TRANSPORT-RELATED FACTORS AFFECTING UPTAKE OF ANTENATAL CARE SERVICES IN KAKAMEGA CENTRAL SUB-COUNTY, KENYA

OMEDI, G.

Department of Geography, Kaimosi Friends University, Kaimosi, Kenya.
e-mail: gilbertmaube[at]gmail.com

(Received 21st May 2024; revised 28th July 2024; accepted 05th August 2024)

Abstract. Proper uptake of antenatal care services is essential in ensuring decent pregnancy outcomes and reduced maternal and early childhood deaths in observance of the third Sustainable Development Goal. This study adopted a cross-sectional research design to probe the effect of distance, nature of roads and accessible means of transport on the uptake of antenatal care services in Kakamega Central Sub-County, Kakamega County, Kenya. Primary data were collected from mothers of reproductive ages from December 2022 through to January 2023. Descriptive statistics and binary logistic regression informed the study analyses. Inferential results indicated that women who took $31 \leq x \leq 60$ minutes to access health facilities were more likely to uptake antenatal care services (aOR=7.661; ρ=0.042). Presence of mud roads (aOR=0.930; ρ=0.037) and human trekking (aOR=0.233; ρ=0.008) were both associated with lesser likelihoods of antenatal care service uptake. Targeted interventions on road improvement and maintenance should be embraced so as attract quicker transport service providers and enhance accessibility and uptake of antenatal care services.
Keywords: *distance, nature of roads, means of transport, antenatal care services, Kakamega Central Sub-County*

Introduction

Spatial organisation is a basic theme in geography focussing on the recognition and organisation of the geographical space in which human activities take place (Wang, 2017). This organisation and arrangement brings about spatial interaction whereby people, ideas and goods dynamically flow from one location to the other guided by the basic principles of complementarity, transferability and intervening opportunities. In "The Geography of Transport Systems", Rodrigue (2024) specified that flows in spatial interactions illustrate inequalities in the characteristics of origins and destinations. Part of the arrangements that bring about varied spatial interactions and behaviour is the infrastructural arrangement in its three dimensions of hard, soft and critical infrastructure. Spatial behaviour is interested in how people make resolutions rather than assuming that they obey certain invariant regulations in their surroundings. The complexity of spatial behaviour dynamics increases with individual motivations and interests, personal socio-demographic characteristics and cultural, political, economic and technological factors (Klapka et al., 2010).

Antenatal care services remain fundamental for any mother nursing a pregnancy. They enable medical practioneers to detect prospective risks for a pregnancy and/or delivery and provide apt treatment for women experiencing health problems during pregnancy (WHO, 2005). They also assist women in developing a birth plan and prepare them for parenting post-delivery (WHO, 2005). It is also during the uptake of antenatal care services that pregnant mothers are vaccinated with tetanus toxoid, serviced with iron supplements and nutritional deficiencies controlled (Darmstadt et al., 2005). Furthermore, uptake of antenatal care services is associated with higher

likelihoods of hospital delivery and delivery under the assistance of skilled birth attendants, and low likelihood of early childhood deaths (Titaley et al., 2010a; 2008; Chen et al., 2007). A study by Darmstadt et al. (2005) demonstrated that about twelve out of every a hundred neonate deaths could be deterred when antenatal care services are provided at a 90 percent rate of coverage.

World Health Organisation recommends a minimum of eight antenatal care visits (WHO, 2016). This was advised by the existing proof that increased number of contacts between a pregnant woman and a skilled health service provider was associated with reduced perinatal deaths and increased women's childcare experience. Yet this advocated-for number of antenatal care visits is hardly the case despite the government efforts geared towards the same. Some mothers initiate antenatal visits for the sake of obtaining cards which they will need when taking their babies for postnatal care services. This probably explains the high antenatal care uptake of any level and low skilled assistance during delivery observed in Kenya. KNBS (2023) documented that though 98 percent of pregnant women ever received an antenatal care from a skilled provider, only two out of every three women had at least four antenatal care visits with a paltry four percent of the women having eight or more visits. An Ethiopian-based study by Kebede et al. (2022) noted that women did not have antenatal care visits for their recent pregnancies due to long travel time, lack of transportation, considering antenatal care visits as unnecessary, workloads, unvoluntary partners, and healthcare providers not being good to the service seekers.

