

Gender Disparities and Age Trend in Child Survival in Nepal

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Abstract

Purpose Child survival rates are critical indicators of a nation's health and development. Despite significant efforts by the Nepalese Government, child mortality rates remain high compared to neighboring and developed countries. This study examines gender disparities in child survival in Nepal, focusing on different age groups.

Methods This study utilizes data from the Nepal Demographic and Health Survey 2016 to assess survival trends and gender disparities among infants, children under two, and children under five. The analysis aims to identify gender bias in these age groups.

Results The study shows a sharp decline in the survival rate during the first five months for infants, stabilizing for children under two years. However, gender disparities persist, with females consistently having lower survival rates across different age groups. The average survival rates for males were 0.975 for infants, 0.974 for those under 2 years, and 0.966 for those under 5 years. In comparison, the average survival rates for females were 0.967 for infants, 0.966 for those under 2 years, and 0.959 for those under 5 years.

Conclusion Addressing these issues requires targeted interventions to ensure equitable healthcare and nutrition for both boys and girls. Improving maternal education, healthcare infrastructure, and social attitudes towards gender can significantly enhance child survival rates and reduce gender disparities in Nepal. Policymakers and health stakeholders must prioritize equitable access to healthcare and implement injury prevention strategies to improve overall child health outcomes in Nepal.

Keywords: Child age, Gender, Infants, Survival analysis

1 Introduction

Child survival rates are one of the most crucial indicators of a country's health and development. They reveal the nation's capacity to provide nutrition, healthcare, and sanitation to its youngest inhabitants (Stein, 2005). Reducing child mortality is given high priority by the Nepalese Government despite notable progress over the past few decades (Pradhan et al., 2012). The country is facing challenges, and the rate notably exceeds compared that of its neighbors and other developed countries (Timilsina et al, 2019; Timilsina et al, 2023; Paudel et al., 2013). There has been no substantial progress in all forms of child mortality in Nepal in the past few decades (Malla et al., 2011).

Neonatal mortality in Nepal declined from 50 to 21 deaths per 1,000 live births between 1996 to 2016 (NDHS, 2017). However, this trajectory slowed and has remained unchanged until 2022 (NDHS, 2023). While much research has been conducted to identify the determinants of child mortality, very few studies have specifically examined survival rates across different age brackets and gender gaps. Survival rates based on age and gender can be crucial to identify critical periods and prioritizing child health during these critical periods.

The causes of death among children vary with their age (Timilsina et al., 2020; Bryce et al., 2005). Major direct causes of infant mortality are acute respiratory infections such as Pneumonia often resulting from distal factors such as low birth weight, malnutrition and lack of exclusive breastfeeding (Kennedy et al., 2020). For children over one-year-old, major direct causes of death include diarrhea, infections such as malaria, measles and unintentional injury. These are often the result of distal factors such as inadequate attention and care, lack of sanitation and hygiene, lack of safe water and food, poor nutrition and hygiene (Bryce et al., 2005). Therefore, it is important to examine the survival status of children separately at different ages.

Another critical factor is the pervasive issue of gender disparities in child survival rates. Gender bias and discrimination can profoundly affect the survival chances of children, particularly girls, in many parts of the world (UNICEF, 2006). Girls may face disadvantages in terms of access to healthcare, nutrition, and educational opportunities, which can result in higher mortality rates compared to their male counterparts (Kenedy et al., 2020). Gender disparities due to son preference have been documented in many developing countries, low- and middle-income countries (LMICs) leading to detrimental consequences such as discriminatory feeding practices, sex-selective abortions, and mortality (Brunson, 2010; Channon, 2015; Frost et al., 2013; Jayaraman et al., 2009;

Fledderjohann et al., 2022). Despite consistent evidence of strong son preference in Nepal which had led to gender disparities such as poorer investments in prenatal treatment when fetal sex is known (Bharadwaj & Lakdawala, 2013); restricted access to healthcare, (Khera et al., 2013); shorter breastfeeding duration (Hafeez et al., 2017; Jayachandran et al., 2011; Fledderjohann et al., 2014) and lower immunization rates (Pande et al., 2003).

