	-
30-60 Km	0.70	0.30-1.50	0.350
>60 Km	0.20	0.08-0.50	0.002

DISCUSSION

Social Demographic Characteristics and Economic Factors of Children Caregivers

The demographic profile of the caregivers indicates a predominantly female population (66.1%), suggesting a strong gendered division of caregiving roles. This finding aligns with existing literature that often highlights women's primary role in child-rearing. in pastoralist communities**.** Such a demographic characteristic underscores the need for targeted health interventions that empower women through education and resources, as they play a crucial role in decision-making regarding health and immunization.(Musuka *et al.*, 2020).The age distribution of caregivers shows that 39.7% are aged between 25-34 years, with a significant proportion (28.8%) falling between 35-44 years. This trend is consistent with other studies conducted in similar settings, indicating that younger to middle-aged women are primarily responsible for childcare (Hermann *et al.*,2019). The predominance of younger caregivers may facilitate a greater receptiveness to new health practices, yet the challenges posed by low educational attainment remain critical. Over half of the caregivers (57.3%) reported having no formal education, which is corroborated by studies indicating that low education levels adversely affect health literacy and healthcare decision-making (Okesanya *et al.*, (2024).The findings related to education reveal significant implications for health literacy. The low levels of education among caregivers may hinder their ability to understand the importance of immunization, as health literacy is directly linked to better health outcomes (Kiptoo *et al.*,2015). Studies have shown that caregivers with higher education levels are more likely to

utilize preventive healthcare services, including vaccinations (Musuka *et al.*, 2020). The observed low education levels in this study suggest a pressing need for community-based educational programs that enhance awareness of immunization benefits.

Healthcare access emerged as a significant barrier to immunization coverage, with nearly half of the caregivers living more than 60 kilometers from a healthcare facility. This finding is consistent with research highlighting geographical barriers as a crucial determinant of healthcare access in rural and nomadic populations (Akinyemi *et al.*,2023). The substantial travel distances often discourage caregivers from seeking timely medical services, particularly for vaccinations, which are crucial for child health. While the findings of this study are consistent with existing literature on the barriers to healthcare access in pastoralist and rural communities, there are noteworthy differences.Some studies in urban settings have indicated that access to healthcare facilities is more influenced by socioeconomic status than geographical distance (Njeumi *et a*l., 2025). In contrast, the current study emphasizes that geographical barriers play a more critical role in the context of nomadic pastoralists, who often face compounded challenges due to mobility and access to resources.

Moreover, the time required to reach healthcare facilities further complicates access. A significant proportion of respondents (32.9%) reported needing more than two hours to reach a hospital, emphasizing the logistical challenges faced in these remote settings. This is consistent with findings from studies in rural Kenya and other sub-Saharan African countries, which document similar barriers to healthcare access (Zemichael *et al.*, 2022). The prolonged travel times can lead to missed immunization appointments and increased risk of vaccine-preventable diseases among children.(Donfouet *et al.*, 2019).

The transportation options available to caregivers also pose significant challenges. The majority relied on public transport (42.0%), which is often less reliable and can exacerbate delays in accessing healthcare services, particularly during emergencies. This finding echoes the concerns raised by Kiptoo *et al.*, (2015) who noted that inadequate transportation infrastructure significantly hampers healthcare access in rural communities. The reliance on public and informal transport methods further limits caregivers' ability to reach health facilities promptly, ultimately affecting immunization rates.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study highlights critical demographic and economic factors that significantly influence immunization coverage among children of nomadic pastoralists in Balambala Subcounty. This study have shown that children caregivers with higher education levels and high household income are more likely to ensure their childrens are fully immunized as compared with those with low lever of education and low income respectively. Children caregivers aged 45 and older were less likely to ensure their children are fully immunized compared to the youngest age group. Addressing these barriers through targeted interventions is essential to improve health outcomes and ensure that children in these communities receive the vaccinations they need to thrive. Future research should continue to explore innovative strategies to overcome these challenges, ensuring that vulnerable populations are not left behind in public health initiatives.

Unique Contribution to Theory Practice and Policy:

Enhance education and awareness by implementing community-based education and awareness programs to improve health literacy among caregivers, particularly focusing on the importance of completing the full immunization schedule. Health education initiatives should target caregivers with no or low levels of formal education and involve community health volunteers for effective dissemination of information.

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