Studies on antenatal care utilisation have been biased on social, cultural, economic and demographic factors (Macharia et al., 2022; Raru et al., 2022; Gitonga, 2017; Muyunda et al., 2016; Ochako and Gichuhi, 2016). A study done by Ikamari (2020) found the odds ratios of doing at least four antenatal care visits to be 2.02, 1.96 and 1.33 for Vihiga, Busia and Bungoma Counties, respectively, with reference to Kakamega County. This paper sought to probe the effect of distance, nature of roads and accessible means of transport on the uptake of antenatal care services in Kakamega Central Sub-County, Kakamega County, Kenya. It was guided by three hypotheses: (1) distance covered to reach the nearby health facility has a significant influence on the uptake of antenatal care services in Kakamega Central Sub-County; (2) nature roads in a given geographical area has a significant influence on the uptake of antenatal care services in Kakamega Central Sub-County; and (3) accessible means of transport has a significant influence on the uptake of antenatal care services in Kakamega Central Sub-County. The study findings point to the need for road improvement and maintenance as such roads would easily be plied on by quicker transport means. Increased uptake of antenatal care services is expected to yield to improved birth outcomes and reduced maternal and early childhood mortalities.

Review of literature

Women in most developing countries irregularly attend antenatal care clinics making them to miss out on important components of prenatal care, including health education, screening and diagnosis, treatment and referral (Ochako and Gichuhi, 2016). This irregular attendance is contributed to by a catalogue of factors, among them, distance to the health facility, nature of roads and accessible means of transport in a given geographical locality. Titaley et al. (2010b) did a study on factors associated with underutilisation of antenatal care services in Indonesia. They determined distance to health facilities to be strongly associated with underutilisation of antenatal care services.

Mothers who said that distance to health facilities was a big problem were more likely to report underutilisation of antenatal care services than those who said that it was a small problem (aOR=1.21; $\rho<0.05$; CI=1.03-1.42). This confirmed findings of other studies that found distance and time taken to reach the nearest health facilities to influence utilisation of health services (Okedo-Alex et al., 2019; King-Schultz and Jones-Webb, 2008). In the rural areas of West Java Province, Indonesia, a long travel time exacerbated by poor roads reduced the uptake of antenatal care services (Titaley et al., 2010c). The study indicated that remoteness from health facilities increased the out-of-pocket expenditure on transport among the community members and that the opportunity costs lost due to travel and waiting time constrained the uptake of antenatal care services.

A study on factors affecting attendance at and timing of formal antenatal care was done by Andrew et al. (2014) in Papua New Guinea. As much as women saw distance and cost as a barrier to antenatal care attendance, the study learnt that those women who lived closer to the health facilities and could easily afford the antenatal care services had poor attendance to antenatal care services. Attending an antenatal care visit was associated with missing out on a day of household and income-generating work. According to Omedi (2023), a longer travel time (due to long distance and impassable roads) may be related to a prohibitive travel cost. A pregnant woman may choose not to seek medical care because it may mean a full-day activity on road and being attended to by healthcare practioneers. An employed woman who is paid per actual work done finds it difficult to forego work and pay in search of antenatal care services. Adow et al. (2020) carried out a study on the uptake of antenatal care services among women of reproductive age in Mandera County, Kenya. About 43.1 percent of the respondents cited long distance to health facilities while another 17.6 percent cited the (high) cost of transport to the health facilities as reasons for non-uptake of antenatal care services. Respondents who took one to one-and-a half hours to reach a health facility were less likely to utilise antenatal care services (OR=0.207; $\rho<0.05$; CI=0.051-0.840). The researchers attributed this finding to those of a study by Amentie et al. (2015) that indicated that usage of antenatal care services was affected by travel time taken to access the services and availability of transportation services. In rural, Zambia, Amentie et al. (2015) found the odds of a woman receiving antenatal care services to decrease by a quarter for each 10 kilometre increase in distance from a health facility.

Mamdani and Bangser (2004) studied poor peoples' experiences of health services in Tanzania. The duo found road transport to be challenging in Tanzania's rural areas leading to teething troubles in accessing healthcare facilities and services. Patients walked for long distances on problematic terrains in order to access health facilities. In support of this, Omedi (2023) indicated that poorly-developed transport infrastructure undermined access to health facilities: there occurred few public motorvehicles on such roads and transport cost was likely to be prohibitive. A study done on health system factors affecting uptake of antenatal care by women of reproductive age in Kisumu County, Kenya by Kilowua and Otieno (2019) established that means of transport used influenced the number of antenatal care visits done by a pregnant woman. Those women who used bicycles, motorcycles, and motor-vehicles made more antenatal care visits than those who trekked to the health facilities. The same study further noted a significant relationship between distance to the health facility and attendance of antenatal care services. Correlating the two implied that pregnant women required transport expenses to access distant health facilities. Tadesse (2020) conducted a study

