Maternal Factors Influencing Under-five Mortality in Karemo Sub-county in Siaya County, Kenya

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Abstract

Background

Despite the substantial reduction of under-five mortality (U5M) across the world, about 15,000 under-fives (U5s) die daily. Majority occurs in developing countries with Sub-Saharan African countries like Kenya accounting for over 50%. In Kenya, the former Nyanza Province in western region exhibits the highest U5MR of 82 deaths/1000 live births. Karemo Sub-County in Nyanza Province displays twice as much U5MR as Nyanza Province despite having relatively good access to private and public health facilities. Moreover, the influence of maternal risk factors on U5M remains unknown.

Methodology:

The current cross-sectional study assessed the influence of maternal risk factors associated with U5M in Karemo Sub-County in Siaya County in 299 households of women of reproductive age (15–49 years). Data was collected using pre-tested structured questionnaire on a face-to-face interview. Differences between proportions were determined using Chi-square test while binary logistic regression was used to determine the association between maternal factors and U5M.

Results

Results show that children of older mothers (35–49 years) had increased mortality relative to those of younger mothers (< 20 years) (OR = 2.484; 95%CI: 1.249–4.940; $P = 0.009$). Short preceding birth interval of (< 2 years) was associated with increased risk of U5M relative to longer preceding birth intervals (> 2 years) (OR = 2.079; 95%CI: 1.240–3.485; $P = 0.005$). Relative to primary education level, children born to mothers who had attained tertiary level had reduced risk of U5M (OR = 0.408; 95%CI: 0.208-0.800; $P = 0.009$). Higher birth orders of 4 and above were five times more associated withU5M compared to lower birth orders (OR = 5.442; 95%CI: 2.789–10.620; $P < 0.0001$). Polygamy was associated with increased risk of U5M (OR = 3.370; 95%CI: 1.922–5.910; $P < 0.0001$). Similarly, lower death rates of about 61% were observed among children of married mothers compared to those of single mothers (OR = 0.382; 95%CI: 0.218–0.669; $P = 0.001$). Employment, subsistent farmers and small-scale business mothers showed increased risk to U5M (OR = 3.505, 95%CI: 1.657–7.414; $P = 0.001$), 2.1 (OR = 2.196; 95%CI: 1.190–4.053; $P = 0.012$) and 5.6 (OR = 5.639; 95%CI: 2.871–11.077; $P < 0.0001$), respectively.

Conclusion

Strategies targeting promotion of girl-child education above primary levels, women economic empowerment and acceptance of family planning are considered fundamental interventions and should be emphasized in reducing U5M in this region.

Introduction

Globally, substantial reduction of under-five mortality rate (U5MR) is evident. Currently,U5MR has scaled down by 58% from 93 deaths per 1,000 live births to 39 deaths per 1,000 live births between 1990−2017 [1]. In spite of this, 5.4 million under-fives (U5s) still die annually translating to 15,000 each day [2]. The reduction rate is not uniform, 99% occurs in developing countries while 50% are accounted for by Sub-Saharan African countries (SSA) including Kenya [2]. Remarkable efforts to reduce under-five mortality (U5M) in SSA have been observed. In recent years, one in every 13 children dies before their fifth birthday compared to 1 in 9 children in 2013 [2]. Contrastingly, half of the total U5M is found in this region despite the region having only a fifth of the total children's population in the world [1, 3]. Moreover, 5 out of 6 countries with U5MR above 100 deaths per 1000 live births are still in this region. Additionally, the region continues to face two significant challenges: First, the highest risk of neonatal death and secondly, the wide disparities of U5M among the countries [1].

In Kenya, just like most SSA countries, the two aforementioned challenges continue to persist. First, neonatal deaths account for 60% of infant deaths, which in turn weigh heavily on U5M[4]. Secondly, huge disparities in the distribution of U5M across previous provinces with the former Nyanza province (82 deaths per 1,000 live births) bearing the greatest burden compared to previous Central province (42 deaths per 1,000 live births) [5, 6]. Impressively, U5MRin Kenya has reduced by 36%;implying that only 1 in every 19 children born dies before age five in 2014 compared to 1 in 9 in the year 2008 [6]. However, the country is twice far meeting SDGs 3 target on U5MR (25 deaths per 1,000 live births).Within the former Nyanza Province, U5MRvaries across different counties with Siaya County out of 6 Counties highly burdened (167 deaths/1000 live births) relative to Nyamira County (52 deaths/1,000 live births) [7]. Moreover, within Siaya County, Karemo Sub-County register the highest U5MR of 184 deaths/1000 live births compared to Boro and Uranga which has U5MR of 171 deaths/ 1000 live births and 125 deaths/1000 live births, respectively [8, 9]. This therefore calls for an investigation to determine factors associated with highU5MR in Kenya and more so in rural areas of the former Nyanza Province like Karemo Sub-County in Siaya County.