Thus, information on the gender bias in the different age groups is essential as it provides greater insights into the evolving impact of child disparities on child mortality (Iqbal et al., 2018). These findings can guide policy implementation activity for policymakers, policy formation staff and those who are interested in survival trends among infants, under two and under five within different genders.

2 Materials and methods

The data for the study were obtained from the Nepal Demographic and Health Survey 2016 (NDHS 2016) which was the fifth nationally representative comprehensive survey conducted as part of the worldwide Demographic and Health Surveys (DHS) Program in the country (Singh, 2019). The standard format of the survey final report included only a descriptive presentation of findings and trends and did not include analytical methods to ascertain the significance of change and association among variables.

The sample for this study included 5,060 children born in the five years preceding the survey from 3,074 mothers. Among these, 2,024 children were under 2 years of age and 968 were infants. Data were collected by interviewing respondents with a structured questionnaire selected through stratified random sampling methods.

Survival analysis was conducted using the life table function from SPSS version 22. The version allows to estimate survival rate, error and confidence intervals. The advantage of this calculation is that it presents and compare the probability of survival and dying simultaneously. The survival rate of the infants in Nepal was generated based on life table methods across seven different headings: interval in the months, total children in each month, number of total deaths in every month, total lost children in every month, the survival rate of children in each month, error and confidence interval. Under the heading interval, there are two rows; the first row refers to the first half year of life of children and the second row represents the second half year of life of children.

3 Results

3.1 Survival rate of infants

An infant is a child in the earliest stage of life, and this is usually defined as a newborn up to one-year-old (Johnson & Blasco, 1997). Table 1 shows the survival rate of infants in Nepal.

Table 1: Survival rate of infants in Nepal, NDHS 2016

Interval in Months	Total	Deaths	Lost	Survival	Error	[95% Conf. Int.]
0 1	931	18	29	0.9804	0.0046	0.9690 0.9876
1 2	884	3	84	0.9769	0.0050	0.9647 0.9849
2 3	797	1	97	0.9756	0.0052	0.9593 0.9838
3 4	699	2	79	0.9726	0.0055	0.9571 0.9803
4 5	618	1	81	0.9709	0.0058	0.9571 0.9803
5 6	536	0	74	0.9709	0.0058	0.9571 0.9803
6 7	462	0	78	0.9709	0.0058	0.9571 0.9803
7 8	384	0	72	0.9709	0.0058	0.9571 0.9803
8 9	312	0	73	0.9709	0.0058	0.9571 0.9803
9 10	239	0	80	0.9709	0.0058	0.9571 0.9803
10 11	159	0	72	0.9709	0.0058	0.9571 0.9803
11 12	87	0	87	0.9709	0.0058	0.9571 0.9803

It shows that 931 children were born within the last year of the data collection period for the survey (weight not applied for survival function), of whom 18 died in their first six months of life and 29 were lost. In context of life table, "lost" refers to those babies not exposed to half of the risk period, which is three 3 months. Based on this, it can be said that only $(931-(29/2))=917$ children were exposed to the risk of death. Therefore, the survival rate for the first six months of the baby is 917 divided by $(931-18)$ which is 0.9804. A similar method was used for all other survival rate calculations. The fifth row in the table describes the survival rate of the child for different ages. Table 1 also includes the standard error value and cumulative survival function at 95% confidence (Table 1).

Figure 1a presents the infant survival plot showing the duration of survival since birth for all the infants before reaching their first birthday (0–11 months). The proportion of surviving is shown in the Y-axis and the

time in month of survival is shown in the X-axis. From Figure 1a we can observe that there are 2 stages of risk die for the infants. The first stage is 0 to 5 months, and the proportion of surviving is decreasing sharply. Stage 2 is from 5 to 11 months where the proportion of surviving is constant throughout.

The proportion of surviving infants' different sexes is shown in the line graph in Figure 1b. The x-axis represents the time in months and the Y-axis shows the proportion of survival infants. The graph includes three lines: the top line of the graph represents the survival proportion of male infants; the bottom line represents the proportion of survival of female infants and the middle line indicates the average survival proportion for both sexes.