in North-East Ethiopia on antenatal care service utilisation of pregnant women attending antenatal care in public hospitals during the covid-19 pandemic period. The study found transport accessibility to increase utilisation of antenatal care services by four units' fold when compared to those pregnant women who had no access to transportation (aOR=4.15; $\rho<0.05$; CI=1.04-16.54). A study done in Nepal by Poudel (2020) supported this finding. The study indicated that lack of transportation led to women developing complications on the way to health facilities and some dying before receiving proper medical attention.

Idowu et al. (2022) did a study on access, perceived quality and uptake of antenatal services in urban communities of Osun state, South-West Nigeria. The trio established that 29.6 percent of pregnant women used motorbike transport to reach health facilities for antenatal care services. Another 28.2 percent, 22.5 percent and 15.9 percent of pregnant women used public transport, walking and private transport, respectively, to reach health facilities for antenatal care visits. A different study by Haji et al. (2022) recognised that 60.44 percent of the respondents paid for transport while another 39.56 percent of the respondents walked in order to access health facilities for antenatal care services. The studies did not however find means of transportation to significantly influence the use of antenatal care services amongst the respondents.

Materials and Methods

Study design and setting

The study used a cross-sectional reseach design. The target population was women of childbearing ages who had an experience of a pregnancy and childbirth in the period 2013 through to 2022. The study was conducted in Kakamega Central Sub-County of Kakamega County, Kenya. The sub-county stretches from 34°37'21" E to 34°48'21" E and from 0°10'49" N to 0°22'13" N, in terms of longitudes and latitudes, respectively. It is approximately 155.2 square kilometres, with a population of 188212 (male-92,774; female-95,432; intersex-6) spread in six administrative wards and thirteen sub-locations (rural-9; urban-4) (KNBS, 2023). It has 53 health facilities: 22 under Ministry of Health; 2 under Non-Governmental Organisations; 3 under Faith-Based Organisations; and 26 under Private Organisations (LabFlow Web Portal, 2024). It houses the Kakamega County General Teaching and Referral Hospital, a level 5 hospital. The sub-county is characterised by tarmac, murram and mud roads in unequal measure. The means of transport on these roads are motorvehicle, motorcycle and human trekking.

Sampling & sample size, tools & data collection, and study variables

Systematic random sampling technique was used to arrive at the households of study. A sample size of 384 households was calculated. Structured questionnaires were used to obtain data from households of study. A single respondent, the most-recent mother, was interviewed in case of a household with multiple women who met the criteria of being interviewees. The dependent variable was uptake of antenatal care services. It was dichotomised as "uptake" for mothers who attended any antenatal care service(s) and "nonuptake" for mothers who did not attend any antenatal care service. The independent variables were distance (in terms of approximate distance and travel-time) to the health facility, nature of roads linking one's homestead and health facility, and accessible means of transport.

Data analyses

Data entry was done on the Statistical Package for Social Sciences (SPSS) version 25 computer program. Descriptive statistics were used to bring out the frequencies of mothers who had ever received antenatal care services during their pregnancies, number of antenatal care visits done, antenatal care service provider, and the duration of pregnancy, in months, at the first antenatal care visit. Binary logistic regression was used to test the association of the independent and dependent variables.

Results and Discussion

Descriptive statistics

Descriptive statistics were done to bring out the proportions of pregnant women who ever received antenatal care services during their pregnancies, the number of antenatal care visits done, the source provider of the antenatal care services, and the month of pregnancy in which a respective woman first sought antenatal care services. *Figure 1* presents the proportion of women who ever received any antenatal care services. From *Figure 1*, we learn that about 98 in every 100 pregnant women in Kakamega Central Sub-County ever received antenatal care services of whichever kind. This is a reflection of the effectiveness of existing interventions aimed at creating awareness about the importance of antenatal care services (Idowu et al., 2022). Another 2 percent of women did not seek antenatal care during their most recent pregnancy. The main reasons cited for not receiving antenatal care services were: ignorance, unaffordability, long distance in accessing the services, and culture and religious affiliation. A study done in select districts of Indonesia by Titaley et al. (2010a) established that women did not attend antenatal care services due to the perceived costs of the services, transportation costs, the perception that free health services were of a lesser quality compared to health services that required some payments, and not having any pregnancy complications. According to Omedi and Amwoliza (2015), affordability, as measured by a high wealth index, enables a pregnant woman to attend antenatal care visits insensible of the distance between the household's residence and the healthcare service providers. In rural Sehala Seyemit district of northern Ethiopia, Kebede et al. (2022) learnt long travel time/lack of transportation, considering antenatal care services as unnecessary, workloads, unvoluntary partners, lack of money, and healthcare providers not being good to the service seekers as barriers to the use of antenatal care services.

