EISSN: 2707-0425

East African Journal of Science, Technology and Innovation, Vol. 3 (4): September 2022

Effects of computed distances, and other determinant factors on place of child delivery in Magadi Ward, Kenya

[1]MALEYO A., [2]OMOKE K.J., [2]MORONGE J.M.*

[1]School of Arts and Social Sciences, Department of Geography and Environmental Studies, Moi University, Eldoret, Kenya.
[2]Faculty of Arts and Social Sciences, Department of Geography, Population and Environmental Studies University of Nairobi, Nairobi, Kenya

***Corresponding Author**: maleyoagnes@gmail.com

Abstract

The choice of place of delivery is still debatable in most sub-Saharan African societies' especially pastoral communities. The decision on whether to deliver at a health facility or at home varies across households. This study sought to evaluate the effects of computed distance, demographic and socio-economic factors on the place of child delivery in rural Magadi, Kenya. The integration of both spatial and statistical techniques was adopted. Distances (straight-line distance, road network distance to the nearest health facility and primary facility) were computed using tools in the Network Analyst toolbox. Computed distances of 246 sampled households together with demographic and socioeconomic factors were further analysed using univariate and multivariate logistic regression. The findings showed that calculated road network distance to the primary facility was a determinant of access and use of place of delivery both for the adjusted and the unadjusted odds. Women aged 20 years or below, having more children, secondary education or above and those who are unmarried are more likely to deliver at health facility. Receiving 1 or 2 childbirth services from a health facility, being aware of a private actor who set up the health facility and involvement of the spouse in the decision-making of place of birth are also linked to the use of health facility for child delivery. Deliveries at home were related to family monthly income level, family occupation, opinion on health facility location and being aged between 21 – 30 years. It was found that though computed road distance to the primary facility was the dominant factor, other variables such as level of education, parity, awareness of local actors, other childbirth services received prior to child delivery and marital status determined whether a woman would access and use health facilities for child delivery.

Keywords: *Computed distance; Health facility; Place of delivery; childbirth services; access and use*

Received: 01/06/22
Accepted: 08/09/22
Published: 29/09/22

Cite as: *Maleyo et al., (2022)* Effects of computed distances, and other determinant factors on place of child delivery in Magadi Ward, Kenya. *East African Journal of Science, Technology and Innovation 3(4).*

Introduction

Sub Saharan Africa (SSA) still suffers a great challenge when it comes to offering health access to all the population. For instance, despite maternal mortality decreasing by 38% between 2000 and 2017, SSA still lags behind, accounting for 68% of maternal deaths worldwide (WHO, 2019a). The path to achieving the set 70 maternal deaths per 100,000 live births (UN, 2018; WHO, 2019a) far looks more like a dream in the continent. The poor access of health facilities for delivery in Africa, (skilled deliveries range 59%

in African region) is partly responsible for these mortality statistics in the region (WHO, 2019b).

However, these figures vary from country to country within the region. For instance, Machira and Palamuleni (2017), by studying factors that draw women to deliver in public health facilities in Malawi, reported that only 36.7% of the women utilized public health facility. In Ethiopia, the numbers are slightly lower, whereby 26.9% of the women delivered in a health facility (Abera *et al.,* 2016) while in Magadi, Kenya, a study on factors influencing deliveries in rural Magadi indicated the number of health facility delivery at 39% (Karanja *et al.,* 2018). It is apparent from empirical studies that socio-economic and demographic factors such as age, marital status, education, parity, wealth status among others plays a role in decision making on the utilization of childbirth services such as antenatal care services, choice of place of delivery and post-natal care services (Bekuma *et al.,* 2020; Caulfield *et al.,* 2016; Enuameh *et al.,* 2016; Kim *et al.,* 2018; Shiferaw & Modiba, 2020).

Geographical accessibility has been seen as a major factor that influences place of delivery in many sub-Saharan nations including Kenya (Gabrysch *et al.,* 2011; Gborgbortsi *et al.,* 2020; Nesbitt *et al.,* 2016). Most studies in urban areas use travel time or distance to model accessibility based on a defined road network. This has been a challenge in rural areas since the road networks are not clearly defined. For instance, in rural Zambia, a study examined the influence of distance on the level of care on place of delivery (Gabrysch *et al.,* 2011) and in rural Ethiopia (Defar *et al.,* 2021) applied the use of straight line distance as an alternative to geographical modelling and access to maternal and child health services. However, such distances do not depict the reality on the ground. Furthermore, the use of straight-line distance is anchored on unrealistic assumptions of the existence of an isotropic plain with no physical barriers. Other studies have relied on reported distance to determine use of health facility for childbirth and not computed distance. However, reported distance has been found to compromise location accuracy (Defar *et al.,* 2021; Hanson *et al.,* 2017). The few studies that have used computed distance are limited to urban settings (Dumitrache *et al.,* 2020; Gborgbortsi *et al.,* 2020; Sharma *et al.,* 2016). This study on the effect of computed distance on place of delivery in the study area, is an attempt to fill this gap.

