International Journal of Social Sciences and Management Review

Volume: 06, Issue: 02 March - April 2023

ISSN 2582-0176

# THE CONTRIBUTION OF THE GEOGRAPHICAL AREA OF RESIDENCE ON RURAL-URBAN DIFFERENTIALS IN INFANT MORTALITY IN KAKAMEGA CENTRAL SUB-COUNTY, KAKAMEGA COUNTY, KENYA

**GILBERT OMEDI[1]*, IRENE MUTAVI[2] & JOYCE OBUOYO[3]**

[1]Lecturer in Geography, Kaimosi Friends University, Kenya

Cellphone contact: +254 727 641 138

[2]Lecturer in Geography and Natural Resources Management, Maseno University, Kenya

[3]Lecturer in Geography and Natural Resources Management, Maseno University, Kenya

https://doi.org/10.37602/IJSSMR.2023.6212

## ABSTRACT

**Background:** Infant mortality remains an indaba in Sub-Saharan Africa, a region currently producing over half of global infant deaths. Kakamega Central Sub-County, a region within Sub-Saharan Africa, has an infant mortality rate of 37. This study examined the contribution of the geographical area of residence on rural-urban differentials in infant mortality in Kakamega Central Sub-County, Kakamega County, Kenya.

**Methods:** A cross-sectional research design was adopted. Primary data were collected from mothers between the childbearing ages of 15 to 49 years who had an experience of childbirth between 2013 and 2022. Secondary data were obtained from the 2019 Kenya population and housing census. Cross-tabulation and multinomial logistic regression analyses were conducted on the statistical package of the social sciences version 25 computer software program.

**Results:** Rural areas with mud roads had higher odds of neonatal (aOR – 2.067) and infant (aOR - 3.867) mortalities when compared to those with tarmacked roads. Areas with 3 to 4 health facilities had 8.248 and 2.651 higher adjusted odds ratios of post-neonatal and infant mortality when compared to areas with at least 5 health facilities in rural and urban areas, respectively. Residing in good housing was associated with lower odds ratios of rural neonatal (aOR – 0.016), urban post-neonatal (aOR – 0.265), and infant (aOR – 0.312) mortalities when compared to residing in durable housing.

**Conclusion:** There is a need for concerted efforts towards road improvement in rural areas; increased access to functional and well-equipped health to ensure an acceptable density of health facilities; and enlightening people on the importance of proper hygiene in the household environments and on good, affordable, dietary practices.

**Keywords:** Geographical area of residence; Nature of roads; Number of health facilities; Population density; Type of housing.

## 1.0 INTRODUCTION

  

Infant mortality is the death of a new-born baby before reaching age one. Being a measure of child survival, it remains to be an excellent pointer to the health of children and the socioeconomic development of society (Omedi, 2011). The United Nations, in 2000, came up with a goal that aimed at reducing under-age-five mortality by about 67 percent in a span of 25 years (UNDP, 2000). National governments intensified efforts to lower under-five mortality and enhance child survival. This bore some fruit as there were observed advances in under-five mortality rates. The Millennium Development Goals Report (UN, 2014) noted that the worldwide rate of under-five mortality dropped from 90 (in 1990) to 43 (in 2015) deaths for every 1,000 live births. However, these improvements did not enable many countries to meet the target by the United Nations.

At the elapse of 25 years, the pressing requisite for ending the avertable death of children was still in existence. Thus, in 2015, the United Nations came up with the third Sustainable Development Goal (SDG) that calls for the termination of avertable deaths of all children below 60 months of age come the year 2030 (UNDP, 2015). Target 3.2 of the Sustainable Development Goals calls for all states to lessen the death of new-borns between birth and exactly 28 life days to at least 12 deaths per 1,000 live births and that of new-borns between birth and sixty months of life to at least 25 deaths per 1,000 live births by the year 2030.

Global infant mortality rate is 28 (neonatal -17; postneonatal – 11) deaths per 1,000 live births. Beyond half (53 percent) of infant deaths occur in sub-Saharan Africa (UNICEF et al., 2020). Kenya's infant mortality rate is 36 while that of Kakamega is 37 infant deaths per 1,000 livebirths (KNBS, 2022). The report by Kenya National Bureau of Statistics (2022) further notes that the proportion of dead children to women is 0.053 in Kakamega, 0.049 in Vihiga, 0.036 in Bungoma, 0.029 in Trans-Nzoia, 0.024 in Nandi, and 0.02 in Uasin Gishu. It could be expected that these neighboring areas depict more or less the same proportion of children dead because of the anticipated similarities in their environments. As explained in the report, the proportion of dead children born to women is a reflection of the level of early childhood mortality. A study conducted in West Africa pointed out that diverse geographical environments have distinctive contextual features (Sombie et al., 2017) that can bring about disparities in factors influencing infant mortality. Thus, the reason for conducting this study is to examine the contribution of the geographical area of residence on rural-urban differentials in infant mortality in Kakamega Central Sub-County, Kakamega County, Kenya. The study tested the following research hypotheses: (1) Population density has a significant relationship influence on the death of infants in rural and urban areas of Kakamega Central Sub-County; (2) Nature of roads has a significant relationship influence on the death of infants in rural and urban areas of Kakamega Central Sub-County; (3) Number of health facilities has a significant relationship influence on the death of infants in rural and urban areas of Kakamega Central Sub-County; and (4) Type of housing has a significant relationship influence on the death of infants in rural and urban areas of Kakamega Central Sub-County. The study findings provide the knowledge necessary for improving child survival and creating awareness of geographical factors which are associated with infant mortality in Kakamega Central Sub-County, and in Kenya, by extension. The created awareness is useful to child health policy and program makers and implementers and in the build-up of literature related to population geography and her related fields.