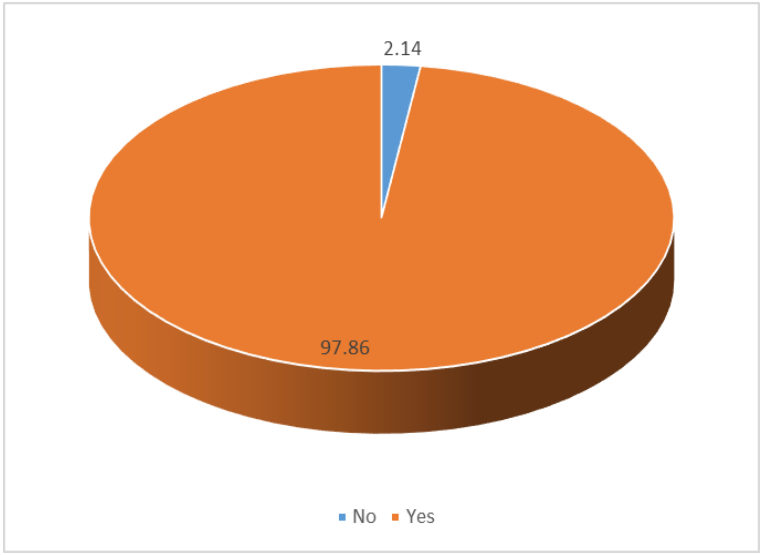

Figure 1. *Ever received antenatal care services during pregnancy.*

Results in *Table 1* show the number of antenatal care visits done by each pregnant woman. From Table 1, it is clear that majority of the women (69.68%) had at least 4 antenatal care visits. This is an improvement from the findings of studies by Ikamari (2020) as well as Omedi and Amwoliza (2015) that established that 46.78 percent and 55.21 percent of pregnant women were able to do at least four antenatal care visits in the whole of Kenya and western region of Kenya, respectively. However, the current study learnt that only 106 in every 10,000 pregnant women had 8 antenatal care visits as recommended by WHO (2016). It is possible that, unaware of this current recommendation, people are still relying on the former (WHO, 2005) recommendation of a minimum of 4 antenatal care visits throughout the pregnancy for a woman without complications. It is not just enough to seek antenatal care services: it is okay to get satisfactory services. Results in *Figure 2* indicate the various antenatal care service providers sought by pregnant women in Kakamega Central Sub-County. From *Figure 2*, we learn that about 47.33 percent, 41.02 percent, 10.19 percent and 1.46 percent of pregnant women sought antenatal care services from doctors/nurses, midwifes, community health volunteers and traditional birth attendants, respectively. Truth is that doctors, nurses and midwifes provide quality services, having underwent specialised training. However, they are not accessible to every pregnant woman; thus, the utilisation of community health volunteers and traditional birth attendants. A qualitative study by Titaley et al. (2010b) noted that pregnant women sought the services of traditional birth attendants because they were cheaper, lived closer to the clients and that such attendants could massage them using traditional herbal medicine. The study further established that other pregnant women sought the services of health professionals over traditional birth attendants due to better equipment and more thorough examination.

