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Survival analysis of time-to-death for under-five children in Somalia: Application of AFT modeling approach

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ABSTRACT

Objectives: Sub-Saharan Africa continues to experience the highest under-five mortality rates globally, contributing 29.7% of all under-five deaths despite a 60% global decline between 1990 and 2022. This study aims to analyze time to death among children under five in Somalia and identify the key factors influencing child survival.

Study design: The data used in this study is a population-based cross-sectional survey using a multistage stratified cluster sampling design.

Methods: In this study, 17,610 children under five from a Somalia 2020 demographic and health survey (DHS) were used. The accelerated failure time (AFT) model was used to analyze the time to death of under-five children. Survival time ratios (TR) and corresponding p-values were used to identify significant determinants of child survival.

Results: Of the total 17,610 children, about 689 children (3.91%) experienced the event (death). Several AFT models were compared, and the Weibull AFT model was selected as the best fit. The results of the Weibull AFT model showed that significant factors that influence child survival include maternal age at the first birth, preceding birth interval, the number of children ever born, and regional disparities. Longer birth intervals (18-59 months) increased survival time for the children, while shorter or excessively long intervals reduced survival. Mothers aged 20-29 at first birth showed a 49.2% increase in survival time (TR = 1.492; p = 0.003), compared to the younger mother. The shape parameter (0.607) suggests a declining hazard rate over time.

Conclusions: This study highlights critical maternal, familial, and regional factors that influence child survival in Somalia. Strengthening targeted interventions, particularly those promoting optimal birth spacing and supporting younger mothers, may substantially improve under-five children survival outcomes.

1. Introduction

Child health is of great importance to demographers and health professionals and indicates the growth of families, societies, and the world in general [1,2]. Approximately 9.7 million newborns and under-five children die each year, with mortality rates and trends for

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under-five children varying widely between local and international locations [3]. The findings state that the global death rate for under-five children has decreased more than at any other point in the past 20 years, from 53% in the 1990s to 43% in 2015 [4,5]. An estimated 9 million under-five children died in developing countries in 2015, accounting for more than 80% of all deaths worldwide. Most of these deaths were from readily preventable diseases such as malaria, pneumonia, and diarrhea [2]. If the reduction in mortality stalls, the existing high mortality will persist, and approximately 94.4 million children are projected to die between birth and exactly 5 years of age from 2016 to 2030 [2,6].

The sub-Saharan Africa region still has the highest mortality rate, accounting for 29.7% of all under-five children's deaths worldwide, although the global under-five mortality rate decreased by 60% between 1990 and 2022. Furthermore, a recent study conducted in different countries (Tanzania, Burundi, Rwanda and Ethiopia) discovered that socioeconomic demographic conditions and the quality of life of mothers and children, as well as environment and behavior, impacted child survival [7–9]. In African nations, the mortality rate for under-five children is still high at approximately 80 per 1000 live births, which is seven times higher than in the European Region. It is also important to develop various strategies to promote the Sustainable Development Goals. By 2030, the Sustainable Development Goals seek to eradicate avoidable infant and young child mortality. Although all these strategies and efforts are undergoing under-five mortality continues to be a serious public health concern in Somalia [10].

Globally, although most countries are on track to meet the Sustainable Development Goals target of at least 25 deaths per 1000 live births by 2030, African countries still will need to double their effort in the annual decline rate to achieve the anticipated plan [11]. The child survival remains urgent, and as recently as 2013, more than 17,000 under-five children perished per day, showing that much work remains [12]. According to estimates, the highest mortality rate occurs in Somalia, where the majority of deaths are caused by internal conflict and in rural areas [4,13]. Despite worldwide efforts to lower the mortality rate for under-five children, socio-demographic issues, substandard living circumstances, and a lack of access to quality healthcare have resulted in high mortality rates in sub-Saharan Africa, especially in Somalia. Previous studies in East Africa (for example, Rwanda, Burundi, Tanzania and Ethiopia) identified key factors such as maternal health, environment, and behavior, but specific information from Somalia remains limited [2,5,7,8,14,15]. This study tried to fill this gap by analyzing time-to-death and its predictors among Somali under-five children using parametric PH and AFT models. In contrast to previous studies, it concentrates on maternal variables and Somalia's particular geographical disparities, providing useful data to inform initiatives and aid in the Sustainable Development Goals to end preventable infant deaths by 2030.