To fast-track progress of reducing under-five mortality, specific proven interventions would have to target specific causes of child deaths [10−12]. Since no single factor can account for the child mortality, there is need to assess various factors influencing U5M to determine specific ones that requires urgent interventions [12−14]. Previous studies have highlighted a number of factors such as: place of residence, age, education, place of delivery, birth order and birth interval, religion of the parent, household headship, socio-economic status and gender of the child [12, 14, 15]. Existing literatures have agreed upon maternal age, education, birth order among other variables to be associated with U5M. However, mixed findings have been observed on place of delivery, place of residence and household socio-economic status. Few studies have included maternal occupation, financial autonomy and income [12, 14, 16]. Despite Karemo Sub-County having relatively good access to public and private health facilities, it exhibits high U5MR of 184 deaths/1000 live births [9]. While many studies have assessed these factors in rural areas, no single study has linked maternal factors with U5M in this region. Moreover, there exists disagreement in the

existing literatures on specific factors associated with U5M. Our study therefore, determined maternal socio-demographic, socio-economic factors and health seeking behaviors associated with U5M in Karemo Sub-County, Siaya County, in western Kenya.

Materials And Methods

Study site

The current study was conducted in Karemo Sub-County, Siaya County in western Kenya. It covers an area of 239.8 KM^2 with a population density of approximately 350 people/$KM^2$and situated between $0.22^0S-0.23^0N$ latitude, $34.53^0W- 34.28^0E$ longitude. It has a total population of 88,705 individuals (male 47%; female 53%). The population is predominantly rural and culturally homogeneous. Over 95% of its members are of the Luo ethnic community. The rainfalls are seasonal with the heaviest 'long' rains occurring from March through May and 'short' rains falling between October and December.

Most of the houses are built of mud, cement or brick walls with roofs of iron sheets or thatched grass. These residents live in households and compounds and earn their livelihoods through subsistence farming and local trading [17]. There are nine (9) government functioning health centres and several private health facilities. However, the community faces a lot of socio-economic challenges which include: low farm productivity, high rates of unemployment [18], high under-five mortality rate (184 deaths per 1000 live births)[9], low literacy levels among mothers, total fertility rate as high as 5.5,-andpoor health-seeking behaviour. Studies have also shown that the major causes of childhood mortality are diarrheal diseases, respiratory diseases (pneumonia), malaria, malnutrition, measles and HIV related complications [19].

Kenya Medical Research Institute (KEMRI) and the US Centers of Disease Control and Prevention (CDC) have been conducting collaborative public health research in Siaya County for a period of over 10 years. In 2006, the population of Karemo Sub-County was also included and is being monitored under Health Demographic Surveillance System (HDSS) that records every birth, death, and migration (into or out of, and within the study area) every 4 months. Families live in compounds and each compound has been mapped using Geographic Information System (GIS) coordinates [17].

Study design

The study used retrospective cross-sectional study design utilizing multi-stage probability sampling, probability proportion to size and simple random sampling technique. The Karemo Sub-County is divided into 4 locations, 17 sub-locations, 168 villages and 21150 households [17]. In the first stage, 5 out of 17 sub-locations namely: Mulaha, Ngiya, Pap Orian'g, Kogelo and Barding' were randomly sampled. This was followed by purposively sampling 35 villages perceived to be far away from the health facilities in the second stage. Lastly, a simple random selection of 299 households with women of reproductive age (15-49 years) was done. Probability proportion to size was used to determine the number of households

to be interviewed per a given village. Only women of reproductive age (15–49 years) who had under-fives and were the actual mothers of under-fives were interviewed.

Sample size determination

Fisher's formula was used for sample size estimation [20]. The prevalence of U5M in Karemo Sub-County was approximated at 0.184. The total population size of women of reproductive age (15–49 years) was 17,780 women at the time of the study. Based on the above formula, the calculated sample size was 230 women of reproductive age. A further 30% was added to the total sample size to enhance precision and for non-respondents that might have occurred during data collection period. Thus, a total of 299 women of reproductive age (15–49 years) who were the actual mothers of U5s were considered for this study.