Table 1*. Number of antenatal care visits done by each pregnant woman.*

Number of ANC visit	Percentage
1 to 3	30.32
4 to 7	68.62
8+	1.06
Total	100

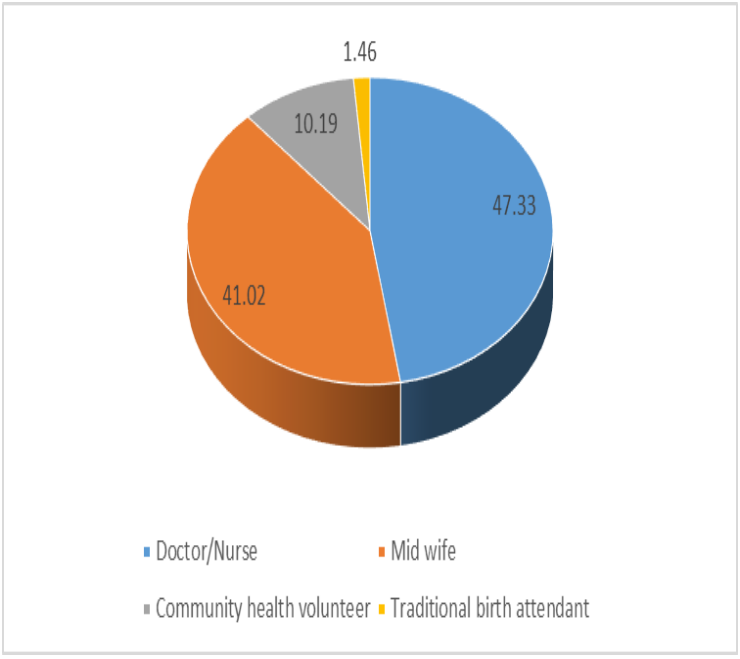

Figure 2. *Antenatal care service provider.*

The timing of antenatal care visits is important inorder to realise its full benefits (Ikamari, 2020). Results in *Figure 3* show the duration of pregnancy, in months, at first antenatal care visit. Results in *Figure 3* indicate that majority of women started antenatal care visits in their third month of pregnancy, with a mean of 3.68 months, median of 4 months and mode of 3 months. This is unlike findings of a study by Ikamari (2020) that found the average number of months at the initiation of antenatal care visits to be 4.83, with a median and mode of 5 months in the four counties of western Kenya. As much as we anticipate a woman to commence antenatal care visits immediately she realises that she is pregnant, only 1.31 percent of women began antenatal care visits in their first month of pregnancy. Another 2.29 percent of women began antenatal care visits 7 months into their pregnancies. It is possible that such women realised some pregnancy-related complications that compelled them to seek for antenatal care services. A study by Titaley et al. (2010c) noted that women did not feel the need to have antenatal care services because they did not experience any pregnancy-related complications.

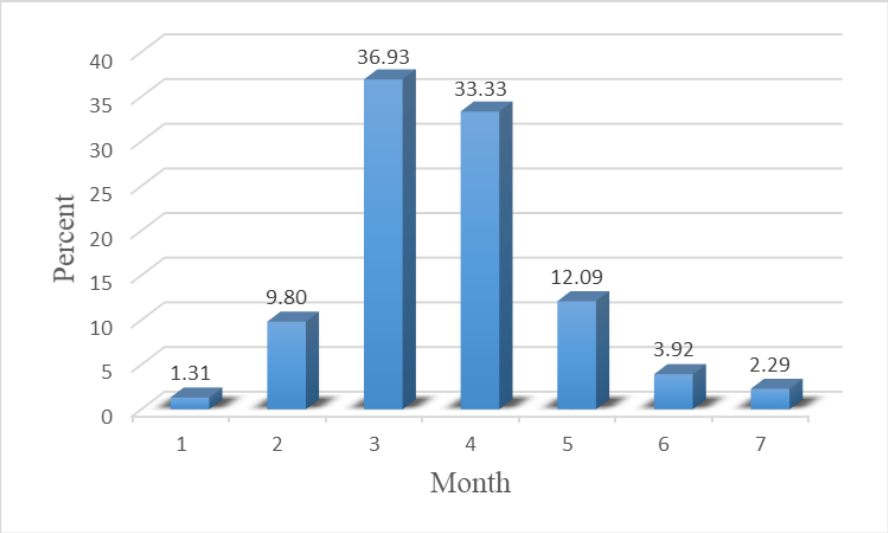

Figure 3. *Duration of pregnancy, in months, at first antenatal care visit.*

Inferential statistics

Results of multivariate logistic regression analysis showed that distance in terms of travel time taken to reach a health facility, nature of roads and accessible means of transport in a given geographical area were significantly associated with the uptake of antenatal care services in Kakamega Central Sub-County (*Table 2*). As much as approximate distance was not significant, a longer distance from one's home to a health facility was associated with reduced chances of uptaking antenatal care services. A travel time of beyond half-an-hour was associated with increased likelihood of uptaking antenatal care services in Kakamega Central Sub-County. Pregnant women who spent about 31 to 60 minutes to reach health facilities were 6.661 times more likely to uptake antenatal care services compared to their counterparts who took at most half an hour to access health facilities (aOR=7.661; $\rho<0.05$). Though this sounded unexpected, it was supported by findings of a study done in Papua New Guinea by Andrew et al. (2014) that established poor attendance to antenatal care services amongst women who lived closer to, and therefore spent lesser time to access, health facilities. Some women relate attending to antenatal care services with missing out on income-generating activities, something heightened by longer time taken to be attended to by service-providers in some health facilities (Omedi, 2023; Andrew et al. 2014; Titaley et al. 2010a).