2. Methods

2.1. Study Design and data sources

The data source for this study is the Somalia 2020 Health and Demographic Survey [16]. This standard demographic and health survey is a nationally representative and population-based cross-sectional survey, and the details of the recorded data were accessed at https://microdata.nbs.gov.so/index.php/catalog/50/get-microdata.

2.2. Population and samples

The source population consisted of all live births in Somalia that occurred five years prior to the survey and involved children under-five years of age. The 2020 standard SHDS birth record file was where the data was taken. The study included 17,610 children under five years of age who met the inclusion and exclusion criteria from the 19,391 survey sample [16].

2.3. Data management and statistical analysis

Data cleaning and management were conducted using STATA, while all statistical analyses were performed using R software. Both non-parametric and parametric survival analysis methods were applied. Preliminary analyses involved estimating survival probabilities using standard non-parametric approaches. Parametric survival models were then fitted to the data, and results were compared across different candidate models [17,18]. Two main classes of models were evaluated Cox proportional hazards (PH) models and Accelerated Failure Time (AFT) models to assess their suitability for the dataset. Statistical significance was evaluated at the 5% level [19–21]. In the univariate analysis, a 25% screening threshold was used to ensure that potentially important predictors were not excluded early. This follows survival modeling recommendations that advise using relaxed inclusion criteria (around 20–25%) during initial variable selection before building the final multivariable model [22].

2.4. Model selection criteria

The popular method for comparing parametric PH and AFT models with different underlying distributions is the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). In both methods, the decision was taken based on the lowest AIC or BIC value [23,24].

3. Results

Table 1 shows that out of the total 17,610 children, 689 (3.91%) died before their fifth birthday. The study further shows variations in child death proportions across background characteristics. Urban areas had a higher proportion of deaths (1.86%) compared to rural (0.98%) and nomadic (1.07%) populations. Mothers with no education experienced a higher child death rate (3.27%) than those with primary (0.52%) or secondary (0.13%) education. Households using unimproved water sources had a slightly higher proportion of child deaths (1.96%) than those using improved water sources (1.95%). The poorest households had the highest proportion of child deaths (1.71%), compared to middle (0.87%) and richer (1.33%) households. Households with more children ever born also had a higher proportion of child deaths (1.26%). By birth interval, shorter intervals showed higher death rates (1.26%), whereas longer intervals showed lower deaths (0.23%), with the highest death observed among children with birth intervals of 60 months or more (1.41%) (see Table 1).

The median survival time of under-five children is presented in the Kaplan-Meier survival plot and shows that the median survival time is found to be 12 months (Fig. 1).

In this study we first tested the proportional hazard assumption and found that some of the factors do not fulfill the cox proportional hazard assumptions.

To select variables for the final model, a univariate Cox proportional hazards (PH) regression was performed for each potential risk factor. Factors that were statistically significant in the univariate analysis were included in the multivariate model to identify predictors associated with time to child death. Model comparison using the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) showed that the Weibull AFT model provided the best fit, with the lowest AIC (7496.532) and BIC (7737.596) among all models evaluated. This indicates that the Weibull AFT model is the most appropriate for capturing the underlying survival patterns in the data (see Table 2).

The accelerated failure time (AFT) model is an alternative to the Cox PH model when the PH assumption is violated. The AFT model can be used to express the magnitude of effect in a more accessible way in terms of the difference between treatments in survival time. Among the

Table 1
Summary of factors associated with under-five mortality.

