Exploring the Influencing Factors for Infant Mortality: A Mixed-Method Study of 24 Developing Countries Based on Demographic and Health Survey data

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Abstract

Objective: This study aimed to discover the prevalence of infant mortality and to assess how different factors influence infant mortality in 24 developing countries by utilizing the latest DHS data. Methods: This study used a mixed-method design to assemble cross-sectional studies to integrate data from 24 other countries due to a widening perspective of infant mortality. Most recent available DHS data of 24 different developing countries from the year 2013 to 2019 was used to conduct the study. Descriptive analysis, binary logistic regression model, random-effect meta-analysis, and forest plot have been used for the final analyses. Results: Binary logistic regression model revealed for Bangladesh that, higher education level of fathers (OR: 0.344, 95% CI: 0.147; 0.807), being 2nd born or above order infant (OR: 0.362, 95% CI: 0.248, 0.527), taking ANC (OR: 0.271, 95% CI: 0.192; 0.382 for 1-4 visits), taking PNC (OR: 0.303, 95% CI: 0.216; 0.425) were statistically significant determinants of lowering infant death. While carrying multiple fetus (OR: 6.634, 95% CI: 3.247; 13.555) was exposed as a risk factor of infant mortality. Most significant factors influencing infant mortality for all 24 developing countries were number of fetus (OR: 0.193, 95% CI: 0.176; 0.213), taking ANC (OR: 0.356, 95% CI: 0.311; 0.407) and taking PNC (OR: 0.302, 95% CI: 0.243; 0.375). Conclusion In this study, the number of the fetus, taking ANC and PNC, was the most significant factor affecting the risk of infant mortality in developing countries. So, anticipation and control projects ought to be taken in the field in regard to these hazard factors.

1. Introduction

The infant mortality rate (IMR), characterized as the number of deaths in youngsters under one year of age for every 1000 live births, has been viewed as a profoundly delicate measure of public health[1]. Infant mortality is found to be one of the most significant parts of under-five child mortality as a vulnerable age group for medicinal administrations, which is particularly necessary for the foundation of wellbeing, social prosperity, and endorsement of standard life [2-7]. The mortality rate of infants underneath one year is one of the most deciding indicators of a nation's advancement[8]. In 1990, 9 million children younger than one year died globally. Till 2011 every year, about 4,000,000 infants used to die during the initial month of life, and worldwide neonatal mortality made up 40% of the complete child mortality[9]. About 99% of these deaths occurred in developing countries, particularly in sub-Saharan Africa and South Asia[10-12]. Consequently, decreasing youngster mortality along with the advancement of healthy lives and prosperity for all children has been one of the principles worldwide difficulties in the course of the most recent years, and decreasing it by 66% between 1990 and 2015 has become the fourth Millennium Development Goal (MDG) of the United Nations (UN). Similarly, under sustainable improvement objectives (SDG), the countries expect to diminish preventable deaths of infants to necessarily as low as 12 for every 1,000 live births and under-five youngsters mortality to as low as 25 for every 1,000 live births[13,14]. As a result of the United Nations Millennium

Development Goals (MDGs), where reduction of the infant mortality rate was a key challenge, the rate of infant mortality reduced from 65 fatalities for every 1000 live births to 29 deaths for every 1000 by 2015[15-18]. Nevertheless, an estimate explicated that 6.3 million children died in 2017, in most cases from preventable causes. About 1.6 million of these deaths occurred at age 1–11 months, with 2.5 million deaths happening in the very first month of life. African countries are holding higher IMR rather than developed countries like European countries. Fifty-three infant deaths per 1000 live births in sub-Saharan Africa whereas three infant deaths per 1000 live births in the European Union in 2018[17-19].

Bangladesh is a small south Asian country that is still underdeveloped. Bangladesh has gained tremendous betterment towards youngster wellbeing in the previous decade[20]. In spite of this decrease in newborn child mortality, the level of infant death rate isn't optimal in Bangladesh contrasted with the other developing countries[21]. The infant mortality rate was 38 for every 1000 live births in the year 2014 though it was 43 and 52 in 2011 and 2007 respectively in Bangladesh[22].