Materials and methods

Study area

The study was conducted from April 2020 to April 2021 in Magadi Ward, Kajiado County, Kenya. The area is zoned into eight (8) community units namely: Oldonyo Nyokie, Musenge, Entasopia, Olkiramatian, Pakase, Shompole, Oloika, and Magadi. According to the 2019 nationwide census, there were a total of 7, 523 households in the area. The most practiced economic activity in the area is pastoralism due to its situation in an arid and semi-arid region. A total of eighteen (18) health facilities are located in the area out of which twelve (12) offer childbirth services. Magadi hospital, a level 4 facility, serves women with birth related complications (Figure 1).

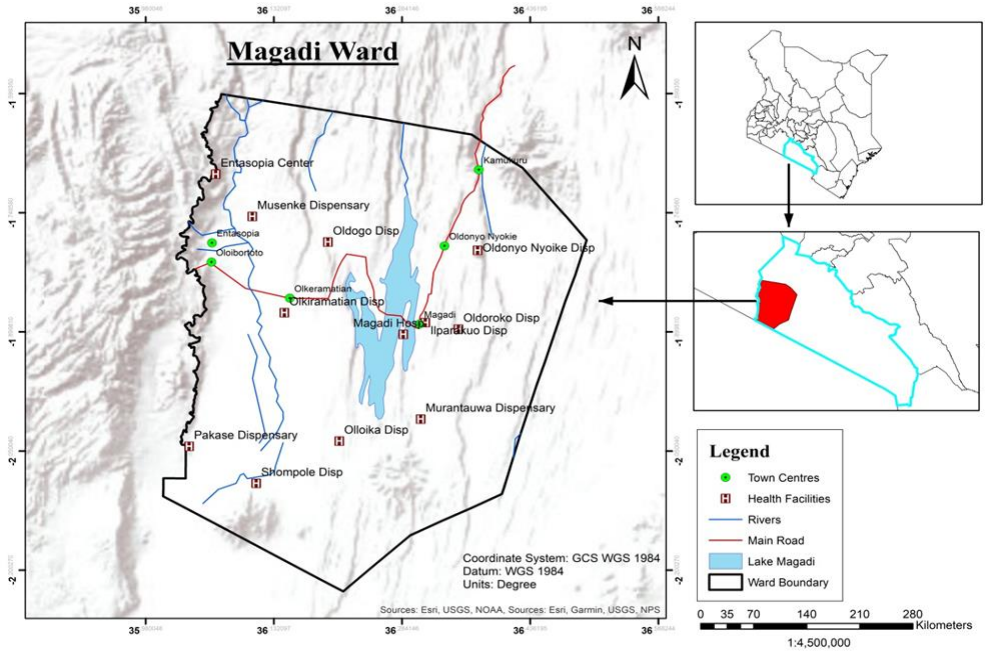


Figure 1. Location of Magadi Ward in Kajiado County, Kenya

Study design and sampling techniques

A cross sectional design approach was selected for this study. The target participants were women of childbearing age (15-49 years) who had given birth within the last one year by the time of data collection. The sample size was 246 women, arrived at using (Yamane, 1967) formula of sample size calculation. The respondents were picked proportionately based on their geographical and sociodemographic traits from the households in the eight community units, Table 1, using a systematic random sampling approach. This approach is where after picking from a household, three households are skipped and it is picked from the fourth household. Where there was no respondent that met the set criterion, the next household was picked until the sample size is attained and distributed per community unit. Some community units received a small sample because of relocation of nomadic pastoralists.

Table 1. Health facilities that offer childbirth services in Magadi Ward and sampled households

Community Units (8)	HF present	Type of HF	No. of Households
Entasopia	Entasopia Health Centre	Level 3	14
Olkiramatian	Olkiramatian Dispensary	Level 2	50
	Oldorko Dispensary	Level 2	
Oldonyo Nyokie	Oldonyo Nyokie Dispensary	Level 2	39
Pakase	Pakase Dispensary	Level 2	16
Shompole	Shompole Dispensary	Level 2	47
	Eldanyo-Oolassio Dispensary	Level 2	
Magadi (Olkeri)	Magadi Hospital	Level 4	40
	Ilparakou Dispensary	Level 2	
	Murantauwa Dispensary	Level 2	
Musenge	Musenge Dispensary	Level 2	36
Oloika	Oloika Dispensary	Level 2	4

Factors associated with place of child delivery
The factors were grouped into two: dependent and independent variables. The independent variables were distance, demographic variables: age, education, parity; and socio-economic characteristics such as awareness of local actors, family occupation, family monthly income, and spouse/relative decides place of delivery; while the dependent variable was place of delivery (home or facility).