Variables	Categories	No of child Death (%)	Total (%)
Place of residence	Urban	327 (1.86%)	7322 (41.58%)
	Rural	173 (0.98%)	4817 (27.35%)
	Nomadic	189 (1.07%)	5471 (31.07%)
Highest educational level	No Education	575 (3.27%)	14,781 (83.94%)
	Primary	91 (0.52 %)	2106 (11.96%)
	Secondary and above	23 (0.13%)	723 (4.11%)
Sex of household head	Male	464 (2.63%)	11,989 (68.08%)
	Female	225 (1.28%)	5621 (31.92%)
Age of household head	Less than 20 years	118 (0.67%)	3532 (20.06%)
	20-40 years	250 (1.42%)	6372 (36.18%)
	greater than 40 years	321 (1.82%)	7706 (43.76%)
Source of drinking water	Improved water	344 (1.95%)	9674 (54.93%)
	Unimproved water	345 (1.96%)	7936 (45.07%)
Wealth quintile	Poor	301 (1.71%)	7872 (44.70%)
	Middle	153 (0.87%)	3553 (20.18%)
	Rich	235 (1.33%)	6185 (35.12%)
Total number of children ever born	0-2	149 (0.85%)	3199 (18.17%)
	3-4	179 (1.02%)	5556 (31.55%)
	5-6	139 (0.79%)	4363 (24.78%)
	7 and above	222 (1.26%)	4492 (25.51%)
Age of respondent at 1st birth	≤19	406 (2.31%)	9585 (54.43%)
	20-29	256 (1.45%)	7614 (43.24%)
	30-49	27 (0.15%)	411 (2.33%)
Current marital status	Married	628 (3.57%)	16,156 (91.74%)
	Divorced	49 (0.28%)	999 (5.67%)
	Widowed	12 (0.07%)	455 (2.58%)
Preceding birth interval	<18	222 (1.26%)	4315 (24.50%)
	18-35	178 (1.01%)	6920 (39.30%)
	36-59	40 (0.23%)	2440 (13.86%)
	≥60	249 (1.41%)	3935 (22.35%)
Place of delivery	Home	547 (3.11%)	14,012 (79.57%)
	Health center	142 (0.81%)	3598 (20.43%)
Region	Awdal	39 (0.22%)	783 (4.45%)
	Woqooyi Galbeed	41 (0.23%)	1164 (6.61%)
	Togdheer	68 (0.39%)	1208 (6.86%)
	Sool	66 (0.37%)	1335 (7.58%)
	Sanaag	56 (0.32%)	1436 (8.15%)
	Bari	41 (0.23%)	1044 (5.93%)
	Nugaal	42 (0.24%)	1028 (5.84%)
	Mudug	40 (0.23%)	1022 (5.80%)
	Galgaduud	39 (0.22%)	945 (5.37%)
	Hiraan	22 (0.12%)	865 (4.91%)
	Middle Shabelle	31 (0.18%)	913 (5.18%)
	Banadir	43 (0.24%)	2005 (11.39%)
	Bay	29 (0.16%)	420 (2.39%)
	Bakool	50 (0.28%)	1186 (6.73%)
	Gedo	33 (0.19%)	1106 (6.28%)
	Lower Juba	49 (0.28%)	1150 (6.53%)

candidate variables in this study, residence, water source, total number of children ever born, age of the household head, age at first birth, preceding birth interval, and region were selected for inclusion in the multivariable Weibull AFT model. These variables were identified based on univariate analyses, applying a 25% significance level for preliminary screening.