Besides, in developing countries, socio-economic condition and health-related factors such as place of residence, education level of parents, wealth index, maternal age at delivery, birth order number, child's size, antenatal care utilization, birth weight, type of infant nutrition, the status of breastfeeding, delivery assistance and many more factors are found to be responsible for the likelihood of infant death[8,23-29].

In this paper, considering the vital facts related to infant mortality, we tried to apprehend the influencing factors of infant mortality in 24 developing countries, including Bangladesh. We introduced a mixed method that was designated to combine data from Bangladesh and 23 other countries, which we think would be more effective to give more insights about infant death than using a simple cross-sectional survey and meta-analysis.

2. Methods

2.1. Design

We applied a mixed-method design to conduct the study. A binary logistic regression (BLR) was conducted for the cross-sectional study of Bangladesh. Afterward, we made a comparison between the results from Bangladesh and the findings of a meta-analysis of 24 developing countries. We could broadly explore the influential determinants of infant mortality by employing this approach. All the data were taken from the Demographic and Health Survey (DHS).

2.2. Data source and data extraction

Demographic and Health Survey (DHS) data is collected using a cross-sectional study design for a large nationally representative sample for every country. Similar questionnaires and the same measures are used to collect the information from the respondent. To select study respondents in most of these surveys, a two-stage cluster sampling design with households in urban and rural strata has been utilized. Detailed information about the sampling and data collection methodology is available on the DHS websites[30]. Initially, for this cross-sectional study, we extracted relevant information for analysis from a nationwide representative secondary dataset, Bangladesh Demography and Health Survey 2014, for binary logistic regression[21]. Besides, we conducted a meta-analysis utilizing the recently accessible datasets (accessed in January 2020) from MEASURE DHS. We adopted the recent available DHS data for the 24 developing countries[16]. Which is Afghanistan (2015), Angola (2015-16), Benin (2017-18), Chad (2014-15), Cambodia (2014), Egypt (2014), Ethiopia (2016), Guinea (2018), India (2015-16), Indonesia (2017), Kenya (2014), Lesotho (2014), Malawi (2015-16), Myanmar (2015-16), Nepal (2016), Nigeria (2018), Pakistan (2017-18), Sierra Leone (2013), South Africa (2016), Tanzania Timor-Leste (2016), Zambia (2013-14), Zimbabwe (2015). The DHS database contains information from 91 countries (http:// dhsprogram.com/data/available-datasets.com); 67 countries were excluded due to excessive missing values and unavailability of information regarding dependent and independent variables in any of the selected countries. Finally, we decided on 24 developing countries that are homogeneous.

2.3. Variables

In this study, we considered *infant mortality* as the dependent variable. We measured this as a two-category dummy variable, and the two distinct levels are "*yes* " if infant death occurs and "*no* " if death doesn't occur. We included a group of relevant socio-economic and demographic factors as an independent variable to execute the research and to discover the impacting determinants that are presumed to influence infant mortality based on the previous literature. Commencing with the *type of place of residence* , which has remained the same as the existing category of DHS datasets. Similarly, the category of*maternal current working* status remained the same as the original datasets. The remaining covariates were subcategorized. We merged*no education* and *primary* to *up to primary* for BDHS data, whereas the other categories were *secondary* and*higher* in terms of parent's education level. Again, for meta-analysis, we combined *secondary* and *higher* to*above primary* while another category was *up to the primary* . In the case of binary logistic regression, the *wealth index* has remained the same as the original data. Further, we changed the label of the variable to *Living below the poverty line* for the meta-analysis with two categories. We combined *poorer* and*poorest* and labeled them as '*yes* ', which means if the individuals are poor, they certainly live below the poverty line, on the other hand, we combined *middle, richer, and richest* with the label '*no* ', which represents the individuals who live above the poverty line. The variable *birth order number* was categorized as*firstborn* and *2^{nd} and above born* for both binary logistic regression and meta-analysis. *Maternal age at delivery* was converted into a nominal scale from the continuous form with the category *less than or equal to 19 years (<=19)*and *above 19 years* [30]. Categories for the variable *number of fetus* were *single* and *multiple*for both methods. For binary logistic regression, we subcategorized*taking antenatal care (ANC)* as *no visits* , *1-4 visits* , *more than 4 visits* , whereas in the meta-analysis, individuals who had at least one *ANC visit* were considered in the category *yes* , otherwise *no* . We used the original variable*taking postnatal care (PNC)* that was categorized as two levels,*yes* and *no,* for both logistic regression and meta-analysis. Finally, *for the child's size,* we subcategorized the variable as *average, larger than average* (combined by very large and larger than average), and *smaller than average*(combined by very small and smaller than average) for the logistic regression analysis. We further recoded this variable for meta-analysis with two independent levels, such as *average* and *larger or smaller than average* .