Data collection and analysis
Computed distances in the study area were generate from Geographic Information System (GIS) software (ArcGIS 10.4). The features were loaded into a geospatial database to enable mapping of sampled households, health facilities and all the roads. The network dataset was built from these features which acted as road network sources and have the connectivity (topology) and attributes associated with them. Firstly, straight-line distances were generated by the 'Near Table tool' to obtain the distances between the households and the health facilities. Next using the 'New Closest Facility' toolset in the Network Analyst toolbox, road network distances were calculated from the 246 households to the nearest of the 12 health facilities that offered childbirth services in Magadi Ward. Analysis was also run for the 246 household's road network distance to the primary facility (Magadi Hospital) using the same tool. The resultant computed distances from every household, together with responses of other variables that were collected in questionnaire form were loaded in STATA 15.1 for further statistical analyses. Descriptive analysis was performed to summarize the characteristics of the target population. Further, univariate and multivariate logistic regression were run on the independent variables to identify determinants of place of delivery.

Ethical considerations
Ethical Approval: The study was conducted according to the guidelines of the Department of Geography, Population and Environmental Studies, and also approval was sought from the Ethics Research Committee of the Kenyatta National Hospital and the University of Nairobi Ethics Research Committee (KNH-UON ERC) (KNH-ERC/A/123) on 6th April 2020.

Consent to participate: Both informed and written consent were obtained from the subject(s) who participated in the study.

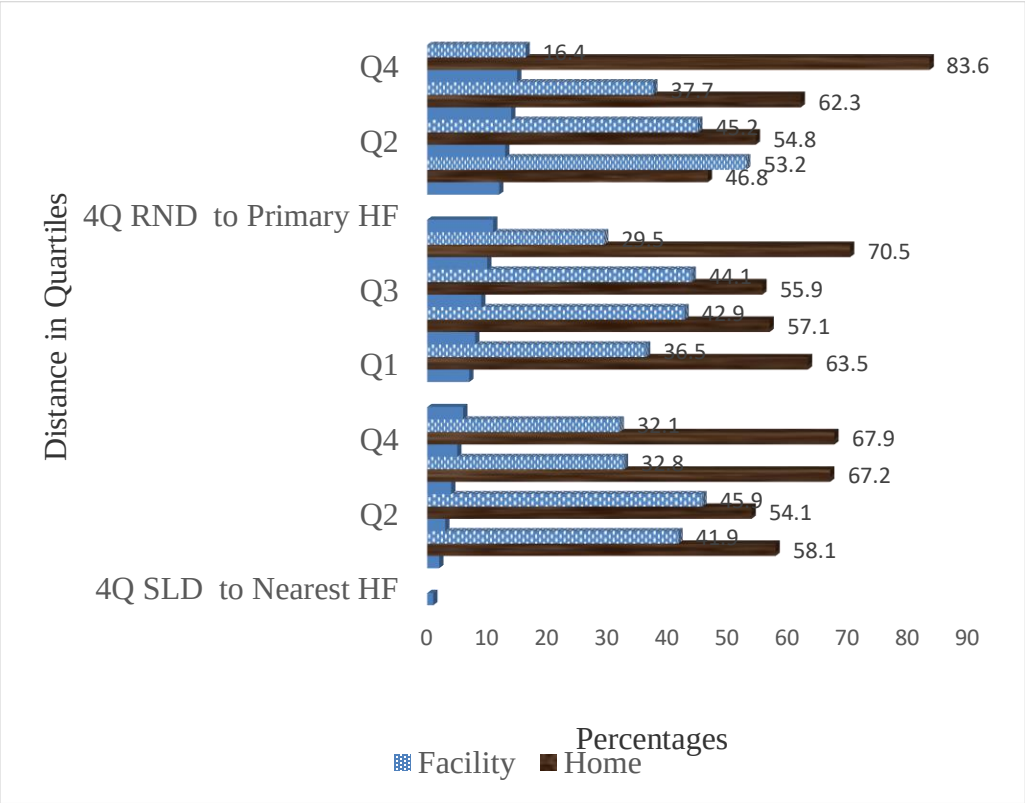
Results

A total of 246 participants responded to the survey in the 8 community units of Magadi Ward. Out of these, majority of the births 61.8% (152) took place at home while 38.2% (94) occurred at health facility.

The computed distances generated from location of women and health facilities were ranging from 200m the nearest and the farthest distance covered was over 50000m, Figure 2. They were represented by 4 quantile (quartile) categories as: Quartile 1 "Households in the first zone around health facility", Quartile 2 "Households in the second zone around health facility", Quartile 3 "Households in the third zone around health facility", Quartile 4 "Households in the fourth zone around health facility" to take care of the huge variation. Overall, the proportion of births at a health facility experienced a significant decline with increasing quartile category for the road network distance to the primary facility (Magadi Hospital). Those who delivered in health facility in the first quartile were 53.2%, in the second quartile 45.2%; in the third quartile 37.7%, and in the fourth quartile 16.4%. This implies that the farther away a woman was from the primary health facility, the lower the chances of giving birth in the health facility, Figure 2 and Table 1.