The Accelerated Failure Time (AFT) model with a Weibull distribution reveals significant factors influencing child survival times. The analysis identifies the total number of children born, age at first birth, preceding birth interval, and the region as statistically significant predictors of child survival time at a 0.05 significance level. The adjusted time ratio (ATR) indicates the effect of these factors on survival, with an ATR greater than 1 linked to longer survival and an ATR less than 1 indicating shorter survival times. Households with 3-4 children have an adjusted time ratio (ATR) of 1.670, indicating a 67% increase in child survival time compared to those with fewer children [ATR = 1.670, 95% CI: 1.140, 2.448]. Mothers who had their first birth between ages 20-29 have a ATR of 1.510, showing a 51% increase in survival time [ATR = 1.510, 95% CI: 1.165, 1.959]. A birth interval of 18-35 months results in an ATR of 2.795, corresponding to a 2.795 times increase in survival time [ATR = 2.795, 95% CI: 2.002, 3.903], while a 36-59 month results in an ATR of 5.728, equivalent to a 5.728 times increase in survival time [ATR = 5.728, 95% CI: 3.240, 10.124]. Regional analysis reveals that children in Hiraan have an ATR of 3.255, indicating a survival 3.255 times longer [ART = 3.255, 95% CI: 1.362, 7.779], while those in Banadir have an ATR of 3.707, reflecting a survival 3.707 times longer [ART = 3.707, 95% CI: 1.761, 7.803]. Gedo also shows an ATR of 2.254, reflecting a survival more than 2.254 times longer [ART = 2.254, 95% CI: 1.035, 4.910]. The shape parameter is 0.606, suggesting a decreasing hazard function over time, meaning that the risk of child survival time decreases as time progresses (see Table 3).

4. Discussions

The results of the Accelerated Failure Time (AFT) model using a Weibull distribution have revealed several significant factors influencing child survival times in Somalia. Key determinants include the number of children ever born, maternal age at first birth, preceding birth intervals, and regional disparities, which have a significant effect on time to death of children under-five years of age. These findings align with existing literature and highlight the need for targeted public health interventions to improve child survival outcomes. The analysis shows that households with 3-4 children have significantly longer child survival times compared to households with fewer children. In contrast, households with 7 or more children reduce survival time. These findings are consistent with studies that indicate that larger family sizes are often associated with reduced resources per child, leading to higher death rates due to inadequate access to nutrition, healthcare, and parental attention. Limiting the number of children through effective family planning can therefore play a crucial role in improving child survival rates [19].

Maternal age at first birth is another significant predictor of the survival time. Mothers who gave birth for the first time between ages 20-29 showed a 51% increase in the child survival time significantly. On the contrary, those who had their first child at 30-49 experienced a 44.6% reduction in survival time. This suggests that childbearing at an optimal

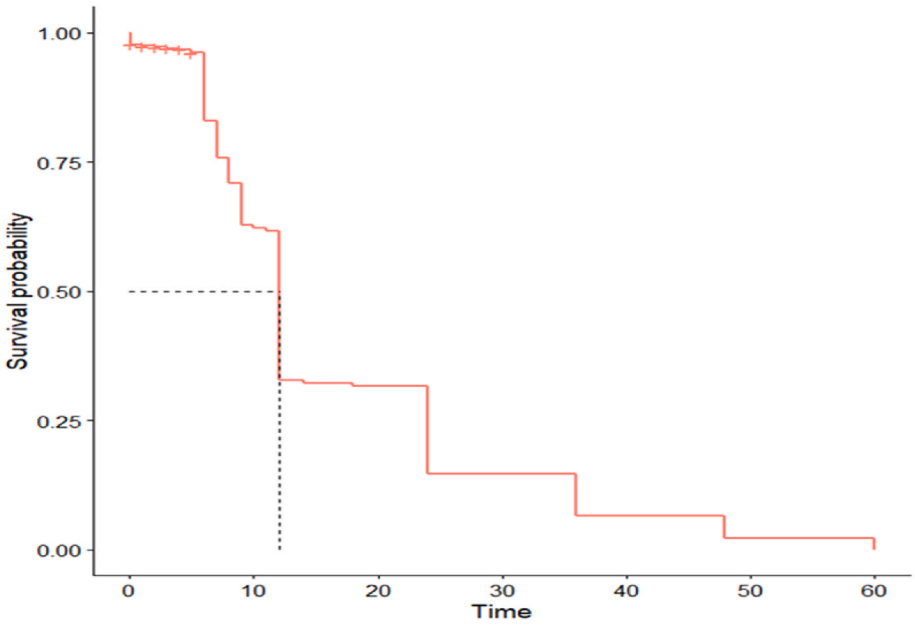

Fig. 1. Kaplan-Meier survival curve for under-five children.