## 2.0 LITERATURE REVIEW

  

Geographical factors of population density, nature of roads, number of health facilities, and type of housing may influence infant mortality in one way or the other. This is because not all geographical areas have equitable distribution of and access to socioeconomic infrastructure nor do they depict similarities in population densities and housing types and patterns. This results in differences in the development of regional welfare. A study done in Mozambique that investigated the relationship between the province of residence of the mother and under-five mortality concluded that population density and distribution of basic infrastructure, including healthcare services, may have confounding effects on geographical differentials in under-five mortality (Macassa et al., 2012).

Population density may explain differentials in geospatial infant mortality by affecting the transmission of such diseases as diarrhea, measles, acute respiratory tract infections and malaria that contribute to infant deaths. It also influences economic growth which indirectly affects the well-being of children (Ghosh, 2005). Further, population density may also influence variations in sanitation and the disease environment. Studies in developing countries have reported that people in densely populated areas are more likely to have access to health services that matter for child survival and development, such as trained doctors, maternal care, and medicines (Magadi et al., 2003; Matthews et al., 2010). High population density without poor sanitation is substantially less dangerous in that the advantages of access to health care and other resources might dominate the disadvantages of disease externalities, yielding a net health benefit of living in dense urban centers (Leon, 2008). Again, urban areas characterized by low population density may not be disadvantaged relative to rural areas characterized by high population density (Hathi, et al., 2017).

A study done in Zimbabwe by Root (1997) argued that regional differences observed in childhood mortality were a result of variations in population densities. Using Cox regression analysis, the study found that children aged between 1 to 4 years residing in the Ndebele provinces experienced a 45 percent lower mortality than their counterparts living in the Shona provinces. The study accepted the hypothesis that low population densities in the Ndebele provinces had contributed to their lower child mortality.

Health facilities are the primary distribution channels for many cost-effective interventions, including immunizations, safe child delivery, and insecticide-treated bed nets (Simmons et al., 2021). Physical distribution of health services is an important determinant of child survival (Karra et al, 2017). In Sub-Saharan Africa, a higher proportion of avertable deaths is associated with poor access to healthcare services than the quality of healthcare services (Kruk et al., 2018). The association between poor access and mortality reflects limited physical access in terms of distance, travel time, and poor distribution of facilities resulting in crowding and unmanageable volumes of patients. It is estimated that 15 to 29 percent of people in Sub-Saharan Africa live beyond 2 hours of travel time from the nearby public hospital (Falchetta et al., 2020; Ouma et al., 2018), something that highlights the geographical distribution of healthcare services (Simmons et al., 2021). However, having a large number of health facilities, each with a low caseload may increase costs and could lower the quality of service provision (Karra et al., 2017).

The number of health facilities in a geographical area can be used to compute the density of health facilities. When we consider the population density and health facility density, then we are able to tell whether or not there is a strain on the usage of the available health facilities. Considering the population present in an area, having a health facility within the village of residence significantly increases the chances of being fully vaccinated (Sanou, et al., 2009) yet vaccination is correlated with infant death. In India, Ghosh (2005) attributed pronounced differences in the prevalence of infectious diseases among under-five children to be a result of differences in the development of basic amenities, infrastructure, healthcare, and such macro-economic indicators as trade, income distribution between and within different provinces, and population density. The current study postulated that the number of health facilities in a region influences the death of infants either directly in terms of availability or indirectly in terms of geographical accessibility, accommodation space, and proper stocking of the necessary drugs and equipment needed for infant survival.

The type of housing is postulated to influence the death of infants. A study by Macassa et al. (2012) found that concerning finished houses, those houses with natural clay floor material had a 0.02 lower risk, while those houses with rudimentary wood and adobe floor materials had a 0.61 higher risk of reporting under-five deaths. While analyzing the 2009 Kenya Population and Housing Census, Gruebner et al. (2015) found the quality of housing to be a risk factor for infant deaths in urban areas as compared to rural areas. The study found 23.34 percent of infant deaths to be reported by urban mothers who lived in non-durable houses. Living in slums was a proactive factor for mothers with previous child death. Slums are defined by the poor structural quality of housing and high population densities (UN-Habitat, 2003) that increase exposure to disease pathogens that aggravates infant mortality (Black, et al., 2003; Agarwal & Taneja, 2005). Unable to afford clean fuel, the non-durable housing-dwellers rely on biomass fuels for cooking and heating. Air pollution is higher inside such smoky dwellings leading to ill health and undermining the quality of life and hope for the future (Mutunga, 2007).

About the risk of infant deaths based on the type and quality of housing, Gruebner et al. (2015) found good and durable housing to reduce the risk of infant death by 31 percent and 18 percent, respectively, compared to non-durable housing in rural areas of Kenya. In urban areas of Kenya, the study found that, compared to non-durable housing, good housing reduced the risk of infant death by 32.33 percent. However, durable housing quality in urban areas was a risk factor for infant death compared to rural areas. Residing in durable housing increased the risk of infant death by 2 percent in urban areas. This finding is related to a better socioeconomic status that is characterized by changing lifestyle patterns and maternal obesity which is a risk factor for infant death (Meehan, et al., 2014). These findings show a mix-up on the effect of the type of housing on infant mortality: durable housing reduces the risk of infant deaths in rural areas while it increases the risk of death in urban areas. The current study anticipated durable housing to reduce the risk of infant deaths by reducing contamination and transmission of disease-causing micro-organisms to infants residing in a household.