Table 2*. Multivariate results of the effect of distance, nature of roads and means of transport n the uptake of antenatal care services.*

Exposure variable		B	S.E.	Sig.	Exp(β)
Approximate distance in km	x≤1 (rc)	-	-	-	1.000
	1.1≤x≤3.9	-1.428	1.072	0.183	0.240
	x≥4	-1.500	1.259	0.234	0.223
Travek time in minutes	x≤ 30 (rc)	-	-	-	1.000
	31≤x≤60	2.036	1.048	0.042	7.661**
	x>60	2.130	1.402	0.129	8.413
Nature of roads	Tarmacked roads (rc)	-	-	-	1.000
	Mud roads	-0.073	1.065	0.037	0.930**
	Murram roads	1.639	0.924	0.124	5.148
Means of transport	Motorvehicle transport (rc)	-	-	-	1.000
	Trekking	-1.458	1.356	0.008	0.233*
	Motorcycle transport	-0.261	1.158	0.822	0.771

*Note: rc=reference category; β=log of odds; Exp(β)=adjusted odds ratio; S.E=standard error; Sig.=statistical significance level; *ρ<0.01; **ρ<0.05.*

Residence in areas with mud roads was associated with a 0.07 lesser likelihood of uptaking antenatal care services compared to residence in areas with tarmacked roads (aOR=0.093; $\rho<0.05$). Poor roads reduce access to and uptake of healthcare services (Omedi, 2023; Titaley et al., 2010b; Mamdani and Bangser, 2004). This can be in a number of varied ways. Areas with poor, impassable roads have a slowed traffic flow that lengthens the time spent on road to reach a health facility. Transport service providers occassionally hike transportation costs on such routes especially in rainy seasons, an act that makes some pregnant women to drop the whole issue of uptaking antenatal care services. Even so, it is difficult to access quicker means of transport on muddy roads especially in the odd hours of the day. Motor-vehicle transport operators target routes which do not have negative impacts on their vehicles. A study by Omedi and Obuoyo (2023) indicated that mud roads delayed the flow of traffic and discouraged patients from seeking healthcare more so late in the night and in rainy seasons. Though insignificant, murram roads were associated with a higher likelihood of uptaking antenatal care services than tarmacked roads. Most of the road network in Kakamega Central Sub-County is murramed. Devolution of services from the central government to the county government has brought about road expansions and murraming, an act that has increased traffic flow on such roads, especially when well-maintained.

Means of transport used by pregnant women to access antenatal care services was significantly associated with the uptake of antenatal care services. Women who trekked in search of antenatal care services were 0.767 times less likely to uptake antenatal care services than those who used motorvehicle transportation (aOR=0.233; $\rho<0.01$). This finding was consistent with findings of studies by Kilowua and Otieno (2019) in Kisumu County of Kenya, Tadesse (2020) in North-East Ethiopia, and Poudel (2020) in Nepal. Kilowua and Otieno (2019) found those women who used bicycle, motorcycle, and motor-vehicle transportation to make more antenatal care visits than their counterparts who walked to the health facilities. Human trekking is associated with mud and dilapidated road network (Omedi and Obuoyo, 2023) and unaffordability of transportation costs. The finding however differed with those of Idowu et al. (2022) in South-West Nigeria and Haji et al. (2022) in Somalia who found means of transportation to be an insignificant influencer on the uptake of antenatal care services. This study might have been limited by some remembrance partialities in reporting the number of antenatal care visits done and the duration in months when a woman initiated her antenatal care visits. This was especially for those women who could not avail the mother and child health handbooks for confirmation of antenatal care visits done. This was lessened by probing and giving the respondents adequate time to reflect and think through the healthcare circumstances that related to their pregnancies.