Table 2
Model comparison of information criteria for survival models.

Models	AIC	BIC
Cox PH	11330.280	11555.800
Weibull PH	7496.534	7737.597
Exponential PH	7758.734	7992.021
Gompertz PH	7678.064	7919.127
Weibull AFT	**7496.532**	**7737.596**
Log-normal AFT	7569.101	7810.164
Exponential AFT	7758.734	7992.021
Log-logistic AFT	7524.525	7765.588

age (but not too early) is beneficial to child health, possibly due to better maternal health status and readiness for child care during the optimal reproductive age [20]. Delayed childbearing can come with increased risks, such as pregnancy complications and poor maternal health, which could adversely affect child survival [20].

The preceding birth interval emerged as a significant factor in determining the survival of the child. A birth interval of 18-35 months was associated with a 2.795 times increase in survival time (ATR = 2.795, 95% CI: 2.002, 3.903), while a 36-59 month interval resulted in a 5.728 times increase in survival time (TR = 5.713, $p < 0.001$). This finding underscores the importance of adequate spacing between births, which has been shown to reduce competition for maternal resources and allow better recovery of maternal health [25]. In contrast, intervals of 60 months or more were associated with a 39.1% reduction in survival time (ATR = 0.609, 95% CI: 0.425, 0.873), possibly due to a decline in maternal health and fertility over prolonged gaps [26,27]. Previous studies suggest that optimal birth spacing not only improves child survival but also improves overall maternal health outcomes [28].

Significant regional disparities in child survival were observed. Children in Hiraan, Banadir, and Gedo exhibited substantially longer survival times than those in Awdal, which may reflect differences in socioeconomic conditions, access to healthcare, quality of maternal and child health programs, and regional policy effectiveness. Regions with better healthcare infrastructure, higher maternal education, and accessible reproductive health services likely experience improved child survival, while regions with limited healthcare access and lower socioeconomic status may have lower child survival [29].

Promoting optimal birth intervals (18-35 months) and family planning is crucial to increasing child survival time. Healthcare providers and policymakers should focus on increasing awareness of the benefits of birth spacing and ensuring access to reproductive health services, especially in rural and underserved regions [30]. Furthermore, addressing regional disparities by implementing successful strategies from high-survival regions, such as improved maternal health services, could contribute to achieving equitable child health outcomes across the study area.

4.1. *Strengths and limitations*

The study is based on data from the country's first-ever demographic and health survey, which is a nationally representative population-based study with appropriate weighting, as well as useful, high-quality data on mothers, households, and communities. Furthermore, the study has a large sample size drawn at random across the country, allowing results to be generalized to women of reproductive age. However, several limitations should be noted when interpreting the findings. First, the reliance on retrospective data may introduce recall bias, particularly for variables such as age at first birth or preceding birth interval, which depend on participants' memory. Second, some key confounders that could influence under-five death were not captured in the dataset. These include access to healthcare services (such as proximity to health facilities, availability of skilled birth attendants, immunization coverage, and quality of maternal and child healthcare), maternal comorbidities (including chronic diseases, malnutrition, anemia, or infections), and maternal health-seeking behavior. The absence of these variables may have led to residual confounding in the analysis. Third, the analysis was restricted to the variables available in the dataset, limiting exploration of other potentially relevant factors such as dietary practices, cultural norms, or environmental conditions that may influence child survival. Furthermore, the study did not explore the underlying factors contributing to the observed regional disparities in child survival. While the study identifies significant differences in child death rates across regions, it did not investigate the specific socioeconomic, cultural, environmental, or healthcare-related factors that might explain these variations. Finally, the generalizability of the findings may be constrained by the specific regional and socioeconomic context of the study population.