Data collection procedures

Data was collected using pre-tested structured questionnaire on a house-to-house survey. Three trained research assistants administered the questionnaires on a face -to -face interviews in the respondents' household. Prior to data collection, the centre of each village was determined by the help of the village elder and the direction of movement was determined by randomly picking a piece of paper written either North, South, West or East. The first household was picked at random according to the direction chosen and then subsequent households until the threshold per village attained. The targeted women of reproductive age were interviewed; however, care givers were not interviewed. Widows who were the actual mothers of under-fives were interviewed and categorized as single mothers. For purposes of confidentiality, other household members were requested to vacate the house at the time of the interview. Upon completion of the interview, the questionnaires were then checked for accuracy and completeness and thereafter kept by the researcher under lock and key to ensure privacy and confidentiality of the respondent's information.

Data analysis

The SPSS® statistical software package version 22.0 (IBM SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. Differences between proportions were determined using Chi-square test (χ2). Binary logistic regression model was used to establish the association between maternal factors and U5M. The epidemiological measure of effects of each variable were estimated by the calculation of odds ratios (OR) and 95% Confidence Intervals (CI). All values with $P \leq 0.05$ were considered statistically significant.

Results

Demographic characteristics of study respondents

We present the summaries of the demographic characteristics of all study participants in Table 1. Majority, 172 (57.6%) were mothers between the age of 21–34 years followed by 66 (22.0%) who were between the age of 35–49 years while the rest, 61(20.4%) were below 20 years of age. About 25 (8.3%) were single mothers while 274 (91.7%) were married. Moreover, 232 (77.5%) were in monogamous union

while 67 (22.5%) were in polygamous union. Mothers who had attained primary education levels alone were 156 (52.1%) followed by 100 (33.4%) who had completed secondary education while only 43 (14.5%) had tertiary levels of education. Most mothers 103 (34.6%) were engaged in business while 92 (30.8%) were housewives or students (none as per results). Only 67 (22.3%) were engaged in subsistence farming while 37 (12.3%) were salaried employed. About 198 (66.2%) had < 2 years while only 101 (33.8%) had > 2 years of birth interval. Majority of the mothers were Christians 297 (99.3%) while others 2 (0.7%) were Muslims. Out of all the mothers, 126 (42.1%) considered themselves financially autonomous while 173 (57.9%) were not. In terms of monthly income, majority 169 (56.7) were earning < KSh. 4999, 23 (7.6%) were earning between KSh. 5,000–10,000, 7 (2.3%) were earning > KSh. 10,000 while others, 100 (33.4%) were not earning anything (Table 1).

Table 1
Demographic characteristics of respondents (N = 299)

Variables	Frequencies	Percentages (%)
Maternal age		
< 20 years	61	20.4
21−34 years	172	57.6
35-49 years	66	22.0
Marital status		
Single	25	8.3
Married	274	91.7
Type of marriage		
Monogamous	232	77.5
Polygamous	67	22.5
Education		
Primary	156	52.1
Secondary	100	33.4
Tertiary	43	14.5
Occupation		
None	92	30.8
Farming	67	22.3
Business	103	34.6
Employed	37	12.3
Birth Interval		
< 2 years	198	66.2
> 2 years	101	33.8
Religion		
Christians	297	99.3
Islamic	2	0.7

Data presented as n (%) unless stated otherwise. Data analysis was performed by calculating frequencies and percentages for each maternal demographic characteristic.

Type of Marriage		
Monogamous	227	75.9
Polygamous	72	24.1
Financial autonomy		
Autonomous	126	42.1
Not autonomous	173	57.9
Monthly income		
None	100	33.4
<KSh. 4999	169	56.7
KSh. 5000–10000	23	7.6
>KSh.. 10000	7	2.3

Data presented as n (%) unless stated otherwise. Data analysis was performed by calculating frequencies and percentages for each maternal demographic characteristic.