Conclusion

This study aimed at probing the effect of distance, nature of roads and accessible means of transport on the uptake of antenatal care services in Kakamega Central Sub-County, Kakamega County, Kenya. The analytical results indicated that distance in terms of travel-time, nature of roads and accessible means of transport were significantly associated with the uptake of antenatal care services. There was a higher likelihood of uptaking antenatal care services amongst pregnant women who took $31 \leq x \leq 60$ minutes to access health facilities (aOR=7.661; $\rho=0.042$). Presence of mud

roads (aOR=0.930; ρ=0.037) and human trekking (aOR=0.233; ρ=0.008) were both associated with lesser likelihoods of antenatal care service uptake. The study accepted the hypotheses that distance in terms of travel-time, nature of roads and accessible means of transport had significant influences on the uptake of antenatal care services in Kakamega Central Sub-County, Kakamega County, Kenya. The study findings identified vulnerable groups to the usage of antenatal care services as those women residing in areas with mud roads and those that trek to access healthcare facilities possibly due to economic challenges or poor roads that shy-off providers of quicker means of transportation. Targeted interventions are required in these areas in order to increase the uptake of antenatal care services. For instance, road improvement and maintenance should be embraced so as attract quicker transport service providers. Pregnant women should also be encouraged to do at least 8 antenatal care visits as stipulated by the World Health Organisation so as to identify and address any possible maternal health complications and reduce maternal and early childhood mortalities.

Acknowledgement

The community of Kakamega Central Sub-County is hereby acknowledged for dedicating their time and considerate responses in this study.

Conflict of interest

No conflict of interest is associated with this publication.

REFERENCES

[1] Adow, I., Mwanzo, I., Agina, O., Wanzala, P., Kariuki, J. (2020): Uptake of antenatal care services among women of reproductive age in Mandera County, Kenya. – African Journal of Health Sciences 33(1): 56-69.

[2] Amentie, M., Abera, M., Abdulahi, M. (2015): Utilization of antenatal care services and influencing factors among women of child bearing age in Assosa District, Benishangul Gumuz regional state, West Ethiopia. – Global Journal of Medical Research 15(2): 10p.

[3] Andrew, E.V., Pell, C., Angwin, A., Auwun, A., Daniels, J., Mueller, I., Phuanukoonnon, S., Pool, R. (2014): Factors affecting attendance at and timing of formal antenatal care: results from a qualitative study in Madang, Papua New Guinea. – PloS One 9(5): 14p.

[4] Chen, X.K., Wen, S.W., Yang, Q., Walker, M.C. (2007): Adequacy of prenatal care and neonatal mortality in infants born to mothers with and without antenatal high-risk conditions. – Australian and New Zealand Journal of Obstetrics and Gynaecology 47(2): 122-127.

[5] Darmstadt, G.L., Bhutta, Z.A., Cousens, S., Adam, T., Walker, N., De Bernis, L. (2005): Evidence-based, cost-effective interventions: how many newborn babies can we save? – The Lancet 365(9463): 977-988.

[6] Gitonga, E. (2017): Determinants of focused antenatal care uptake among women in tharaka nithi county, Kenya. – Advances in Public Health 2017(1): 4p.

[7] Haji, O.A., Suleiman, M.A., Juma, J.N. (2022): Factors influencing the uptake of antenatal care services among pregnant women in South Gaalkacyo district, Mudug region, Somalia. – International Journal of Community Medicine and Public Health 9(6): 2457-2461.