Table 3
Results of Accelerated Failure Time (AFT) model using a Weibull distribution.

Variables	CTR [95%CI]	ATR [95%CI]	St. error (ATR)
Constant		198.97 (86.63,456.98)	84.41
Residence (ref = Urban)			
Rural	1.366 (1.011, 1.845)	1.044 (0.752, 1.450)	0.175
Nomadic	1.464 (1.093, 1.963)	1.080 (0.784, 1.488)	0.176
Water source (ref = Improved water)			
Unimproved water	0.749 (0.587, 0.955)	0.837 (0.635, 1.103)	0.118
Household head age (ref Less than 20 years)			
20-40 years	0.786 (0.550, 1.122)	0.857 (0.586, 1.254)	0.166
greater than 40 years	0.750 (0.531, 1.057)	0.946 (0.641, 1.396)	0.188
Total Number of children (ref = 0-2)			
3-4	2.778 (1.953, 3.952)	1.670 (1.140, 2.448)	0.326
5-6	3.026 (2.081, 4.402)	1.360 (0.874, 2.116)	0.307
7 and above	1.515 (1.085, 2.115)	0.655 (0.428, 1.003)	0.142
Age of respondent at 1st birth (ref=<19)			
20-29	1.524 (1.180, 1.968)	1.510 (1.165, 1.959)	0.200
30-49	0.552 (0.292, 1.042)	0.554 (0.289, 1.063)	0.184
Preceding birth interval (ref = <18)			
18-35	2.723(1.955, 3.793)	2.795 (2.002, 3.903)	0.476
36-59	5.523 (3.136, 9.726)	5.728 (3.240, 10.124)	1.665
≥60	0.661 (0.491, 0.891)	0.609 (0.425, 0.873)	0.112
Region (ref = Awdal)			
Woqooyi Galbeed	1.652 (0.807, 3.379)	1.694 (0.818, 3.508)	0.629
Togdheer	0.838 (0.441, 1.593)	1.047(0.541, 2.025)	0.352
Sool	0.993 (0.521, 1.893)	1.198 (0.613, 2.341)	0.410
Sanaag	1.425 (0.731, 2.776)	1.702 (0.860, 3.367	0.592
Bari	1.421 (0.695, 2.905)	1.438 (0.690, 2.999)	0.539
Nugaal	1.261(0.620, 2.568)	1.275 (0.610, 2.663)	0.479
Mudug	1.317 (0.641, 2.704)	1.209 (0.575, 2.541)	0.458
Galgaduud	1.237 (0.600, 2.551)	1.351 (0.643, 2.841)	0.512
Hiraan	2.816 (1.197, 6.626)	3.255 (1.362, 7.779)	1.447
Middle Shabelle	1.655 (0.766, 3.574)	1.629 (0.741, 3.580)	0.655
Banadir	3.691(1.809, 7.528)	3.707 (1.761, 7.803)	1.408
Bay	0.504 (0.230, 1.105)	0.567 (0.249, 1.293)	0.238
Bakool	1.214 (0.613, 2.403)	1.400 (0.694, 2.825)	0.502
Gedo	2.278 (1.067, 4.864)	2.254 (1.035, 4.910)	0.895
Lower Juba	1.221 (0.615, 2.423)	1.421 (0.707, 2.855)	0.506
Log(scale)	0.499 (−0.566,-0.432)		
Scale	1.65		
Shape	0.606		