It can be seen from the graph that the proportion of survival for female infants was significantly lower compared to male infants from the first month of life to 11 months. Interestingly, the survival rate for female infants remained constant from four months of age to 11 months indicating no further deaths occurred in this age group during that period. In contrast, the survival rate for male infants stabilized after five months, suggesting that male infants are vulnerable to death for one month longer than female infants in the context of Nepal. Based on the child survival plot, the mortality rate of the infants was calculated per 1000 live births. These mortality rates are presented in **Figure 1b**.

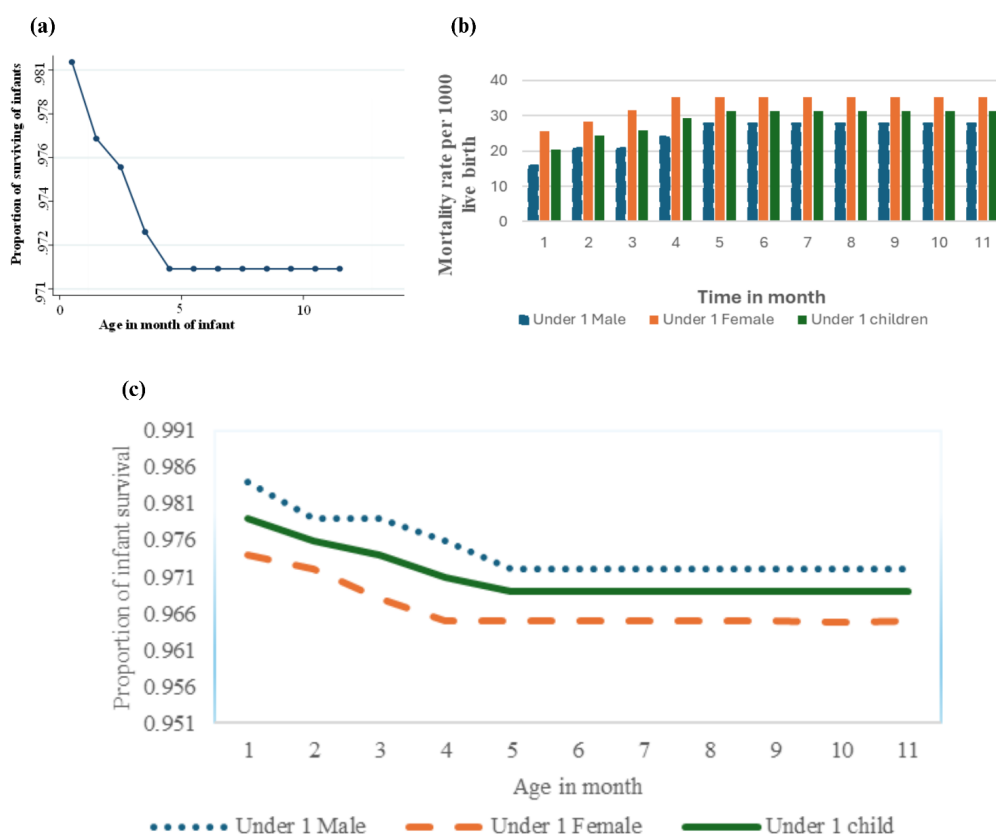


Figure 1: Child survival plot for (a) all children who died before reaching their first birthday, (b) male and female infants mortality rate in Nepal, and (c) mortality rate of male and female infants, covering the period 2012-2016 based on NDHS 2016.

Figure 1c shows the infant mortality rate per 1,000 live births. The x-axis of the bar graph represents the infant's death in time and the y-axis shows the mortality per 1,000 live births. The graph uses three colours to differentiate between male infants under one-year, female infants under one year, and the combined mortality rate for all infants under one year. The graph shows that the mortality rate for female infants is consistently higher than that for male infants across all months. However, the mortality rate of female children remains constant from four months of age to 11 months, indicating there were no further deaths of female infants from four months of age to 11 months.