[8] Idowu, A., Israel, O.K., Akande, R.O. (2022): Access, perceived quality and uptake of antenatal services in urban communities of Osun state, Southwest Nigeria. – African Journal of Reproductive Health 26(12): 78-89.
[9] Ikamari, L. (2020): Uptake of maternal services and associated factors in the western region of Kenya. – Pan African Medical Journal 37(1): 15p.
[10] Kebede, A.A., Taye, B.T., Wondie, K.Y. (2022): Factors associated with comprehensive knowledge of antenatal care and attitude towards its uptake among women delivered at home in rural Sehala Seyemit district, northern Ethiopia: a community-based cross-sectional study. – Plos One 17(10): 18p.
[11] Kenya National Bureau of Statistics (KNBS) (2023): Demographic and health survey 2022. – Republic of Kenya 105p.
[12] Kilowua, L.M., Otieno, K.O. (2019): Health system factors affecting uptake of antenatal care by women of reproductive age in kisumu county, Kenya. – International Journal of Public Health and Epidemiology Research 5(2): 119-124.
[13] King-Schultz, L., Jones-Webb, R. (2008): Multi-method approach to evaluate inequities in prenatal care access in Haiti. – Journal of Health Care for the Poor and Underserved 19(1): 248-257.
[14] Klapka, P., Frantál, B., Halás, M., Kunc, J. (2010): Spatial organisation: development, structure and approximation of geographical systems. – Moravian Geographical Reports 3(2010): 53-66.
[15] LabFlow Web Portal (2024): Health facilities in Kakamega Country. – LabFlow Web Portal 16p.
[16] Macharia, P.M., Joseph, N.K., Nalwadda, G.K., Mwilike, B., Banke-Thomas, A., Benova, L., Johnson, O. (2022): Spatial variation and inequities in antenatal care coverage in Kenya, Uganda and mainland Tanzania using model-based geostatistics: a socioeconomic and geographical accessibility lens. – BMC Pregnancy and Childbirth 22(1): 16p.
[17] Mamdani, M., Bangser, M. (2004): Poor people's experiences of health services in Tanzania: A literature review. – Reproductive Health Matters 12(24): 138-153.
[18] Muyunda, B., Makasa, M., Jacobs, C., Musonda, P., Michelo, C. (2016): Higher educational attainment associated with optimal antenatal care visits among childbearing women in Zambia. – Frontiers in Public Health 4: 7p.
[19] Ochako, R., Gichuhi, W. (2016): Pregnancy wantedness, frequency and timing of antenatal care visit among women of childbearing age in Kenya. – Reproductive Health 13: 1-8.
[20] Okedo-Alex, I.N., Akamike, I.C., Ezeanosike, O.B., Uneke, C.J. (2019): Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. – BMJ Open 9(10): 14p.
[21] Omedi, G.M. (2023): Rural-urban differentials in infant mortality in Kakamega Central Sub-County, Kakamega County, Kenya. – Maseno University 212p.
[22] Omedi, G., Amwoliza, V. (2015): Factors associated with low birth weights in Kenya. – Research on Humanities and Social Sciences 5(22): 97-106.
[23] Omedi, G., Obuoyo, I.M.J. (2023): The contribution of the geographical area of residence on rural-urban differentials in infant mortality in Kakamega central sub-county, Kakamega county, Kenya. – International Journal of Social Sciences and Management Review 6(2): 165-180.
[24] Poudel, A.A. (2020): 200 percent increase in maternal mortality since the lockdown began. – The Kathmandu 7p.
[25] Raru, T.B., Ayana, G.M., Zakaria, H.F., Merga, B.T. (2022): Association of higher educational attainment on antenatal care utilization among pregnant women in east africa using Demographic and Health Surveys (DHS) from 2010 to 2018: a multilevel analysis. – International journal of Women's Health 10p.
[26] Rodrigue, J.P. (2024): Transportation and spatial organization. – The Geography of Transport Systems Web Portal 19p.

[27] Tadesse, E. (2020): Antenatal care service utilization of pregnant women attending antenatal care in public hospitals during the COVID-19 pandemic period. – International Journal of Women's Health 12: 1181-1188.
[28] Titaley, C.R., Dibley, M.J., Roberts, C.L. (2010a): Factors associated with underutilization of antenatal care services in Indonesia: results of Indonesia Demographic and Health Survey 2002/2003 and 2007. – BMC Public Health 10: 1-10.
[29] Titaley, C.R., Dibley, M.J., Roberts, C.L., Hall, J., Agho, K. (2010b): Iron/folic acid supplements protect against early neonatal mortality in Indonesia. – Bull World Health Organ 88: 500-508.
[30] Titaley, C.R., Hunter, C.L., Heywood, P., Dibley, M.J. (2010c): Why don't some women attend antenatal and postnatal care services?: a qualitative study of community members' perspectives in Garut, Sukabumi and Ciamis districts of West Java Province, Indonesia. – BMC Pregnancy and Childbirth 10: 1-12.
[31] Titaley, C.R., Dibley, M.J., Agho, K., Roberts, C.L., Hall, J. (2008): Determinants of neonatal mortality in Indonesia. – BMC Public Health 8(1): 1-15.
[32] Wang, J. (2017): Spatial organization and structure. – International Encyclopedia of Geography: People, the Earth, Environment and Technology 10p.
[33] World Health Organization (WHO) (2016): WHO recommendation son antenatal care for a positive pregnancy experience. – Geneva: WHO Web Portal 3p.
[34] World Health Organization (WHO) (2005): The World Health Report: 2005: Make Every Mother and Child Count. – Geneva: WHO Web Portal 2p.