Roads are used to convey traffic between one's residence and such amenities as health and trading centers that are necessary for infant care and raising. The nature of roads demonstrates the actual routes that an ill infant would probably follow to reach the nearest health facility for medication. It also demonstrates the routes a parent would take to reach a trading center to acquire basic needs for proper infant care. Muddy and dilapidated roads can be impassable and hence curtail access to health and trading centers. A study done in Tanzania by Masuma and Bangser (2009) reported that transport in rural Tanzania was problematic and often patients had to walk long distances to the nearest health facilities, sometimes in difficult terrains. Well-maintained murram and tarmac roads improve the traffic flow between residential areas and health and trading centers, and in the long run, reduce infant mortality when other factors are held constant.

## 3.0 DATA AND METHODS

### 3.1 Study area and research design

The area of this study was Kakamega Central Sub-County, Kakamega County, Kenya. Its longitudinal extent is from 34037’21” E to 34048’21” E while its latitudinal extend is from 0010’49” N to 0022’13” N. The sub-county is approximately 161.8 square kilometers, with a population of 188,212 (92,774 male and 95,432 female and 6 intersexes) (KNBS, 2019). The sub-county has 52,015 households with an approximate household size of 3.6 persons. A cross-sectional research design was employed. The primary data source was mothers between the childbearing ages of 15 to 49 years who had an experienced childbirth between 2013 and 2022. The secondary data source was the 2019 Kenya Population and Housing Census.

### 3.2 Study sample

A total of 384 households were chosen for the study guided by a formula developed by Fisher et al. (1983). To cater for non-response and missing data, questionnaires were administered to an extra ten percent of households in each of the thirteen geographical areas. A systematic random sampling technique was used to arrive at households that were involved in the study. The study data was gathered from mothers between the childbearing ages of 15 to 49 years who had experienced childbirth between 2013 and 2022. Only one respondent, the most recent mother, was presented with a questionnaire in households with multiple cases of childbirth from multiple respondents.

### 3.3 Study variables

The independent variables in this study were population density, nature of roads, number of health facilities, and type of housing. The covariates were socioeconomic, demographic, and distance factors. The outcome variable was infant mortality: neonatal mortality and post-neonatal mortality at the time of the survey, according to the geographical area of residence. Segmenting the outcome variable at neonatal, post-neonatal, and infant mortality levels were guided by existing literature that indicates that the influence of various on the death of infants varies with age (Kuse et al., 2022; Madise, et al. 2003; Da Vanzo et al., 1983).

### 3.4 Methods of data analysis

Data analyses were conducted at descriptive and inferential analysis levels on the Statistical Package for Social Sciences (SPSS) version 25 computer software program. The descriptive analysis involved cross-tabulation analysis to obtain the prevalence of infant mortality in rural and urban areas by study variables. Inferential analysis engaged multinomial logistic regression modeling at univariate and multivariate analytical levels. In the logistic regression model, data were fitted in a logit function logistic curve to estimate the occurrence of an outcome as a result of the influence of each of the explanatory variables. The findings, in terms of crude odds ratios, were arrived at by considering the exponential function of appraised coefficients of regression. Further, all the exposure variables were fitted in the multinomial logistic regression model controlling for covariates to study the independent effect of each one of them on neonatal, post-neonatal, and infant deaths in terms of adjusted odds ratios. This was aimed at examining the major influential factors of early childhood mortalities in rural and urban areas of Kakamega Central Sub-County. The hypotheses were tested at 95% significance level.

### 3.5 Minimising potential biases

Since the study was based on retrospective birth history, recall bias was minimized by engaging recent mothers as respondents. Adequate time was given to the respondents to reflect and think through the circumstances that related to the lives of their infant births. The in-migration and inter-ethnic marriage factors might lead to the problem of a language barrier between the researcher and the respondents. To mitigate this, the researcher engaged the services of bilingual research assistants who assisted in interpreting the English words on the research instrument to Kiswahili and Luhya when the need arose. This was done to ensure there was precision with the questions asked to augment the accuracy of the responses given.

### 3.6 Ethical issues

This study observed research ethics to minimize the risk of participant exposure to get optimum responses from the target population. The research was ethically endorsed by Maseno University Scientific and Ethics Review Committee, reference number MSU/DRPI/MUSERC/01119/22. A research license numbered NACOSTI/P/22/22577, was gotten from the National Commission for Science, Technology, and Innovation (NACOSTI). A research authorization, numbered CGK/OCS/GEN.CRR./04/(621), was gotten from the Kakamega County Secretary's Office.

## 4.0 RESULTS AND DISCUSSION

### 4.1 Results of descriptive analysis

A descriptive analysis was carried out to bring out the percentage distribution of infant deaths according to geographical factors. The results are presented in Table 1.