3.2 Survival rate of under-2 children

The survival rate of under two children in Nepal, it is described using seven categories, similar to those used for infants. These seven categories are: interval in the month, total children in each month, number of total deaths in each month, total lost children in each month, the survival rate of children in each month, error, and confidence interval (**Table 2**).

Table 2: Survival rate of under 2 children, NDHS 2016.

Interval in Months		Total	Deaths	Lost	Survival	Error	[95% Conf. Int.]	
0	1	1,964	18	29	0.9836	0.0029	0.9769	0.9884
1	2	1,903	3	84	0.9809	0.0031	0.9738	0.9862
2	3	1,814	1	97	0.9787	0.0033	0.9712	0.9843
3	4	1,713	2	79	0.9764	0.0035	0.9685	0.9823
4	5	1,630	1	81	0.9752	0.0036	0.9670	0.9813
5	6	1,547	0	74	0.9745	0.0036	0.9663	0.9807
6	7	1,472	0	78	0.9745	0.0036	0.9663	0.9807
7	8	1,394	0	72	0.9745	0.0036	0.9663	0.9807
8	9	1,322	0	73	0.9745	0.0036	0.9663	0.9807
9	10	1,249	0	80	0.9745	0.0036	0.9663	0.9807
10	11	1,169	0	72	0.9745	0.0038	0.9651	0.9800
11	12	1,097	0	87	0.9736	0.0038	0.9651	0.9800
12	13	1,009	0	85	0.9736	0.0038	0.9651	0.9800
13	14	924	0	86	0.9736	0.0038	0.9651	0.9800
14	15	838	0	76	0.9736	0.0038	0.9651	0.9800
15	16	762	0	100	0.9736	0.0038	0.9651	0.9800
16	17	662	0	83	0.9736	0.0038	0.9651	0.9800
17	18	579	0	68	0.9736	0.0038	0.9651	0.9800
18	19	511	0	86	0.9736	0.0038	0.9651	0.9800
19	20	425	0	71	0.9736	0.0038	0.9651	0.9800
20	21	354	0	90	0.9736	0.0038	0.9651	0.9800
21	22	264	0	88	0.9736	0.0038	0.9651	0.9800
22	23	176	0	89	0.9736	0.0038	0.9651	0.9800
23	24	87	0	87	0.9736	0.0038	0.9651	0.9800

From the **Table 2**, 1,964 children were born in the within the last two years of the data collection period for the survey (weight not applied for survival function), of whom 18 died in their first six months of life and 29 were lost. In context of life table, “lost” refers to those babies who were not exposed to half of the risk period, which is three months. Based on this it can be said that only $(1,964 - (29/2)) = 1,950$ children were exposed to the risk of death. Therefore, the survival rate for the first 6 months of the baby is 1,950 divided by $(1,964 - 18)$ which is 0.9836. A similar method was used to calculate all other survival rate. The fifth row in the table describes the survival rate of the child at different ages. The table also include the standard error value and cumulative survival function at a 95% confidence interval (**Table 2**). These survival rates are thoroughly shown in the child survival plot in **Figure 2**.

Figure 2a, presents the child survival plot showing the duration of survival from birth until the second birthday (0–23 months). The y-axis shows the proportion of survival, while the x-axis indicates the time in month. The figure divides the risk of death for children under two into three stages: the first stage from 0 to 5 months, the second stage from 5 to 12 months, and the third stage from 12 to 23 months. The proportion of survival decreases sharply until a child reaches around 5 months of age. However, after five months, the survival rate remains constant until 12 months, after which it decreases slightly and remains stable up to 23 months.

The proportion of surviving of under 2 children for different sexes is shown by the line graph in **Figure 2c**. The x-axis represents the time in months and y-axis shows the proportion of survival of the under 2 children. The graph includes three lines, the top line represents the survival proportion of male children, the bottom line represents the survival proportion of female children, and the middle line indicates the average survival proportion for both sexes. It can be seen from the graph that the survival proportion for the females under 2 children was significantly lower than that of male children from the first month of life to 23 months. Interestingly the survival rate for the female child remains constant from four months of age to 11 months, indicating no further deaths of female children after 8 months of age to 23 months. For male children, the survival proportion becomes constant after ten months, suggesting that male children under two are vulnerable to death for two months longer compared to female children.