Proportional differences between maternal factors and under-five mortality

A total of 594 births were captured in the survey (Tables 2 and 3). Of these, 141 (23.7%) had died before age five prior to the survey. Most of these deaths, 38% (57 deaths/93 live births) were observed among mothers between 21–34 years followed by 25.3% (56 deaths/165 live births) among mothers below 20 years while12.6% (28 deaths/195 live births) occurred among mothers above 35 years. Maternal age significantly influenced under-five mortality ($P < 0.0001$). Similarly, 32.5% (66 deaths/137 live births) of U5M occurred among married mothers while 19.2% (75 deaths/316 live births) died to single mothers. About 19.9% (76 deaths/306 live births) under-fives in polygamy unions experienced deaths while 30.7% (65 deaths/147 live births) deaths occurred among under-fives in monogamous union. Marital status and type of marriage were found to statistically influence U5M ($P < 0.0001$ and $P = 0.003$ respectively). Birth order slightly influenced U5M ($P = 0.049$) with most deaths; 29.5% (46 deaths /110 live births) experienced among under-fives with lower birth order of 3 and below while 21.7% (95 deaths/343 live births) died to under-fives of higher birth order of 4 and above. Longer preceding birth intervals of 2 years among under-fives experienced 33.7% (60 deaths/118live births) deaths while 19.5% (81 deaths/335 live births) deaths occurred among siblings of shorter birth intervals of < 2 years. The relationship between birth intervals and U5M was statistically significant at $P < 0.0001$.

Table 2
Maternal factors influencing U5M in Karemo Sub-County (n = 594)

N (%) with characteristic in study groups[a]				Associations with U5M	
Variables	Live births (%)	Deaths (%)	*P-value*	OR (95%CI)[b]	*P-*value
Maternal age					
< 20 years	165 (74.7)	56(25.3)	**< 0.0001**	1.00	
21–34 years	93 (62.0)	57(37.7)		0.489 (0.282–0.846)	**0.011**
35–49 years	195 (87.3)	28 (12.6)		2.484 (1.249–4.940)	**0.009**
Marital status					
Single	316 (80.8)	75 (19.2)	**< 0.0001**	1.00	
Married	137 (67.5)	66 (32.5)		0.382 (0.218–0.669)	**0.001**
Birth Interval					
< 2years	335 (80.5)	81 (19.5)	**0.001**	2.079 (1.240–3.485)	**0.005**
> 2 years	118 (66.3)	60(33.7)		1.00	
Birth order					
< 3 births	110 (70.5)	46(29.5)	**0.049**	1.00	
4 + births	343 (78.3)	95 (21.7)		5.442 (2.789–10.620)	**< 0.0001**
Type of marriage					
Monogamous	147 (69.3)	65 (30.7)	**0.003**	1.00	
Polygamous	306 (80.1)	60 (16.5)		3.370 (1.922–5.910)	**< 0.0001**
Religion					
Christian	445 (75.1)	141 (24.1)	0.112	-	-
Muslim	8.(100.0)	0.(0.0)		-	

[a]Data presented as n (%) unless stated otherwise. Data analysis was performed using Chi-square analysis. [b]Data analysis was performed using binary logistic regression model. **Bold** font shows *P-*values considered significant at *P* < 0.05.

N (%) with characteristic in study groups[a]				Associations with U5M	
Variables	Live births (%)	Deaths (%)	*P-value*	OR (95%CI)[b]	*P-value*
Maternal age					
Place of the delivery					
Hospital	297 (73.9)	105 (26.1)	**0.048**	**1.00**	0.372
Home	156 (81.2)	36 (18.8)		1.298 (0.732–2.303)	
Distance to the nearby hospital					
< 3KM	223 (80.5)	54 (19.5)	**0.042**	**1.00**	
3-5KM	104 (69.8)	45 (30.2)		0.659 (0.366–1.187)	0.659
> 5KM	126 (75.0)	42 (25.0)		0.219 (0.110–0.435)	**0.001**

[a]Data presented as n (%) unless stated otherwise. Data analysis was performed using Chi-square analysis. [b]Data analysis was performed using binary logistic regression model. **Bold** font shows *P*-values considered significant at $P < 0.05$.

Table 3
Maternal factors influencing U5M in Karemo Sub-County (n = 594)

N (%) with characteristic in study groups[a]				Associations with U5M	
Variables	Deaths (%)	Live births (%)	P-value	OR (95%CI)[b]	P-value
Education level					
Primary	270(81.8)	60 (18.2)	**0.002**	1.00	
Secondary	120 (70.2)	51 (29.8)		0.382 (0.220−0.664)	**0.001**
Tertiary	63 (67.7)	30 (33.3)		0.408 (0.144−0.560)	**0.009**
Occupation					
None	116(62.7)	69 (37.3)	**< 0.0001**	1.00	
Farming	122 (78.7)	33 (21.3)		2.196 (1.190−4.053)	**0.012**
Business	152 (86.9)	23 (13.1)		5.639 (2.871−11.077)	**< 0.0001**
Employed	63 (79.7)	16 (20.3)		3.505(1.657−7.414)	**0.001**
Autonomy					
Autonomous	321 (75.0)	107 (25.0)	0.245	-	-
Not −autonomous	132 (79.5)	34 (20.5)		-	-
Monthly Income					
None	173 (76.9)	52 (23.1)	**0.048**	1.00	
<KSh.. 4,999	193 (80.4)	47 (19.6)		1.036 (0.546−1.966)	0.913
KSh.. 5,000−10,000	48 (67.6)	23 (32.4)		0.553 (0.259−1.184)	0.127
>KSh.. 10,000	39 (67.2)	19 (32.8)		0.443(0.198−0.994)	**0.048**
Quality of care					
Poor	66 (76.7)	20 (23.3)	0.370	-	-
Fair	208 (78.8)	56 (21.2)		-	-
Good	164 (72.6)	62 (27.4)		-	-
Excellent	15 (83.3)	3 (16.7)		-	-