**Table 1: Distribution of deaths according to geographical factors**

| | RURAL | | | URBAN | | |
|---|---|---|---|---|---|---|
| Exposure variable | Neonate | Post-neonate | Infant | Neonate | Post-neonate | Infant |
| **Population density** | | | | | | |
| x≤599 | 19.35 | 25.53 | 23.08 | - | - | - |
| 600≤x≤999 | 80.65 | 74.47 | 76.92 | - | - | - |
| x≥1000 | - | - | - | 100.00 | 100.00 | 100.00 |
| **Nature of roads** | | | | | | |
| Mud roads | 6.45 | 31.91 | 21.79 | 1.92 | 4.94 | 3.76 |
| Murram roads | 70.97 | 51.06 | 58.97 | 30.77 | 34.57 | 33.08 |
| Tarmacked roads | 22.58 | 17.02 | 19.23 | 67.31 | 60.49 | 63.16 |

Volume: 06, Issue: 02 March - April 2023

ISSN 2582-0176

| | | | | | | |
|---|---|---|---|---|---|---|
| **Number of health facilities** | | | | | | |
| x≤2 | 83.87 | 72.34 | 76.92 | - | - | - |
| 3≤x≤4 | 12.90 | 17.02 | 15.38 | 9.62 | 16.05 | 13.53 |
| x≥5 | 3.23 | 10.64 | 7.69 | 90.38 | 83.95 | 86.47 |
| **Type of housing** | | | | | | |
| Non-durable housing | 3.23 | - | 1.28 | 19.23 | 32.10 | 27.07 |
| Good housing | 80.65 | 85.11 | 83.33 | 28.85 | 29.63 | 29.32 |
| Durable housing | 16.13 | 14.89 | 15.38 | 51.92 | 38.27 | 43.61 |

76.92 percent of infant deaths occurred in areas with a population density of between 600 to 999 persons per square kilometer, 58.97 percent, 76.92 percent and 83.33 percent occurred in areas with murram roads, at most 2 health facilities and in homes with good housing, respectively, in rural areas of Kakamega Central Sub-County. Further, 63.16 percent, 86.47 percent, and 43.61 percent of infant deaths occurred in urban areas characterized by tarmacked roads, at least 5 health facilities, and durable housing, respectively. Worth noting is that all urban areas under study had a population density of above 1,000 persons per square kilometer and more than 2 health facilities.

These findings showed that there was a higher prevalence of infant mortality in rural areas characterized by a population density of 600≤x≤999 (76.92 percent), than those with a population density of less than 600. Generally, Kenya's population is positively growing yet the land size is static. Geospatial areas with a population density of less than 600 are fading out with time. A higher population density points to crowding, competition for space, and health infrastructure, all of which might lead to a higher prevalence of infant mortality. There was a higher prevalence of infant mortality in rural areas with murram roads (58.97 percent) and urban areas with tarmacked roads (63.16 percent). Murram roads outweigh tarmacked roads in virtually all rural geographical areas. On the contrary, tarmacked roads outweigh murram roads in most urban settings.

There was a higher prevalence of infant mortality in rural areas with at most 2 health facilities (76.92 percent) and urban areas with at least 5 health facilities (86.47 percent). The density of health facilities is generally in favor of urban settings in most regions in Kenya. This is due to the high population densities in urban than rural areas. Since health facilities are part of basic social infrastructure, then many of them are constructed in urban areas than in rural areas. However, some dispensaries remained closed over weekends and on public holidays implying that the differentials in the prevalence of infant mortality might not be fully explained by the physical number of health facilities present in a given geographical area but also by the ability of a sick infant to access the necessary health services and attention.

Considering the type of housing, the study found a higher prevalence of infant mortality in rural areas with good housing (83.33 percent) and in urban areas with durable housing (43.61 percent). Generally, dilapidated grass-thatched houses and houses with perforated roofs are on a decrease in rural areas of Kakamega Central Sub-County. With the ever-increasing population and its related demand for land for farming, grasslands have not been spared. The majority of them have been cleared for crop farming and settlement clipping the supply of grass

  

Volume: 06, Issue: 02 March - April 2023

ISSN 2582-0176

for thatching houses. The initially earth-floored and mud-walled houses are being improved by cementing to graduate them into a semi-permanent category. Because of differentials in economic levels of the urbanites, some are not able to afford durable housing and thus end up residing in good and non-durable housing. This might explain the observed differentials in the prevalence of infant mortality based on the type of housing (non-durable housing – 27.07 percent; good housing – 29.32 percent; durable housing – 43.61 percent).

### 4.2 Results of univariate analysis

Univariate multinomial logistic regression analysis was done to establish the influence of geographical area of residence on the death of infants in rural and urban areas of Kakamega Central Sub-County. The results are presented in Table 2.

**Table 2: Crude odds ratios on the influence of geographical factors on neonatal, post-neonatal, and infant mortality**

| | RURAL | | | URBAN | | |
|---|---|---|---|---|---|---|
| Exposure variable | Neonatal | Post-neonatal | Infant | Neonatal | Post-neonatal | Infant |
| **Population density** | | | | | | |
| $x \le 599$[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| $600 \le x \le 999$ | 1.441 | 0.921 | 1.154 | - | - | - |
| $x \ge 1000$ | - | - | - | 1.533 | 0.706 | 0.936 |
| **Nature of roads** | | | | | | |
| Tarmacked roads[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Murram roads | 1.178 | 1.138 | 1.247 | 0.930 | 1.015 | 0.970 |
| Mud roads | 9.116* | 0.683 | 2.077** | 1.369 | 0.521 | 0.613 |
| **Number of health facilities** | | | | | | |
| $x \ge 5$[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| $x \le 2$ | 2.798 | 0.615 | 1.050 | - | - | - |
| $3 \le x \le 4$ | 0.583 | 1.445 | 0.904 | 0.608 | 1.574 | 1.109 |
| **Type of housing** | | | | | | |
| Durable housing[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Non-durable housing | 1.005 | 1.074 | 1.061 | 0.852 | 1.173 | 1.019 |
| Good housing | 0.535 | 3.507 | 2.173 | 1.471 | 0.664 | 0.873 |