This was further confirmed by an analysis of road network distance to the nearest health facility which indicated that the highest proportion of women who delivered at home were found in the fourth quartile (70.5% of the respondents), Figure 3. However, 63.5% of the respondents who delivered at home were found in the first quartile while the lowest percentage of women who delivered at home (55.9%) were found in the third quartile. This implies that as far as the secondary health facilities were concerned, apart from those respondents residing farthest from the facility, the rest of the respondents may not have been significantly influenced by road distance from the facility. As far as straight-line distance to the nearest facility is concerned, a high proportion of women who delivered at home were found in the

fourth and third quartiles accounting for 67.9% and 67.2% respectively figure 2.



SLD= Straight line distance; RND=Road network distance; Q1, Q2, Q3, Q4 = Quartiles 1-4
Figure 2: Computed distance to health facilities and place of delivery

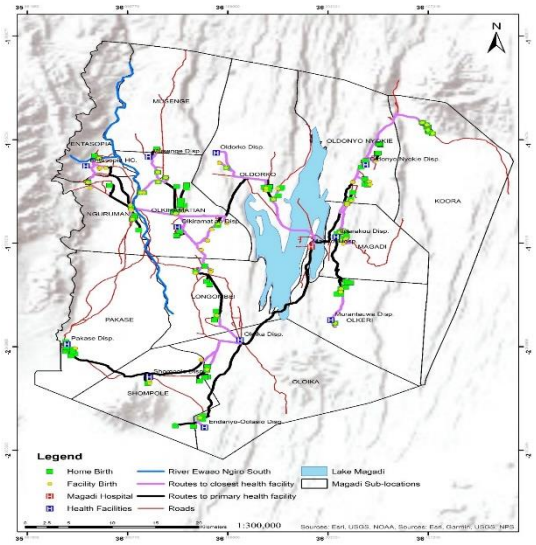


Figure 3. Spatial distribution of households, health facilities and existing routes to nearest facility and primary facility and access to place of delivery in Magadi Ward.

The association between computed distance and place of delivery in Magadi

Computed distances were further subjected to regression analysis, only the road network distance to the primary health facility showed statistical significance when adjusted for confounders, Table 2: unadjusted ratio {first quartile (OR = 5.80, 95%CI = 2.50 – 13.46), second quartile (OR = 4.20, 95%CI = 1.82 – 9.75) and third quartile (OR = 3.09, 95%CI = 1.32 – 7.34)} and adjusted ratios {first quartile (OR =8.87, 95%CI = 2.16 – 36.35), second quartile (OR =6.73, 95%CI = 1.77 – 25.5) and third quartile (OR = 11.89, 95%CI = 3.05 – 4.98), Table 2.

Table 2. Univariate and multivariate regression showing distances and place of delivery

Variable	Crude OR	95%CI	P value	Adjusted OR	95%CI	P value
(a) 4 Quantile straight line distance to nearest health facility						
1	1.52	0.72 – 3.24	0.273	0.64	0.66 – 6.16	0.696
2	1.79	0.84 – 3.81	0.130	3.95	0.56 – 27.89	0.168
3	1.03	0.48 – 2.20	0.935	0.93	0.23 – 3.74	0.918
4 (Ref.)						
(b) 4 Quantile Road network distance to nearest health facility						
1	1.37	0.65 - 2.91	0.408	0.64	0.66 – 6.16	0.412
2	1.79	0.85 – 3.77	0.124	3.95	0.56 – 27.89	0.924
3	1.88	0.89 – 4.00	0.100	0.93	0.23 – 3.74	0.488
4 (Ref.)						
(c) 4 Quantile Road network distance to primary health facility						
1	5.80	2.50 – 13.46	**<0.001**	8.87	2.16 – 36.35	**0.002**
2	4.20	1.82 – 9.75	**0.001**	6.73	1.77 - 25.5	**0.005**
3	3.09	1.32 – 7.24	**0.010**	11.85	3.05 – 4.98	**<0.001**
4 (Ref.)						

Ref.* Reference: *The quartile category that was referenced*

Other factors associated with place of delivery in Magadi

The unadjusted odds ratios demonstrated that attaining secondary level of education and above, women aged 20 years and below, knowledge of private entities as local actors that set up health facilities in community units, receiving two childbirth services, spouse/ relative deciding or sometimes deciding place of delivery for women, and total number of children a woman has ever bore (parity) were significantly associated with delivering in a health facility in Magadi Ward (Table 3). The likelihood of delivering at health facility was not associated with unadjusted age of women (between 21 – 30), having primary level of education, being unmarried, receiving one childbirth service, monthly family income level, types of family occupation and also opinion whether health facility location is proper (Table 3).