Focusing on the child survival plot, mortality rate of the under 2 children was calculated per 1,000 live births. Under 2 mortality rates are rarely calculated as they are usually explained in the context of under 5 children. However, the under-two mortality rate is crucial because the causes of under 2 mortalities are different compared to those of under 5 and under 1 child such as malnutrition and unintentional injury. Therefore, understanding under-two mortality is important for public health professionals developing child health policies. These under two mortality rates are presented in the graph below as **Figure 2b**.

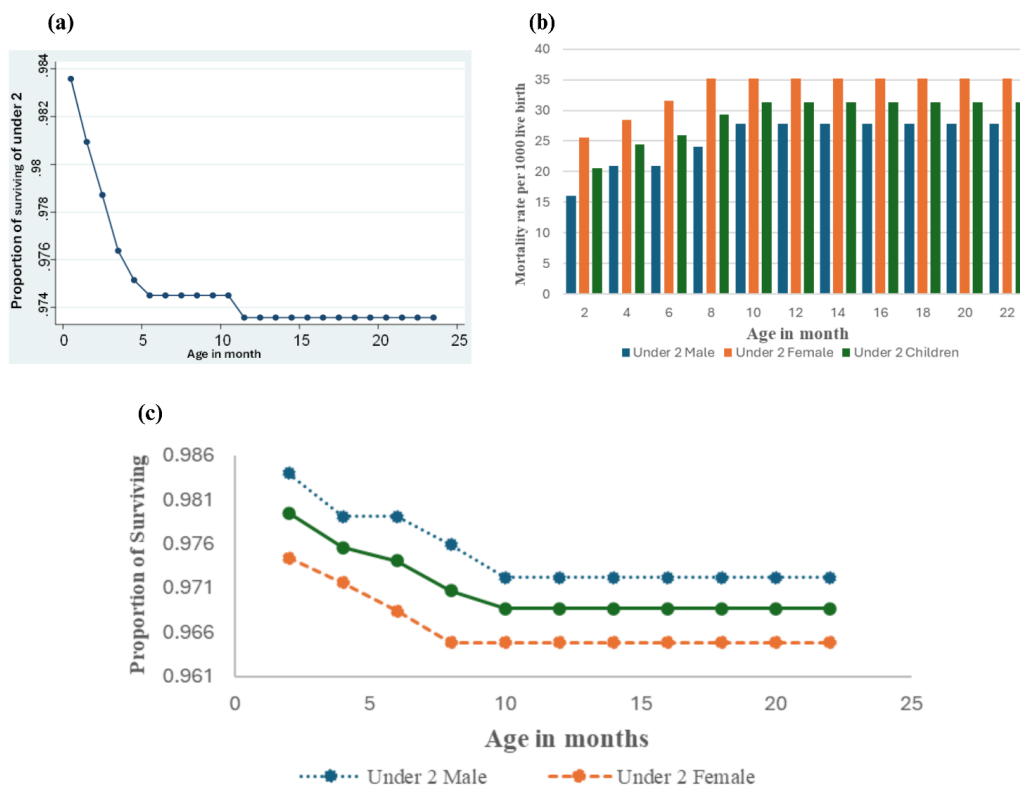


Figure 2: (a) Child survival plot for all children that died before reaching their second birthday, (b) mortality rate of under 2 children and (c) survival plot of male and female under 2 children covering the period 2012-2016 based on NDHS 2016.

The x-axis of the bar graph represents the time of death for children under two, while the y-axis shows the mortality rate per 1,000 live births. The graph uses three colors to represent male infants, female infants, and a combination of both. The bar graph indicates that the mortality rate for female children is consistently higher than that for male children throughout the months. Notably, the mortality rate for female children remains constant from 8 months to 24 months. For male children, the mortality rate stabilizes after 10 months of age. The mortality rate for males under two was around 27 per 1,000 live births, compared to 35 for females. Overall, the mortality rate for children under two was approximately 32 per 1,000 live births.