*$\rho<0.01$; **$\rho<0.05$

a Reference category

Rural areas characterized by mud roads were significantly more likely to experience neonatal (cOR = 9.116; $\rho<0.01$; CI = 2.010 – 41.337) and infant mortality (cOR = 2.077; $\rho<0.05$; CI = 0.959 – 4.499) concerning rural areas characterized by tarmacked roads. There were insignificant lower crude odds ratios for mud roads being a contributor to post-neonatal mortality in rural areas. Population density, the number of health facilities, and the type of housing were insignificant both in rural and urban areas of Kakamega Central Sub-County. The nature of roads was equally insignificantly related to infant mortality in urban areas of Kakamega Central Sub-County.

### 4.3 Results of multivariate analysis

Multivariate multinomial logistic regression analysis incorporating all the variables of the study to establish the net effect of each geographical factor on infant mortality was carried out. The results are presented in Table 3.

**Table 3: Adjusted odds ratios on the influence of geographical factors on neonatal, post-neonatal, and infant mortality controlling for all other study factors**

| | RURAL | | | URBAN | | |
|---|---|---|---|---|---|---|
| Exposure variable | Neonatal | Post-neonatal | Infant | Neonatal | Post-neonatal | Infant |
| **Population density** | | | | | | |
| x≤599[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 600≤x≤999 | 5.524 | 0.402 | 0.651 | - | - | - |
| x≥1000 | - | - | - | 0.694 | 0.269 | 0.274 |
| **Nature of roads** | | | | | | |
| Tarmacked roads[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Murram roads | 0.409 | 1.818 | 1.210 | 0.802 | 0.958 | 0.982 |
| Mud roads | 2.067** | 0.832 | 3.867** | 1.641 | 0.041 | 0.069 |
| **Number of health facilities** | | | | | | |
| x≥5[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| x≤2 | 1.039 | 8.225 | 2.962 | - | - | - |
| 3≤x≤4 | 0.202 | 9.248** | 1.363 | 1.442 | 3.715 | 3.651** |
| **Type of housing** | | | | | | |
| Durable housing[a] | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| Non-durable housing | 2.827 | 0.561 | 1.543 | 0.373 | 0.949 | 0.618 |
| Good housing | 0.016** | 3.575 | 2.885 | 0.813 | 0.265** | 0.312** |

*ρ<0.01; **ρ<0.05

a Reference category

The results in Table 3 show that the adjusted odds ratios of the likelihood of neonatal mortality were 2.067 (ρ<0.05; CI = 1.065 – 4.012) while those of infant mortality were 3.867 (ρ<0.05; CI = 1.079 – 3.857) among babies born to rural mothers who resided in areas with mud roads when compared to their counterparts who resided in areas with tarmacked roads. Furthermore, there was a higher likelihood of post-neonatal mortality in rural geographical areas that had 3 to 4 health facilities (aOR = 9.248; ρ<0.05; CI = 0.979 – 87.389) concerning rural areas with at least 5 health facilities. Urban areas with 3 to 4 health facilities had higher adjusted odds ratios of infant mortality (aOR = 3.651; ρ<0.05; CI = 0.790 – 6.883) in comparison to urban areas with above-4 health facilities. The type of housing was a significant contributor to neonatal mortality in rural areas and post-neonatal mortality and infant mortality in urban areas. In rural areas, neonates housed in good housing were 0.984 times less likely to experience neonatal mortality when compared to their counterparts in a durable housing. There were lower likelihoods of post-neonatal mortality (aOR = 0.265; $\rho<0.05$; CI = 0.070 – 1.010) and infant mortality (aOR = 0.312; $\rho<0.05$; CI = 0.089 – 1.097) amongst children residing in good housing when compared to children residing in durable housing in urban areas.

Nature and availability of roads, geospatial distribution of health facilities, and kind of housing vary across administrative regions and geographical areas. Mud roads delay the flow of traffic and, in some instances, they might even discourage a patient from getting out of their homes to seek medication, especially late nights and in rainy seasons. That there are higher odds of infant mortality in rural areas with mud roads when compared to those with tarmacked roads is unsurprising. Unlike rural areas which are mainly characterized by mud and murram roads with few stretches of tarmacked roads, urban areas are characterized by tarmacked roads with few stretches of mud roads. This might explain why nature of roads is an insignificant contributor to infant mortality in urban areas of Kakamega Central Sub-County.

The foremost distribution channel for many cost-effective maternal, new-born and childcare interventions are health facilities. Areas with less than five health facilities were generally found to have higher likelihoods of experiencing infant mortality. The adjusted odds ratios were 8.248 and 2.651 times higher for post-neonatal and infant mortality in rural and urban areas, respectively in areas that had 3 to 4 health facilities when compared to areas with at least 5 health facilities. A reduced health facility density points to increased distance to accessing health care services and congestion in the available health facilities, both of which can contribute to infant mortality in an affected population. Thus, insufficient health systems hamper progress in infant survival.