After adjusting for odds, women aged 20 and below, having secondary and above level of education, awareness of private and public/private categories of local actor, unmarried women, receiving one or two other childbirth services at a health facility, spouse/ relative deciding for place of delivery for women, and having a total of 3 – 4 children are significantly associated with delivering at a health facility (Table 3). The adjusted ratios that did not present any significant likelihood of delivering at a health facility are: women aged 21-30, attaining primary level of education and above, monthly family income levels, family occupation, opinion on health facility location and having between 5 – 8 children by women in Magadi were not related to delivering in a health facility (Table 3).

Table 3. Univariate and Multivariate regression showing demographic and socioeconomic characteristics on place of delivery

Variable	Crude OR	95%CI	P value	Adjusted OR	95%CI	P value
Age						
< 20	2.23	1.09 – 4.56	**0.027**	4.08	1.05 - 12.75	**0.042**
21-30	1.81	0.87 -3.71	0.111	2.21	0.68 – 7.12	0.185
>30 (Ref.)						
Education level						
Never attended (Ref.)						
Primary	1.31	0.67 – 2.56	0.434	1.43	0.52 - 3.95	0.494
Secondary and above	5.37	2.57 – 11.23	**<0.001**	11.38	2.54 - 50.91	**0.001**
Marital status						
Married (Ref.)						
Not married	1.40	0.71 – 2.77	0.336	0.07	0.01 - 0.33	**0.001**
Awareness of Local Actors						
Government (Ref.)						
Private	4.21	2.26 – 7.86	**<0.001**	7.08	2.43 – 20.65	**<0.001**
Public/private	0.58	0.12 – 2.83	0.502	0.10	0.01 – 0.81	**0.031**
Other CBS received						
1 CBS	0.55	0.24 – 1.27	0.160	0.20	0.05 - 0.75	**0.017**
2 CBS	0.22	0.09 – 0.55	**0.001**	0.06	0.02 - 0.25	**<0.001**
3 CBS or more (Ref.)						
Monthly family income level						
< 5000 (Ref.)						
5000 - 10000	0.60	0.32 – 1.12	0.111	0.42	0.16 - 1.06	0.066
> 10000	1.02	0.50 – 2.11	0.951	0.79	0.27 - 2.32	0.662
Family occupation						
1 type of occupation (Ref.)						
2 type of occupation	1.75	0.76 – 4.00	0.186	0.99	0.39 – 2.49	0.985
3 type of occupation	2.07	0.25 – 17.11	0.499	0.87	0.08 – 9.81	0.913
Spouse decides place of delivery						
No (Ref.)						
Yes	2.50	1.42 – 4.38	**0.001**	6.40	2.45 - 16.78	**<0.001**
Sometimes	3.40	1.33 – 8.69	**0.011**	2.07	0.55 – 7.87	0.284
Opinion whether HF location proper						
Yes (Ref.)						
No	1.91	0.75 – 4.90	0.176	5.20	1.11 - 24.44	0.037
Parity						
1-2 (Ref.)						
3-4	0.41	0.22 – 0.78	**0.006**	0.20	0.06 – 0.59	**0.004**
5 - 8	0.39	0.21 – 0.75	**0.004**	0.60	0.17 – 2.11	0.423

Ref* Reference*: The variable category that was referenced*
CBS* – *Childbirth Services*

Discussion

The aim of this study was to determine how distance and other factors affect the access and use of place of delivery in Magadi Ward. The results indicated that computed road network distance to the primary health facility was a determinant when choosing place of delivery. This could be because the primary facility (Magadi hospital) is the only facility that can handle complicated cases during childbirth in the area. Therefore, distance is a significant factor because it could dissuade the choice of delivery in health facility. It was also noted that most of the existing roads in the study area (Figure 3); which were used to generate the road network distances were non-all weather, thus posing a challenge to accessing health facilities. This result agrees with the findings by Lohela *et al.,* (2012) in a study on relationship between distance and care, facility births and early neonatal mortality in Zambia and Malawi , using measured straight-line distance showed that in both countries, distance to care is associated with place of delivery. This is based on the fact that straight-line distance may not be the real representation of the friction of distance. It is imperative to point out that reported and computed distances may not be the sole factors determining use of health facility for childbirth. In Ethiopia, Godefay *et al.,* (2016) found that availability of standby ambulances made freely accessible to the public for pregnancy-related cases reduced maternal mortality in Tigray during childbirth.

Despite education levels amongst women in Magadi being low, the findings from this study also illustrated that the utilization of skilled delivery increased with increase in education level. This is indicative of the significant role of education in choice of place of delivery. In the Democratic Republic of Congo, a study analyzed the maternal education level and maternal healthcare utilization; It was established that the woman's level of education is associated with the utilization of maternal healthcare services (Wang *et al.,* 2021). Furthermore, Machira and Palamuleni (2017) studied the factors associated with the utilization of healthcare services during childbirth in Malawi also stated that education level increased the likelihood of using health facility during delivery Machira and Palamuleni, (2017); both studies concurring with the findings herein. However, a study in Eritrea on factors influencing the choice of delivery place among mothers living in rural Eritrea, reported diverging result in that the maternal level of education was not linked to place of delivery (Kifle *et al.,* 2018).