[a]Data presented as n (%) unless stated otherwise. Data analysis was performed using Chi-square analysis. [b]Data analysis was performed using binary logistic regression model. **Bold** font shows P-values considered significant at $P < 0.05$.

Children born to mothers who had attained tertiary levels of education experienced more deaths, 33.3% (30 deaths/63live births) followed by those whose mothers had secondary education levels 29.8% (51 deaths/120live births) while 18.2% (60 deaths/270 live births) died to mothers who had attained primary education levels alone. The proportions of the education levels were statistical significant, $P = 0.002$. Moreover, maternal occupation was significantly proportioned to U5M at $P < 0.0001$. Under-fives of housewives or students experienced37.3% (69 deaths/116 live births) deaths followed by those whose mothers are farmers 21.3% (33 deaths/122 livebirths). Moreover, about 20.3% (16 deaths/63 live births) under-fives died of employed mothers while 13.1% (23 deaths/152 live births) under-fives died of mothers engaged in businesses, ($P = 0.048$). More deaths; 32.8% (19 deaths/39 live births) were observed among under-fives whose mothers had a monthly income of KSh.10, 000 and above followed by 32.4% (23 deaths/48 live births) among those whose mothers had a monthly income between KSh. 5000 to 10,000. In addition, about 23.1% (52 deaths/173 live births) deaths occurred to mothers with no income at all while 19.6% (47 deaths/193 live births) deaths occurred to mothers who had a monthly income of less than KSh. 5000.

Concerning place of delivery, about18.8% (36 deaths/156 live births) of U5s died of mothers who delivered at home while 26.1% (105 deaths/297 live births) died of mothers who delivered at the hospital. Place of delivery had a slight significant influence on U5M at $P = 0.048$. Distance covered to the nearby hospital, was slightly associated with U5M ($P = 0.042$). Under-fives whose mothers lived below the perceived 3 KM radius from the hospital experienced 19.5% (54 deaths/223 live births) deaths, followed by 25.0% (42 deaths/126 live births) among those whose mothers lived above the perceived 5 KM radius while 30.2% (45 deaths/104 live births) occurred among those whose mothers lived between the perceived 3−5 KM radius. Religion of the mother ($P = 0.112$), perceived quality of care ($P = 0.370$) and maternal financial autonomy ($P = 0.245$) did not show any significant associations with U5M.

Association between maternal factors and under-five mortality

Maternal age (Tables 2 and 3), significantly impacted under-five mortality. Under-fives of older mothers (35−49 years) were twice more likely to die before age five (OR = 2.484; 95%CI: 1.249−4.940, $P = 0.009$) compared to those born to younger mothers (< 20 years). However, under-fives born to mothers between the age of 21−34 years were 52% (OR = 0.489; 95%CI: 0.282−0.846; $P = 0.011$) less likely to experience deaths compared to those born to mothers of < 20years.

The probability of under-fives of higher birth order of ≥ 4 dying before age five was five times compared to their counterparts of lower birth order of ≤ 3 (OR = 5.442;95% CI: 2.789−10.620; $P < 0.0001$). Marital status also had significant impact on U5M, with under-fives of married women being 61% less likely to experience U5M compared to those of single mothers (OR = 0.382; 95%CI: 0.218−0.669; $P = 0.001$). Moreover, polygamous union were three times more likely to experience U5 deaths compared to monogamous union (OR = 3.370; 95%CI: 1.922−5.910; $P < 0.0001$). Furthermore, under-fives of short birth

intervals of < 2 years were twice more likely to die compared to their counterparts with longer birth intervals of > 2years (OR = 2.079; 95%CI: 1.240−3.485, P = 0.005).