There were generally significantly reduced likelihoods of neonatal (rural – aOR = 0.016), post-neonatal (urban – aOR = 0.265) and infant (urban –aOR = 0.312) mortalities amongst infants born in good housing than their counterparts born in durable housing. Durable housing might point to improved socioeconomic lifestyle that brings in non-communicable diseases and challenges of maternal obesity which heightens the likelihood of mortality. A house might be durable but unhygienic with poor sewerage systems, blocked flush toilet facilities that speeds up the spread of diarrheal diseases. On the other hand, a house might be less-durable but the household observes the expected hygiene and lifestyle practices.

### 4.4 Discussion

This study sought to examine the contribution of geographical area of residence on the death of infants in rural and urban areas of Kakamega Central Sub-County. The analytical findings showed that geographical factors contributed to rural-urban differentials in infant mortality in Kakamega Central Sub-County. The higher prevalence of infant mortality in rural areas with a population density of $600\leq x\leq 999$ compared to their counterparts with a population density of $x\leq 599$ might be due to the latter being less-crowded than the former. All the urban areas of study had a population density of $x\geq 1000$ and thus all infant deaths were captured under that category. As explained by Ghosh (2005), population density may explain differentials in geospatial infant mortality by affecting the transmission of such diseases as diarrhea, measles, acute respiratory tract infections and malaria that contribute to infant deaths.

As pertains to the nature of roads in a geographical area, rural areas are mostly characterized by mud and murram roads with a few stretches of tarmacked roads as compared to urban roads which are mainly tarmacked. This explains the 80.76 percent prevalence in infant deaths in rural areas with non-tarmacked roads vis-à-vis the 63.16 percent prevalence in infant deaths in urban areas with tarmacked roads. A study done in rural areas of Tanzania by Masuma and Bangser (2009) noted that transport was problematic and that often patients had to walk long distances, sometimes in difficult terrains, to reach the nearest health facilities. Improving access to road transport not only affects distance required to travel to a health facility but also reduces the travel time (Karra et al., 2017). Such a practice will improve access to health facilities and considerably improve infant health outcomes.

Nature of roads was a significant contributor to infant mortality in rural areas but not in urban areas. In the full model, rural areas with mud roads were 1.067 times and 2.867 times more likely to experience neonatal and infant mortality, respectively, in comparison to rural areas with tarmacked roads. This is in agreement with the findings of a community-based cross-sectional study done in rural Ethiopia that found people living in remote areas to have higher risks of childhood mortality (Okwaraji et al., 2012). Many remote areas are characterized by poorly-developed transport infrastructure including mud and dilapidated roads. Mud and dilapidated roads are many at times impassable and this curtails access to health centers in case of an expectant mother wanting to do hospital childbirth delivery or in case of a sick infant seeking medical attention. The major means of transport along mud and dilapidated roads is human trekking. Motorcycle operators occasionally decline to transport people along certain routes especially during rainy seasons. This is unlike tarmacked roads that depict improved traffic flow by motorcycles and motor-vehicles between residential areas and health centers all-year round. Human trekking is equally easier and faster along tarmacked roads than along mud and dilapidated roads.

The number of health facilities present in an area was found to be significantly associated with differentials in infant mortality at post-neonatal level in rural areas and at infant level in urban areas. In comparison to areas with at least 5 health facilities, areas with 3 to 4 health facilities had higher adjusted odds ratios of post-neonatal (aOR = 9.248) and infant mortality (aOR = 3.651) in rural and urban areas, respectively. A lesser density of health facilities in an area reduces chances of an expectant mother attending antenatal care visits, delivering in a health facility and an infant being fully vaccinated. Fewer health facilities in comparison to the surging population demands for healthcare leads to loss of infant lives as a result of stressed healthcare systems. A cross-sectional study done in Nouna district, Burkina Faso noted that having a health facility within a village significantly increased chances of being fully vaccinated (Sanou, et al., 2009) yet vaccination is correlated to infant mortality.

Worth noting is that access to a health facility is not directly related to proper infant care services. A country-wide study done in Kenya by Toda et al. (2012) found a quarter of medical centers to be poorly stocked with family planning and vaccination commodities. Furthermore, some health facilities remained closed over weekends and on public holidays. An infant getting sick on such a health facility closure day might lose life that could otherwise be salvaged suppose the health facilities remained open all days. As appreciated by Armstrong (2008), even peripheral health facilities have huge potential to improve the health and survival of families if distance and travel-time be reduced. The findings of this study are however inconsistent with the findings of a study by Simmons et al. (2021) that found a higher ratio of health facilities relative to the population to be associated with improved child survival but not infant survival.

Considering the type of housing in which an infant resided, the study found lower adjusted odds ratios of neonatal mortality in rural areas and post-neonatal mortality and infant mortality in urban areas amongst residents of good housing with reference to residents of durable housing. Residing in good housing reduced the likelihood of neonatal mortality by 98.4 percent compared to residence in durable housing in rural areas. In urban areas, residing in good housing reduced the likelihood of post-neonatal and infant mortality by 73.5 percent and 68.8 percent, respectively, compared to residing in durable housing. These findings are in agreement with findings of other studies (Macassa et al., 2012; Meehan et al., 2014; Gruebner et al., 2015). A study on geographic differentials in mortality of children in Mozambique by Macassa et al. (2012) found houses with natural clay floor material to have a 0.02 lower risk of reporting under-five deaths with reference to finished (durable) houses. On their side, Gruebner et al. (2015) found residence in durable housing to increase the risk of infant death by 2 percent in urban areas.