The study also sought to establish whether there was a relationship between maternal age and place of delivery. The outcome was that women advanced in age did not mainly deliver in health facilities. This could be due to the assumption that women of higher age have probably had successful previous delivery experiences with no complications thus boosting their confidence in home delivery. Another plausible explanation could be borrowed from Grossman's model (Grossman, 1972) which conceptualized that the younger the population the higher the demand for health services. The research findings are also supported by a study in Zimbabwe that explored factors affecting uptake of maternal services (Mupwanyiwa *et al.,* 2020). Accordingly, younger women are more likely to use modern health care as compared to older women. Studies in rural Kenya and Tanzania concurred with this finding regarding age whereby, it was reported that a woman's age was one of the risk factors associated with home delivery. For instance, (Mrisho *et al.,* 2007) in a study on the effects of home delivery in rural Tanzania found that a mother's age was an important independent determinant of place of delivery. The results were similar to those of van Eijk *et al.,* (2006), who undertook a study on the use of antenatal care and child delivery services in a rural community in Western Kenya and found that, despite high use of antenatal care services in rural western Kenya, low records of institutional child delivery were reported by older women.

The utilization of other childbirth services such as antenatal and postnatal care increased the odds of health facility delivery. This could perhaps be due to the fact that women who use these services understand or are advised on the benefits of delivering in a health facility. The results however differ with the study findings by Kifle *et al.,* (2018), while analyzing the factors influencing the choice of place of delivery in rural Eritrea. Kifle, noted that despite women who receive

antenatal care, home deliveries are still rampant in the area.

Similarly, the same was witnessed in the number of children. Women with more children are more likely to deliver at health facility. The reason could be because of the likely negative experiences they encountered with child delivery at home during previous deliveries. Women who give birth for the first child may have less experience at child delivery thus, uncertainties about the difficulties during labor and delivery at home. There are consistencies of these findings with Macharia *et al.,* (2017) on the factors influencing women's utilization of public health care services; who found that institutional delivery in rural Malawi was influenced by the birth order and the number of children a woman has.

Spousal decision on place of delivery suggests that, the more men are involved in deciding place of birth the greater the possibility of women to utilize health facilities for child delivery. The community in Magadi is patriarchal thus the need to involve men in decisions related to childbirth. A sentiment also hailed by Temba *et al.,* (2013) in addressing efforts of cultural constraints to girls' access to education among the Maasai community in Tanzania. They established that the possibility of husbands controlling their spouses within the Maasai community was dominant factor.

Pastoral communities majorly rely on animal husbandry to sustain a living. This type of economic activity leaves very little room for a variety of occupation to exist. More so, the income input is one-sided where the males are overly relied on to work so as to earn a living. This could explain the reasons why this study found the two variables to be statistically insignificant. Nonetheless, when scaling up by category there were greater chances of women from a higher family income level and those in households with more types of occupation to seek delivery in health facility. This implies that women from families with a higher monthly income have the capacity to meet monetary costs associated with delivering in a health facility. This finding agrees with the findings of Sahoo *et al.,* (2015) in India that was assessing whether choice of place of delivery is a factor of family income. It was established that as family income decreased, the odds of delivering at home increased significantly. Correspondingly in Ghana, women from a poor household were less likely to have health facility delivery due to the cost as Dankwah *et al.,* (2019) revealed in a study on the social determinants of skilled delivery in health facility. In addition, the families with many types of occupation are able to increase the chances of meeting the associated cost of delivering at a health facility. These finding also correspond with those of a study investigating the determinants of place of delivery among women in Zaria northern Nigeria (Idris *et al.,* 2006). They found that the spouse's employment status enabled the women to deliver in a health facility.

Conclusion

Although road network distance was strongly associated with child delivery at the primary facility, it was not associated with child delivery in the nearest facilities. An indication that the primary facility is farther and key in offering childbirth services than the nearest facilities. In addition, maternal age, level of knowledge, use of other childbirth services (e.g antenatal and postnatal care) and the number of children a woman has are demographic factors that played a major role on where to undertake child delivery.

Consequently, interventions need to be sort out on increasing the utilization of health facilities for delivery among pastoral communities. For instance, interventions towards improving road conditions and building more primary facilities that could handle complicated cases would go a long way in addressing the challenges associated with distance to health facilities. A reliable transport system which could also play a major role includes better modes of transporting expectant mothers such as: modernised ambulances, taxis, vehicles dedicated for maternity care among others. More so, a good road network is essential for the effective working of the different modes as a means of reducing financial barriers to care (Fournier *et al.,* 2009).

Efforts should also be put to address access and use of childbirth services by strengthening of

initiatives within and outside public health designed to empower females with education as a tool. Furthermore, older women in the community should be targeted as a way to sensitive them on the importance of facility delivery. Plans to improve health facility delivery should emphasize on care providers enlightening women on the significance of institutional delivery during their routine antenatal visits.