4.2. Conclusions

This study aimed to examine the determinants of the time to death of under-five children. The Weibull AFT model was found to provide the best fit to assess the impact of selected household factors on child survival. The AFT model using a Weibull distribution reveals key factors that affect child survival times. Significant determinants include the number of children ever born, maternal age at first birth, preceding birth intervals, and regional disparities. Households with 3-4 children and mothers who had their first child between the ages of 20-29 are associated with significantly longer child survival times. Furthermore, optimal preceding birth intervals of 18-35 months and 36-59 months are associated with substantial increases in survival rates. On the contrary, having 7 or more children, giving birth later (ages 30-49), and birth intervals of 60 months or more correlate with reduced survival times. Regional analysis shows that children in Hiraan, Banadir, and Gedo exhibit notably higher survival rates compared to other areas. These findings highlight the critical role of family planning and birth spacing in improving child survival. Public health programs should prioritize promoting optimal birth intervals (18-35 months) and increasing maternal awareness of reproductive health. Furthermore, targeted interventions in regions such as Hiraan and Banadir, which exhibit better survival outcomes, could provide valuable strategies for improving conditions in regions with poorer outcomes. More research is needed to investigate the underlying factors that contribute to regional disparities in child survival, which could inform more effective public health strategies.

Ethics statement and consent to participate

This study did not require separate ethical approval because it is based on secondary analysis of publicly available, de-identified data from the Somalia Health and Demographic Survey (SHDS) 2020. The dataset contains no personal identifiers, and all information was collected in accordance with ethical standards established by the survey's implementing institutions. Permission to access and use the data was obtained from the DHS Program. Since no direct contact with participants occurred and no identifiable information was used, additional ethical clearance was not necessary.

Consent for publication

Not applicable.

Availability of data and materials

The data used in this study is from demographic and health survey data and can be accessed at https://microdata.nbs.gov.so/index.php/catalog/50/get-microdata. The dataset is publicly available and can be accessed for research purposes.

Authors' contribution

DBB, MDY and AAM analyzed and drafted the manuscript. SAY, MIA, JM, NAB, TZN, ATB and KDF reviewed the draft and contribute in revising the draft. D.G.C. and YAS critically reviewed the manuscript and follow ups all the steps. All authors read and approved the final manuscript.

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Declaration of competing interest

Denekew Bitew Belay, Minilik Derseh Yismaw, Ashefet Agete Mengste analyzed and drafted the manuscript. Seyifemickael Amare Yilema, Mahad Ibrahim Ali, Jama Mohamed, Nigussie Adam Birhan, Teshager Zerihun Nigussie, Yegnanew A Shiferaw, Alebachew Taye

Belay, Kenaw Derebe Fentaw reviewed the draft and contribute in revising the draft. Ding-Geng Chen and Yegnanew A Shiferaw critically reviewed the manuscript and follow ups all the steps. All authors read and approved the final manuscript. All authors read and approved the final manuscript and all the authors declare that they have no conflict of interest. We the authors also declared that this manuscript is original, has not been published before and not currently considered for publication elsewhere.

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List of abbreviations

AFT	Accelerated failure time
DHS	Demography and Health Survey
UNICEF	United Nations International Children's Emergency Fund