3.3 The survival rate of under-5 children

The survival rate of under-5 children in Nepal is shown in **Table 3**, covering the period 2012-2016 based on NDHS 2016-17. The tables contain seven headings with their respective explanations. Under the heading “interval”, there are two rows; the first row refers to the first half-year of life and the second row the second half-year of life. It can be seen that 5,038 children were born in the last 5 years (weight not applied for survival function) of whom 150 died in their first six months of life and 444 were lost. The meaning of lost in this life table refers to babies who were not exposed to half of the risk period which is three months. Based on this, it can be said that only $(5,038 - (444/2)) = 4,816$ children were exposed to the risk of death. Therefore, the survival rate for the first 6 months of the baby is 4,816 divided by $(5,038 - 150) = 4,888$ which is 0.9689. A similar method of calculation was adopted for all other survival rate calculations. The fifth row in the table describes the survival rate of the child for different ages (**Table 3**).

The child survival plot showing the duration of survival since birth for all the children before reaching their fifth birthday (0–59 months). The proportion of survival is shown in the y-axis and the time in the month of survival is shown in the x-axis. The risk of death can be observed in 3 stages. The proportion of survival decreases constantly until the child reaches around 2 years of age. After that it remains constant until the child reaches around 3 years, the declines again and remains constant thereafter. The decrease in surviving proportion is quite high in the early life of children but improves as the child grows older (Figure 3).

The proportion of surviving of under 5 children for different sexes is shown in the line graph in Figure 3c. The x-axis of the line graph represents the time in months and the y-axis of the line graph shows the proportion of survival of the under 5 children. The graph includes three lines: the upper line represents the proportion of survival for male children, the lower line represents the proportion of survival for female children, and the

middle line represents the average proportion of survival for both sexes. It can be seen from the graph that the proportion of survival for females under 5 children was significantly lower compared to that of male children from the first month of life to 59 months. Interestingly the survival rate for the female child remains constant from 38 months to 59 months, indicating no further deaths in this age group during this period. For the male children, the survival rate becomes constant after 43 months, suggesting that males under 5 children are 5 months vulnerable to death for five months longer compared to females.

Table 3: Survival rate of under 5 children, NDHS 2016.

Interval in Years	Total	Deaths	Lost	Survival	Error	[95% Conf. Int.]
0 1	5,038	150	444	0.9689	0.0025	0.9635 0.9734
1 1	4,444	11	462	0.9663	0.0026	0.9608 0.9711
1 2	3,971	5	498	0.9650	0.0027	0.9594 0.9699
2 2	3,468	3	511	0.9641	0.0027	0.9584 0.9691
2 3	2,954	6	458	0.9620	0.0028	0.9560 0.9672
3 3	2,490	0	490	0.9620	0.0028	0.9560 0.9672
3 4	2,000	2	535	0.9609	0.0030	0.9547 0.9663
4 4	1,463	0	449	0.9609	0.0030	0.9547 0.9663
4 5	1,014	0	491	0.9609	0.0030	0.9547 0.9663
5 5	523	0	482	0.9609	0.0030	0.9547 0.9663
5 6	41	0	41	0.9609	0.0030	0.9547 0.9663