Level of maternal education also had significant effect on U5M. Children born to mothers who had attained tertiary education were about 60% less likely to die compared to those born to mothers who had attained primary levels of education alone (OR = 0.408; 95%CI: 0.208-0.800, P = 0.009) while those with secondary education were 62% less likely to die compared to those born to mothers who had attained primary levels of education alone (OR = 0.382; 95%CI: 0.220−0.664, P = 0.001). In addition, maternal occupation had significant influence on U5M (P < 0.0001). Children born to mothers who were engaged in farming, small scale business and those of the employed mothers were 2.1 (OR = 2.196; 95%CI: 1.190−4.053; P = 0.012), 5.6 (OR = 5.639; 95%CI: 2.871−11.077; P < 0.0001) and 3.5 (OR = 3.505; 95%CI: 1.657−7.414; P = 0.001) times more likely to experience death compared to those whose mothers who had no form of employment (students, housewives). In contrast, maternal income, place of delivery and distance to the health facility were not associated with U5M, however, within the cohorts of maternal income, higher survivorship was observed among children whose mothers had an income of KSh. 10,000 and above (OR = 0.443; 95%CI: 0.198−0.994; P = 0.048) as compared to children born to mothers with no income at all.

Place of delivery was not statistically associated with U5M.The odds however, revealed that home deliveries were 1.298 (OR = 1.298; 95%CI: 0.732−2.303; P = 0.359) times more likely to die compared to hospital deliveries. Lastly, distance to the hospital was insignificantly associated with U5M. Though, the odds revealed that children born far above 5 kilometers had a 78% survivorship rate (OR = 0.219; 95%CI: 0.110−0.435; P < 0.0001) similar to those born between 3−5 kilometers radius which had a 35% survivorship rate (OR = 659; 95%CI: 0.366−1.187; P = 0.659) as compared to those born within the 3 KM radius to the nearby health facilities.

Discussion

We determined the influence of maternal socio-demographic, socio-economic and health seeking behaviour on U5M in Karemo Sub-County, Siaya County in Kenya. Our results revealed that maternal age at birth was significantly associated with U5M. Higher likelihood of deaths was observed among children born to older mothers above 35years of age as compared to those born to mothers below 20 years. As evident in previous studies [4, 21−23], older women may experience old age-related complications during pregnancy and delivery and thus may lack adequate knowledge to access better health services for their children. Contrastingly, other studies [22, 24], claim that relatively younger mothers are likely to experience more U5M compared to the older cohorts because of biological reasons such as immature reproductive system and lack of decision-making experience and authority. Accordingly, previous studies suggest that younger mothers may not be socially and psychologically mature enough to deal with the requirements of infant and childcare, or they may lack the domestic decision-making authority that older mothers possess. The observed change of trend in which U5M was reduced in younger women in this study could be attributed to increased knowledge acquisition among young mothers than older mothers with regard

to child health probably due to increased access to information. Since they are more knowledgeable, the younger mothers are able to translate the knowledge for the betterment of the child's survival. This observation is supported by another study revealing the value of high literacy levels of above 92% among young mothers [7].

Short period preceding birth interval of less than 2years was significantly associated with U5M.This finding was supported by other previous studies which highlighted a three-fold possibility [4, 25–27]. First, women with short birth interval tended to have multiple pregnancies, thus have insufficient time to restore their nutritional reserves, a situation which is thought to adversely affect fetal growth. Secondly, due to high parity which is characterized by short birth intervals, there might be economic, emotional and other burdens affecting the mothers that may influence the child's survival. Further, competition among siblings for resources was also considered a plausible reason associated with under-five mortality [28].These factors could have collectively contributed to the observed U5M associated with parity in the current study.

We further observed that married women were less likely to experience U5M compared to single mothers. This was consistent with previous studies, which revealed that children born to married women had higher survivorship compared to children that are singly-parented [4, 15, 29]. The possible reason being married women may receive moral and emotional support from their husbands during antenatal through to postnatal care which can reduce risk of child mortality. Importantly, marriage may also confer advantages such as pooling of resources to either patronize good health services or provide adequate care with respect to providing good nutrition to infants and children [15]. Contrarily, other authors argued that single mothers are more autonomous and therefore are able to frequently visit health facilities when the child is sick [29]. However, this might also depend on the economic ability of the mother to access these services for the betterment of the child.