References

[1] M. Acheampong, C. Ejiofor, A. Salinas-Miranda, An analysis of determinants of under-5 mortality across countries: defining priorities to achieve targets in sustainable developmental goals, Matern. Child Health J. 21 (2017) 1428–1447.
[2] D. You, et al., Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN inter-Agency group for child mortality estimation, Lancet 386 (10010) (2015) 2275–2286.
[3] Unicef, Levels and Trends in Child Mortality, 2021.
[4] W.H. Organization, Trends in Maternal Mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/population Division, World Health Organization, 2023.
[5] J.W. McGuire, Basic health care provision and under-5 mortality: a cross-national study of developing countries, World Dev. 34 (3) (2006) 405–425.
[6] T. Wardlaw, et al., UNICEF report: enormous progress in child survival but greater focus on newborns urgently needed, Reprod. Health 11 (2014) 1–4.
[7] W.G. Alamirew, et al., Prevalence and associated factors of neonatal mortality in Ethiopia, Sci. Rep. 12 (1) (2022) 12124.
[8] B.B. Debelu, D.B. Belay, N.D. Terye, Bayesian multilevel model application on determinants of perinatal mortality in Ethiopia using 2011 and 2016 EDHS data, Ethiopian Journal of Science and Technology 14 (1) (2021) 39–55.
[9] D. Rwanda, *National Institute of Statistics of Rwanda (NISR)[Rwanda], Ministry of Health (Moh)[Rwanda], and ICF International.* Rwanda Demographic Health Surv, vol. 15, 2014.
[10] J.R. Khan, N. Awan, A comprehensive analysis on child mortality and its determinants in Bangladesh using frailty models, Arch. Public Health 75 (2017) 1–10.
[11] United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), Levels & Trends in Child Mortality: Report 2017: Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation, United Nations Children's Fund, 2017.
[12] UNICEF, W.H. Organization, Levels and Trends Child Mortality-Report 2023: Estimates Developed by the United Nations Inter-agency Group for Child Mortality Estimation, 2024.
[13] D.K. Kinyoki, et al., Conflict in Somalia: impact on child undernutrition, BMJ Glob. Health 2 (2) (2017) e000262.
[14] L. Janssen, The Frailty Model, Springer Science+ Business Media, 2008. LLC.
[15] M.R. Nyinawajambo, Survival Analysis of Time to Event Data: an Application to Child Mortality in Sub-saharan Africa Region Using their Demographic and Health Surveys, 2018.
[16] SHDS, Somalia Health and Demographic Survey 2020, 2020.
[17] O.O. Aalen, Survival and Event History Analysis: a Process Point of View, Springer-Verlag, 2008.
[18] D.G. Kleinbaum, M. Klein, Survival Analysis a self-learning Text, Springer, 1996.
[19] J. Cleland, et al., Contraception and health, Lancet 380 (9837) (2012) 149–156.
[20] J.E. Finlay, E. Ozaltin, D. Canning, The association of maternal age with infant mortality, child anthropometric failure, diarrhoea and anaemia for first births: evidence from 55 low- and middle-income countries, BMJ Open 1 (2) (2011) e000226.
[21] S.P. Khanal, V. Sreenivas, S.K. Acharya, Accelerated failure time models: an application in the survival of acute liver failure patients in India, Int. J. Sci. Res. 3 (6) (2014) 161–166.
[22] A. Talebi, et al., Survival analysis in gastric cancer: a multi-center study among Iranian patients, BMC Surg. 20 (1) (2020) 152.
[23] H. Akaike, Fitting autoregreesive models for prediction, in: Selected Papers of Hirotugu Akaike, Springer, 1969, pp. 131–135.
[24] G. Schwarz, Estimating the dimension of a model, Ann. Stat. (1978) 461–464.
[25] S.O. Rutstein, DHS working papers, The DHS Wealth Index: Approaches for Rural and Urban Areas, USAID, 2008.
[26] J. DaVanzo, et al., The effects of pregnancy spacing on infant and child mortality in matlab, Bangladesh: how they vary by the type of pregnancy outcome that began the interval, Popul. Stud. 62 (2) (2008) 131–154.
[27] A. Conde-Agudelo, et al., Effects of birth spacing on maternal, perinatal, infant, and child health: a systematic review of causal mechanisms, Stud. Fam. Plann. 43 (2) (2012) 93–114.
[28] A. Conde-Agudelo, A. Rosas-Bermúdez, A.C. Kafury-Goeta, Birth spacing and risk of adverse perinatal outcomes: a meta-analysis, JAMA 295 (15) (2006) 1809–1823.
[29] M.C. Hogan, et al., Maternal mortality for 181 countries, 1980–2008: a systematic analysis of progress towards millennium development goal 5, The lancet 375 (9726) (2010) 1609–1623.
[30] W.H.O. WHO, WHO Recommendations on Postnatal Care of the Mother and Newborn, World Health Organization, 2014.