However, creating awareness to women should not be the primary focus. The patriarchal nature of the community suggests that men's involvement would expose them to pregnancy information thus encourage them to support their women during childbirth. Though (Mohammed *et al.,* 2020) stated that it would be useless to promote interventions on male involvement without considering women's perspective. Thus, the authors recommended that male friendly environments be provided during antenatal visits and childbirth while still considering the woman's comfort. Hence, despite distance being the dominant factor, other variables affect access and use of health facilities for child delivery as considered in this study.

Acknowledgement

This research was supported by the Consortium for Advanced Research Training in Africa (CARTA). CARTA is jointly led by the African Population and Health Research Center and the University of the Witwatersrand, South Africa and is funded by Sida (Grant No: 54100113), Carnegie Corporation of New York (Grant No. G-19-57145), the DELTAS Africa Initiative (Grant No: 107768/Z/15/Z). The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust (UK) and the UK government. The statements made and views expressed are solely the responsibility of the Fellow.

The authors wish to thank the County government of Kajiado for approving the data collection in Magadi Ward.

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests. In addition, the funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

Abera A.N., Bukola, F., & Ayodele, A. (2016). Determinants of use of health facility for childbirth in rural Hadiya zone, Southern Ethiopia. *BMC Pregnancy and Childbirth*, *16*(355). https://doi.org/10.1186/s12884-016-1151-1

Bekuma T. T., Belaynesh F., Melese G. N., Gemechu K., & Haile B. (2020). Factors Affecting Choice of Childbirth Place among Childbearing Age Women in Western Ethiopia: A Community-Based Cross-Sectional Study. *International Journal of Reproductive Medicine*, *2020*, 1–9. https://doi.org/10.1155/2020/4371513

Caulfield, T., Onyo, P., Byrne, A., Nduba, J., Nyagero, J., Morgan, A., & Kermode, M. (2016). Factors influencing place of delivery for pastoralist women in Kenya: A qualitative study. *BMC Women's Health*, *16*(1), 1–11. https://doi.org/10.1186/s12905-016-0333-3

Defar, A., Okwaraji, Y. B., Tigabu, Z., Persson, L. Å., & Alemu, K. (2021). Distance, difference in altitude and socioeconomic determinants of utilisation of maternal and child health services in Ethiopia: A geographic and multilevel modelling

analysis. *BMJ Open*, *11*(2), 1–9. https://doi.org/10.1136/bmjopen-2020-042095

Dumitrache, L., Nae, M., & Simion, G. (2020). Modelling Potential Geographical Access of the Population to Public Hospitals and Quality Health Care in Romania.

Enuameh, Y. A. K., Okawa, S., Asante, K. P., Kikuchi, K., Mahama, E., Ansah, E., … and Kamiya, Y. (2016). Factors influencing health facility delivery in predominantly rural communities across the three ecological zones in Ghana: A cross-sectional study. *PLoS ONE*, *11*(3), 1–16. https://doi.org/10.1371/journal.pone.0152235

Fournier, P., Dumont, A., Tourigny, C., Dunkley, G., & Dramé, S. (2009). Improved access to comprehensive emergency obstetric care and its effect on institutional maternal mortality in rural Mali. *Bulletin of the World Health Organization*, *87*(1), 30–38. https://doi.org/10.2471/BLT.07.047076

Gabrysch, S., Cousens, S., Cox, J., & Campbell, O. M. R. (2011). The Influence of Distance and Level of Care on Delivery Place in Rural Zambia: A Study of Linked National Data in a Geographic Information System. *PLoS Medicine*, *8*(1), e1000394. https://doi.org/10.1371/journal.pmed.1000394

Gborgbortsi, W. D.-, Dwomoh, D., Alegana, V., Hill, A., Tatem, A. J., & Wright, J. (2020). The influence of distance and quality on utilisation of birthing services at health facilities in Eastern Region , Ghana. *BMJ Global Health*, 1–11. https://doi.org/10.1136/bmjgh-2019-002020

Godefay, H., Kinsman, J., Admasu, K., & Byass, P. (2016). Can innovative ambulance transport avert pregnancy – related deaths ? One – year operational assessment in Ethiopia, *6*(1). https://doi.org/10.7189/jogh.06.010410

Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health. *The Journal of Political Economy*, *80*(2), 223–255.

Hanson, C., Gabrysch, S., Mbaruku, G., Cox, J., Mkumbo, E., Manzi, F., … & Ronsmans, C. (2017). Access to maternal health services: Geographical inequalities, united republic of Tanzania. *Bulletin of the World Health Organization*, *95*(12). https://doi.org/10.2471/BLT.17.194126

Idris, S. H., Gwarzo, U. M. D., & Shehu, A. U. (2006). Determinants of Place of Delivery among Women in a Semi-Urban Settlement in Zaria, Northern Nigeria. *Annals of African Medicine*, *5*(2), 68–72.