In the current study, higher birth order above 3 was associated with under-five mortality. As supported by other workers [4, 30, 31], the possible reasons might be due to multiple pregnancies which in turn deplete a woman nutritional resource and straining of her reproductive system; hence children of higher orders might be born with low birth weight or might be malnourished due to competition among siblings. Moreover, there might be financial or economic constrains earlier on stated, which may compound further the state of the child and hamper them from gaining quality health services or eating balanced diet [15]. The author further argues that in resource-poor settings similar to our study site, there is the aspect of financial or economic constrains that might be associated with higher birth order or parity hence children born with higher birth order are more likely to die due to inadequate finances or resources to seek quality service or balance diet. On the contrary, other authors found no influence of birth order on child mortality [32, 33].

Polygamous marriages had higher probability of under-fives deaths compared to those of monogamous marriage [5, 13, 15]. Our observation was that in our set-up, women in polygamous marriages tend to be the sole breadwinner of their households. Their husbands only provide a little of resources needed but the

sole burden is bore by them. Thus, the mothers are forced to leave their infants at home to search for job for their upkeep and for the well-being of their children. This finding was consistent with another study done in rural parts of Ghana [15],which claimed that women in rural areas are likely to be unemployed and often tend to rely on the little resources that are provided by their husbands. Thus, women in polygamous marriages will be double-stretched with regards to resources because the little available resources provided by the husband will have to be shared among more than one wife. Moreover, there are possibilities of neglect by the husband during pregnancy and early child care among women in polygamous unions [15].

We also observed in the current study that maternal level of education is a strong predictor and exerts a positive influence on U5M as previously noted [6]. Similar to previous studies [5, 6, 22, 34], the current study found out that children born to mothers with post-primary education were less likely to die before the age of five compared to those whose mothers had primary levels of education. Educated mothers can easily get access to health information during pregnancy and even identify symptoms of ill health when the child is sick; thus able to gain timely health care [22]. Moreover, educated women may also have economic advantages since some are more likely to be employed and thus are financially-empowered and with ability to translate the health-seeking information [22]. Another author argue that education delays the mother from early marriage and thereafter motherhood hence decreasing the total number of children a woman gives birth to [5]. In addition, educated mothers are more autonomous in making child health decisions and are most likely to seek treatment from well-resourced health facilities [35]. Notably, low levels of maternal education could be a main constraint against child feeding, health seeking and hygiene practices [36]. To crown it all, other investigators brings the concept of the use of contraceptives among highly educated women or women with highly educated partners than the less or un-educated counterparts [37] with regards to U5M.

Maternal occupation was significantly associated with U5M. Mothers that were employed or engaged in subsistence farming and those in small-scale businesses had higher chances of experiencing U5M compared to housewives and students. This finding was in agreement with other several studies done in the past [14, 16, 38, 39]. Previous authors reasoned that non-employed mothers (housewives or students) have enough time to take care of their children compared to those employed who possibly leave their house in the morning and only comes back in the evening for their young ones [38]. This may have substantial effects through lack of proper feeding and particularly breastfeeding in early life of the child[30]. On the other hand, employment brings economic advantage hence employed mothers can get access to better health care services when the child is sick; they are able to get well balanced diet hence nutritionally stable and as such might experience less U5M as compared to women who are housewives or students who totally rely on the income of the husband or guardians, respectively. This notion is in agreement with a previous study, that claimed that work outside home is associated both with modernity and higher family income, both of which will probably increase child's chances of survival [26].

Place of delivery did not show any significant association with under-five mortality. However, the odds revealed higher likelihood of U5M among home deliveries. This finding was in agreement with other

studies done in the developing countries of Nigeria and South Africa [40, 41]. However, other studies have revealed a lower probability of child's death among deliveries that occurs in health facilities as compared to home deliveries [10, 21, 23]. The difference in child survival have largely been driven by the use of skilled delivery care at health facilities as compared to unattended deliveries that occur at home. The observation in previous versus current study may be attributed to the current new policies put in place to train all TBAs on techniques of safe deliveries. Thus, the current TBAs are well trained and have adequate skills to assist mothers in labor at home before referring them to the nearby health facilities. They have also become watchdogs of mothers to ensure that after deliveries mothers must attend clinics. The only challenge with the TBAs might be lack of modern equipment to deal with complicated deliveries as previously noted in other studies [42].