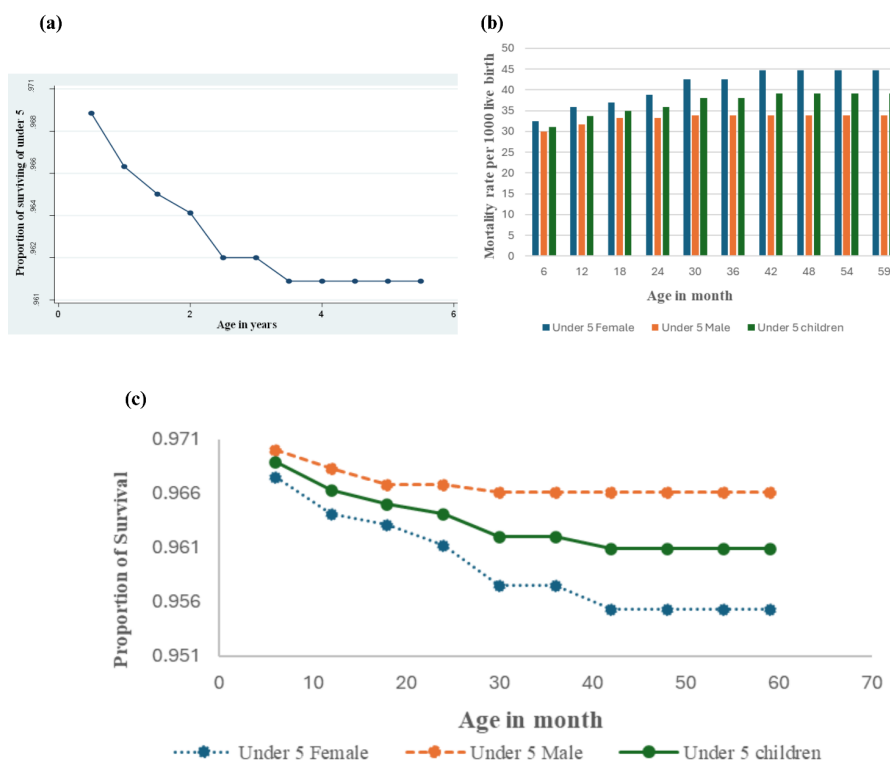


Figure 3: (a) Child survival plot for all children that died before reaching their fifth birthday, (b) mortality rate of under 5 and (c) survival plot of male and female under 5 children covering the period 2012-1016 based on NDHS 2016.

Focusing survival plot of under 5 children, the mortality rate of the under 5 children was calculated per 1,000 live births. These under-5 mortality rates are presented in the graph as **Figure 3b**. The x-axis of the bar graph represents the age in months and the y-axis shows the mortality rate per 1,000 live births. The graph uses three colors to represent the data: under 5 male, under 5 female and combined under 5 category for both sexes. From the figure, it is evident that the mortality rate for female children is consistently higher compared to male children across all months. Specifically, the mortality rate for male children is approximately 34 per 1,000 live births, while for female children, it is about 44 per 1,000 live births by the age of 59 months. The overall mortality rate for children under five is around 39 per 1,000 live births.

4 Discussion

4.1 The infant survival rate in Nepal

The study has shown that birth to the first five months is a high-risk period for the infant and their chances of survival improve significantly afterward. Previous studies have also shown that the survival of infants at the first five months is very crucial due to several reasons. Many women in Nepal have poor maternal health and prenatal care which affects the health condition of both mother and infant. (Pradhan et al., 2010). Similarly, other factors such as infectious diseases (Bhandari & Gurung 2014), malnutrition and feeding practices (Joshi et al., 2012), low birth weight and prematurity (Shrestha et al., 2010) and other socioeconomic factors (Acharya et al., 2016) negatively impact the infant's survival. It is also important to look at the infant survival plot separately for males and females in the context of Nepal. The study has also shown that higher survival rate for male infants compared to females in the first few months. As Nepal is a highly patriarchal Hindu society and son preferences are very high. Therefore, there is chance female children are neglected in their early years of life and may have a higher risk of death. Similar findings were observed by Kenedy et al. (2020), Brunson (2010), Sawyer (2012), Channon (2015), Frost et al. (2013), Jayaraman et al.(2009) and Fledderjohann et al.(2022) different settings. These findings show that the urgency for targeted interventions focused on the first critical months of life, especially for female infants, to improve survival outcomes and reduce gender disparities in infant mortality in Nepal. However, the mortality rate stabilizes for both genders around 5 months, suggesting other factors might influence later infant deaths.