Karanja, S., Gichuki, R., Igunza, P., Muhula, S., Ofware, P., Lesiamon, J., … & Ojakaa, D. (2018). Factors influencing deliveries at health facilities in a rural Maasai Community in Magadi sub-County, Kenya. *BMC Pregnancy and Childbirth*, *18*(1), 1–11. https://doi.org/10.1186/s12884-017-1632-x

Kifle, M. M., Kesete, H. F., Gaim, H. T., Angosom, G. S., & Araya, M. B. (2018). Health facility or home delivery? Factors influencing the choice of delivery place among mothers living in rural communities of Eritrea. *Journal of Health, Population and Nutrition*, *37*(1), 1–15. https://doi.org/10.1186/s41043-018-0153-1

Kim, M. K., Lee, S. M., Bae, S.-H., Kim, H. J., Lim, N. G., Yoon, S.-J., … Jo, M.-W. (2018). Socioeconomic status can affect pregnancy outcomes and complications, even with a universal healthcare system. *International Journal for Equity in Health*, *17*(1), 2. https://doi.org/10.1186/s12939-017-0715-7

Lohela, T. J., Campbell, O. M. R., & Gabrysch, S. (2012). Distance to Care , Facility Delivery and Early Neonatal Mortality in

Malawi and Zambia, *7*(12). https://doi.org/10.1371/journal.pone.0052110

Macharia, P. M., Odera, P. A., Snow, R. W., & Noor, A. M. (2017). Spatial models for the rational allocation of routinely distributed bed nets to public health facilities in Western Kenya. *Malaria Journal*, 1–11. https://doi.org/10.1186/s12936-017-2009-3

Machira, K., & Palamuleni, M. (2017). Factors influencing women's utilization of public health care services during childbirth in Malawi Public health facility utilization. *Afri Health Sci*, *17*(2), 400. https://doi.org/10.4314/ahs.v17i2.14

Mohammed, S., Yakubu, I., & Awal, I. (2020). Sociodemographic Factors Associated with Women ' s Perspectives on Male Involvement in Antenatal Care , Labour , and Childbirth, *2020*.

Mrisho, M., Schellenberg, J. A., Mushi, A. K., Obrist, B., Mshinda, H., & Tanner, M. (2007). Factors affecting home delivery in rural Tanzania Factors affecting home delivery in rural Tanzania, (October 2019). https://doi.org/10.1111/j.1365-3156.2007.01855.x

Mupwanyiwa, A., Chundu, M., Mavesere, I., & Dengedza, M. (2020). Exploring Factors That Influence the Uptake of Maternal Health Care Services by Women in Zimbabwe, 46–70. https://doi.org/10.4236/jss.2020.810005

Nesbitt, R. C., Lohela, T. J., Soremekun, S., Vesel, L., Manu, A., Okyere, E., … & Gabrysch, S. (2016). The influence of distance and quality of care on place of delivery in rural Ghana. *Nature Publishing Group*. https://doi.org/10.1038/srep30291

Sahoo, J., Singh, S. V., Gupta, V. K., Garg, S., & Kishore, J. (2015). Do socio-demographic factors still predict the choice of place of delivery : A cross-sectional study in rural North India. *Journal of epidemiology and global health*. https://doi.org/10.1016/j.jegh.2015.05.002

Sharma, D. K., Vangaveti, V. N., & Larkins, S. (2016). Geographical access to radiation therapy in North Queensland: a retrospective analysis of patient travel to radiation therapy before and after the opening of an additional radiotherapy facility. *Rural and Remote Health*, *16*(1), 3640.

Shiferaw, B. B., & Modiba, L. M. (2020). Why do women not use skilled birth attendance service ? An explorative qualitative study in north West Ethiopia, *0*, 1–14.

Temba, E. I., Warioba, L., & Msabila, D. T. (2013). Assessing Efforts to Address Cultural Constraints to Girls' Access to Education Among the Maasai in Tanzania: A Case Study of Monduli District. *Journal of International Cooperation in Education*, *15*(3), 21–37.

UN (2018). Sustainable Development Goal 3: Progress and Info 2018. Retrieved May 17, 2019, from https://sustainabledevelopment.un.org/sdg3

van Eijk, A. M., Bles, H. M., Odhiambo, F., Ayisi, J. G., Blokland, I. E., Rosen, D. H., … & Lindblade, K. A. (2006). Use of antenatal services and delivery care among women in rural western Kenya: a community based survey. *Reproductive Health*, *3*(1), 2. https://doi.org/10.1186/1742-4755-3-2

Wang, H., Frasco, E., Takesue, R., & Tang, K. (2021). Maternal education level and maternal healthcare utilization in the Democratic Republic of the Congo: an analysis of the multiple indicator cluster survey 2017/18. *BMC Health Services Research*, *21*(850). https://doi.org/10.1186/s12913-021-06854-x

WHO (2019a). Maternal mortality.

WHO (2019b). *World Health Statistics: Monitoring Health for SDGs*.