In search for explanation, Meehan et al. (2014) indicated that durable housing was related to better socio-economic status characterized by changing lifestyle patterns and maternal obesity which are risk factors for infant mortality. It is possible that, with better socioeconomic status, expectant mothers in durable housing seek for planned caesarean section prior to the expected due dates. Rich women might perceive vaginal delivery as painful, stressful, embarrassing and complicated and thus opt for planned caesarean section delivery in pursuit of protecting their societal image (Omedi et al., 2020). Such premature deliveries are associated with elevated risks of early childhood mortalities. In search of further understanding, a key informant was asked on the characteristic features of a geographical area of residence with anticipated higher infant mortality. She responded:

We anticipate higher infant mortality in areas characterized by: poor roads; poor infrastructure at the nearest health facilities; inadequate workforce at the health facilities; absence of emergency services during odd hours; ignorance; obsolete knowledge, attitudes and practices; and challenging socioeconomic status.

(Community Health Volunteer, Mahiakalo)

## 5.0 CONCLUSION

This study examined the contribution of geographical area of residence on rural-urban differentials in infant mortality in Kakamega Central Sub-County, Kakamega County, Kenya. The results of univariate logistic regression analysis showed that nature of roads was a significant determinant of neonatal and infant mortalities in rural but not in urban areas. The same trend was observed at multivariate analysis level. Rural areas with mud roads had higher odds of neonatal (aOR – 2.067) and infant (aOR - 3.867) mortalities when compared to those with tarmacked roads. Additionally, the study found number of health facilities present in a given geographical area to significantly influence post-neonatal mortality in rural areas and

  

Volume: 06, Issue: 02 March - April 2023

ISSN 2582-0176

infant mortality in urban areas. Areas with 3 to 4 health facilities had 8.248 and 2.651 higher adjusted odds ratios of post-neonatal and infant mortality when compared to areas with at least 5 health facilities in rural and urban areas, respectively.

Further, type of housing in which an infant resided was significantly associated with rural neonatal mortality and urban post-neonatal and infant mortalities. Residing in good housing was associated with lower odds ratios of rural neonatal (aOR – 0.016), and urban post-neonatal (aOR – 0.265) and infant (aOR – 0.312) mortalities when compared to residing in durable housing. The introduced significant relationship between geographical factors and infant mortality at multivariate analysis level means that the geographical factors of number of health facilities and type of housing influence infant mortality independent of socioeconomic, demographic and distance factors. For instance, type of housing can be correlated with maternal occupation to some extent.

However, the most significant independent contributor to rural-urban differentials in infant mortality in Kakamega Central Sub-County was the nature of roads which mainly influenced rural mortalities. The study therefore accepted the following research hypotheses: (1) Number of health facilities had a significant influence on the death of infants in rural and urban areas of Kakamega Central Sub-County; (2) Type of housing had a significant influence on the death of infants in rural and urban areas of Kakamega Central Sub-County; and (3) Nature of roads had a significant influence on the death of infants in rural areas of Kakamega Central Sub-County.

**5.4 Recommendations**

With the study findings that nature of roads, number of health facilities and type of housing as the major factors influencing infant mortality in rural and urban areas of Kakamega Central Sub-County, the study recommends the following:

i. Concerted efforts towards road improvement in rural areas of Kakamega Central Sub-County. Roads are important traffic conveyors between places and improved roads will reduce the travel-time taken by a mother and infant in to reach a medical facility when need arises.
ii. Increased access to health facilities in Kakamega Central Sub-County to ensure an acceptable density of health facilities. The health facilities need to open-up on daily basis and not having some stay closed over weekends and public holidays as was observed by the researchers. Further, the health facilities need to be well-stocked with the necessary drugs and equipment, and have medical personnel on duty.
iii. Enlightening people on the importance of proper hygiene in the household environments: whether non-durable housing, good housing or durable housing, and on good, affordable, dietary practices.

**REFERENCE**

Agarwal, S. & Taneja, S. (2005). All slums are not equal: child health conditions among the ruban poor. Vol. 42; pp. 233-244.

  

Armstrong, S. J., Mrisho, M., Manzi, F., Shirima, K., Mbuya, C., Mushi, A., et al. (2008). Health and survival of young children in southern Tanzania. BMC Public Health, 8:194.

Black, R. E., Morris, S. S. & Bryce, J. (2003). Where and why are 10 million children dying every year? Lancet, 361: 2226-2234.

Da Vanzo, J., Butz, W. P. & Habitcht, J. P. (1983). How biological and behavioural influences on mortality in Malaysia vary during the first year of life. Population Studies 37.

Falchetta., G., Hammad, A. T., & Shayegh, S. (2020). Planning universal accessibility to public health care in Sub-Saharan Africa. Proc. Natl. Acad. Sci. 117 (50), 31760.

Ghosh, S. (2005). Does economic inequality matter in cases of infectious childhood diseases? An analysis for India. Asia Pac Popul J; 20:37-62.

Gruebner, O., Lautenbach, S., Khan, M. M. H., Kipruto, S., Epprecht, M., & Galea, S. (2015). Place of residence moderates the risk of infant death in Kenya: evidence from the most recent census 2009. PLOS ONE 10(10).