4.2 Survival Rate of Under-2 Children in Nepal

The first and second months, the survival rate slightly declines to 98.09%, and it continues to drop gradually to 97.45% by the fifth month. This early period is critical due to various factors such as birth complications, infections, and inadequate postnatal care. From six months onwards, the survival rate stabilizes at 97.45%, remaining constant up to the twenty-fourth month. This stabilization suggests that once children survive the initial high-risk period, their chances of survival improve significantly, although they remain vulnerable to other health challenges. Globally, the trends in child survival rates are similar, with the highest risk period being the first month of life. According to UNICEF, the neonatal period (the first 28 days) is the most critical, accounting for nearly 47% of all under-five deaths worldwide (UNICEF, 2019). The stabilization observed in Nepal's data after the first few months aligns with global patterns, where the survival rate improves significantly after infancy. In the South Asian context, countries like India and Bangladesh show similar trends. For instance, a study in India found that the neonatal mortality rate was highest in the first month and then gradually declined (Arokiasamy & Gautam, 2008). The proportion of surviving male and female children under the age of two in Nepal showed a distinct trend in survival rates by gender, highlighting potential disparities between male and female children. Gender disparities in child survival rates are a common issue in South Asia. Studies have shown that female children often receive less healthcare and nutritional support compared to male children, leading to higher mortality rates for females (Clark, 2000; Pande, 2003).

In India, similar trends have been observed where female infants have a higher mortality rate compared to male infants due to gender bias in healthcare and nutrition (Arokiasamy & Gautam, 2008). Research in Nepal also indicates that cultural and social factors contribute to gender disparities in child survival. Female children are often disadvantaged in terms of healthcare access and nutritional intake (Frost, Pratt, & Amin, 2013). Fledderjohann & Channon, (2022) in their study highlighted that girls in Nepal are less likely to receive appropriate healthcare compared to boys, contributing to higher mortality rates among female children.

4.3 Survival Rate of Under-5 Children in Nepal

The survival rate of children under five years old in Nepal from 2012 to 2016 showed a gradual decline from birth to five years, highlighting the critical periods and overall trends in child mortality. The survival rates for under-5 children in Nepal are comparable to global trends observed in other low- and middle-income countries. According to UNICEF (2019), under-5 mortality rates have been declining globally, but the highest risk remains in the first few years of life due to preventable causes such as infections, malnutrition, and inadequate healthcare services. Nepal has seen a significant decline in under-5 mortality rates over the past decades, reflecting improvements in healthcare services, maternal education, and child health interventions. However, neonatal mortality remains a critical concern, accounting for a large proportion of under-5 deaths.

The study also showed gender disparities among the males and females of under 5 children. It has shown that female survival rates are consistently lower than male survival rates in the first five years of children. By five years, the survival rate for females drops closer to 95.5%, while males stabilize around 96.5%. India and Bangladesh have shown improvements in under-five mortality rates but continue to face challenges in ensuring equal care for boys and girls. It seems like cultural and social factors play a significant role in these disparities in the developing world.

The analysis of survival rates for infants, children under two, and children under five in Nepal underscores significant gender disparities and critical age trends. Female children consistently face higher mortality risks compared to males, driven by cultural biases, inadequate healthcare, and nutritional disparities. Addressing these issues requires targeted interventions to ensure equitable healthcare and nutrition for both boys and girls. Improving maternal education, healthcare infrastructure, and social attitudes towards gender can significantly enhance child survival rates and reduce gender disparities in Nepal.

5 Conclusion

The analysis of infant, under-2, and under-5 mortality rates in Nepal shows disparities between male and female children. Female children are more vulnerable to death compared to male children in Nepal and the rate of vulnerability is much higher in the initial months of life. For both males and females' vulnerability to die is higher in the initial stage of life. These findings emphasize the urgent need for targeted interventions tailored to address the specific health challenges faced by female infants, particularly during the first critical months of life. Strategies should focus on improving nutrition, enhancing healthcare access, and implementing injury prevention measures to effectively reduce gender disparities in child mortality and promote better overall health outcomes in Nepal. Policymakers and health stakeholders must prioritize these efforts to ensure equitable access to healthcare and sustainable improvements in maternal and child health across the country.

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Conflict of interest

The authors declare that they have no conflict of interest.

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