Perceived distance to the nearby health facility was statistically insignificant with under-five mortality. This was contrary to a cross-sectional study which revealed that increase in distance demoralizes the mothers or care givers to take the child to the health facility hence decreases chances of child survival [43]. Another qualitative study done in rural areas of Homa-Bay County, western Kenya also showed that mothers experience a higher financial burden to take their children to the health facility as distance increases [42]. The decline in health care utilization for mothers with U5s with increase in distance is termed as distance decay [43]. Other authors, however, noted that the main problem might not be the physical distance but rather the cost of transport to the health facilities since most of the rural roads to the health facilities may only be accessible by foot or by bicycle. In recent years, such accessibility has been complicated by the emergence of motorbikes, which appear to be expensive and thus not affordable by most mothers [43]. Other studies carried out in poor resource settings of Vietnam and Nigeria also found a higher likelihood of U5M from mothers with transportation difficulties [41, 44]. However, the results between the previous studies and the current study should be translated cautiously due to time differences. There is likely to be several changes within that period occasioned by accessibility to most roads and reduced transport costs within this rural setup.

The current study further revealed that perceived quality of care was not significantly associated with U5M. This was contrary to other studies that link U5M with quality of care. This observation might be due to adequately staffing of health personnel thus the time taken to treat U5s are reduced. Moreover, the government came up with measures where U5s are treated in separate rooms away from other patients within the health facilities. This has reduced the turn-around time between the U5s and the doctors thus reducing deaths-associated long queues particularly at the dispensaries. This contradicts in the previous studies is noted [29], and was shown that there were more deaths at the health facilities due to long queues caused by under staffing of doctors or lack of doctors at the health facilities or the clinicians making hasty examinations thus missing out some relevant information, appropriate for treatments. Moreover, others pointed out that the quality of care in SSA was still very low in poor rural areas [45]. According to other investigators, they noted that U5M could be due to low levels of competence and lower levels of performance on the health care practitioners posted to these facilities [46].

The current study found no association between financial autonomy and under-five mortality. In line with a previous study conducted in Ghana, the possible reason might be the disparity in the definition of the practice of financial autonomy of women in male-headed households [15]. This variable has not been widely researched and the parameters being used vary. The authors further proposed that there should be one standard parameter set for measuring autonomy since different scholars have used several measures ranging from household headship, employment, income or autonomy in decision making with regard to the health of the child. However, financial autonomous women will get access to better health care and nutritionally stable while non-autonomous will only get direction from their husbands or from someone else who controls their finances with regard to seeking health and nutrition [13, 21, 47].

Our study did not find any significant association between maternal income and under-five mortality in the binary regression analysis. However, mothers who had a monthly income is KSh. 5000 and above tends to experience less U5M compared to those that earned below KSh. 4999 or none. This is because of free maternal and child health services in public health facilities in Kenya as a way of accelerating progress of zeroing maternal and child mortality. In addition, women in this setup majorly rely on the income of their husbands since culturally; the husband is the head of the household and should be the sole provider of the family. Thus, other related cost of care such as transport to the health facilities and/or purchase of certain drugs and accessories due to lack of them in public health facilities [42, 43] are met by the income of the husband.

Conclusion

The continued high U5M in Karemo Sub-County of Siaya County, Western Kenya is due to a combination of maternal socio-economic and socio-demographic factors such as the mother's age at childbirth, single marital status and polygamy, high parity, short birth intervals, unemployment and lack of post-primary education. The study therefore recommends pragmatic approaches such as: mobilization and sensitization of all mothers and adolescent girls to accept and use birth control mechanisms which is vital in increasing births spacing and reducing higher birth orders; involvement of mothers in economic empowerment activities in order to increase their monthly income, and, lastly, empowerment of the girl child by providing education beyond primary school level as a priority.

List Of Abbreviations

IGME Inter-Global Agency Mortality Estimation

KDHS Kenya Demographic Health Survey

KEMRI Kenya Medical Research Institute

KNBS Kenya National Bureau of Statistics

KSh Kenya Shillings

MICS Multiple Indicators Cluster Survey

MUERC Maseno University Ethical and Review Committee

SCRH Siaya County Referral Hospital

SDGS Sustainable Development Goals

SPSS Statistical Package for Social Sciences

SSA Sub Saharan Africa

U5M Under-Five Mortality

U5s Under fives

UN United Nations

UNICEF United Nations Children's Fund

WHO World Health Organization

PPS Probability Proportion to Size

TBAs Traditional Birth Attendants

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Maseno University Ethical Review Committee (MUERC: REF: MSU/DRPI/MUERC/00254/15). Informed consent was obtained from respondents that were above 18 years of age while for mothers who were below 18 years, informed consent was obtained from their parents/ legal guardians. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not Applicable

Availability of data and materials

All data generated or analyzed during this study are included

Competing interests

The authors declare that they have *no* competing interests

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