Hathi, P., Haque, S., Pant, L., Coffey, D. & Spears, D. (2017). Place and child health: the interaction of population density and sanitation in developing countries. Demography, 54:337-360.

Karra, M., Fink, G., & Canning, D. (2017). Facility distance and child mortality: a multi-country study of health facility access, service utilization, and child health outcomes. International Journal of Epidemiology, Volume 46, Number 3.

Kenya National Bureau of Statistics. (2022). 2019 Kenya population and housing census volume VII: analytical report on mortality. KNBS.

Kenya National Bureau of Statistics. (2019). 2019 Kenya population and housing census volume II: distribution of population by administrative units. KNBS.

Kruk, M. E. et al. (2018). Mortality due to low quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. Lancet (London, England), 392 (10160), 2203-2212.

Kuse, K. A., Chikako, T. U., Hagan, J. E., Seidu, A. A. & Ahinkorah, B. O. (2022). Assessing individual and community-level variability in predictors of neonatal, infant and under-five child mortality in Ethiopia using a multilevel modelling approach. Children, 9, 1071.

Leon, D. A. (2008). Cities, urbanisation and health. International Journal of Epidemiology, 37, 4-8.

  

Volume: 06, Issue: 02 March - April 2023

ISSN 2582-0176

Macassa, G. & Ghilagaber, G., Charsmar, H., Walander, A., Sundin, O. & Soares, J. (2012). Geographical differentials in mortality of children in Mozambique: their implications for achievement of Millenium Development Goal 4. J Health Popul Nutr. (3):331-45.

Madise, N. J., Banda, E. M., & Benaya, K. W. (2003). Infant mortality in Zambia: socioeconomic and demographic correlates. Social Biology, 50 (1-2), 148-166.

Magadi, M. A., Zulu, E. M., & Brockerhoff, M. (2003). The inequality in maternal healthcare in urban sub-Saharan Africa in the 1990s. Population Studies, 57, 347-366.

Masuma, M., & Bangser, M. (2009). Poor people's experiences of health services in Tanzania. Dar es Salaam, Tanzania: Women's Dignity Project.

Matthew, Z., Channon, A., Neal, S., Osrin, D., Madise, N., & Stones, W. (2010). Examining the urban advantage in maternal healthcare in developing countries. PLoS Medicine, 7(9).

Meehan, S., Beck, C. R., Mair-Jenkins, J., Leonardi-Bee, J., & Puleston, R. (2014). Maternal obesity and infant mortality: a meta-analysis. Paediatrics, 133:863-871.

Mutunga, C. J. (2007). Environmental determinants of child mortality in Kenya. WIDER Research Paper, Number 2007/83. The United Nations University World Institute for Development Economics Research, Helsinki.

Okwaraji, Y. B. et al. (2012). Effects of geographicalal access to health acilities on child mortality in rural Ethiopia: a community based cross sectional study. Plos one, 7(3): p. e33564.

Omedi, G., Mwaila, M., & Wanja, S. (2020). Vaginal or caesarean delivery? A comparative study of factors associated with the choice method of childbirth delivery in Kenya and Egypt. European Journal of Medical and Health Sciences, Volume 2, Issue 6, 2020.

Omedi, M. G. (2011). A comparative study of infant mortality: the case of Kenya and Tanzania. Unpublished Master of Arts Thesis, University of Nairobi.

Ouma, P. O. et al. (2018). Access to emergency hospital care provided by the public sector in Sub-Saharan Africa in 2015: a geocoded inventory and spatial analysis. Lancet Glob. Health, 6(3), e342-e350.

Root, G. (1997). Population density and spatial differentials in child mortality in Zimbabwe. Soc Sci Med; 44:413-21.

Sanou, A., Simboro, S., Kouyate, B., et al. (2009). Assessment of factors associated with complete immunization coverage in children aged 12-23 months: a cross-sectional study in Nouna district, Burkina Faso. BMC Int Health Hum Rights; 9(suppl 1):S10.

  

Volume: 06, Issue: 02 March - April 2023

ISSN 2582-0176

Simmons, R. A., Anthopolos, R., & O'Meara, W. P. (2021). Effect of health systems context on infant and child mortality in Sub-Saharan Africa from 1995 to 2015, a longitudinal cohort analysis. Scientific Reports, 11:16263.

Sombie, I., Bouwaye, A., Mongbo, Y., Keita, N., Lokossou, V., Johnson, E., Assogba, L., & Crespin, X. (2017). Promoting research to improve maternal, neonatal, infant and adolescent health in West Africa: the role of the West African Health Organisation. Health Research Policy and Systems, 15 (Suppl 1):53.

Toda, M., Opwora, A., Waweru, E, Noor, A, Edwards, T., Fegan, G., et al. (2012). Analysing the equity of public primary care provision in Kenya: variation in facility characteristics by local poverty level. Int J Equity Health, 11:75.

United Nations Children Fund, World Health Organisation, The World Bank & United Nations Development Programme. (2020). Levels and trends in child mortality. estimates developed by the UN Inter-Agency Group for Child Mortality Estimation. UNICEF, New York, USA.

United Nations Development Programme. (2000). United Nations Millennium Declaration. UNDP, New York.

United Nations Development Programme. (2015). transforming our world: the 2030 Agenda for Sustainable Development. UNDP, New York.

United Nations. (2014). The millennium development goals report. New York.

UN-Habitat. (2003). Slums of the world: the face of urban poverty in the new millennium? Nairobi.