2.4 Statistical analysis

We used statistical software SPSS V.23 (SPSS Inc. Chicago, USA) and R V.3.6.2 (Bell Laboratories, New Jersey, USA) to carry out the analysis. Binary logistic regression was practiced to determine the key factors that have an impact on infant mortality in Bangladesh using BDHS data[31,32]. Besides, we applied meta-analysis on the DHS data from Bangladesh and 23 other developing countries[33]. Heterogeneity was assessed by enumerating values from I^2 and p values among datasets[34,35]. We performed a random-effects model in the meta-analytical approach as significant heterogeneity was found by which we estimated DerSimonian and Laird's pooled effect[36]. Forest plots were used to display 95% CI, summary measure, and weight of each study for the most significant determinants[37]. As a summary measure, we used Odds Ratio (OR), and all findings were weighted to handle bias due to under-sampling and oversampling[38].

3. Results

Table 1 shows the baseline characteristics of the selected covariates for BDHS data. Most of the respondents are from a rural area (about 68.2%). Up to primary education is available for 41.5% women and 53.5% men and only 11.5% of the women and 15.2% of the men have higher education. Also, we find about 78.1% of women are not working currently, and 75.3% of women are above 19 years old at delivery time. Most of the respondents (98.7%) included in the analysis carry a single fetus. Again 67.4% of children are average in size, and 19.6% are smaller than average, while 61.6% are taken for postnatal check-ups. About 54.5% of respondents visit 1-4 times for antenatal care, and 25.5% of respondents do not go for the check-ups.

Table 1 Baseline characteristics of different variables with levels for BDHS data

Variable	Levels of the variables with code	Frequency	Percentage
Dependent variable Infant mortality	No [0] Yes [1]	4561 163	96.5 3.5
Covariates Type of place of residence	Rural [0] Urban [1]	3220 1504	68.2 31.8
Maternal education	Up to primary [0] Secondary [1] Higher [2]	1959 2224 541	41.5 47.0 11.5
Father's education	Up to primary [0] Secondary [1] Higher [2]	2526 1478 720	53.5 31.3 15.2
Wealth index	Poorest [0] Poorer [1] Middle [2] Richer [3] Richest [4]	1011 902 901 980 930	21.4 19.1 19.1 20.7 19.7
Maternal current working status	No [0] Yes [1]	3689 1035	78.1 21.9
Birth order number	First born [0] Second and above [1]	1943 2781	41.1 58.9
Maternal age at delivery	<=19 [0] Above 19 [1]	1168 3556	24.7 75.3
Number of fetus	Single [0] Multiple [1]	4662 62	98.7 1.3
Taking ANC	No [0] 1-4 visits [1] More than 4 visits [2]	1204 2573 947	25.5 54.5 20.0
Taking PNC	No [0] Yes [1]	1816 2908	38.4 61.6
Size of child	Average [0] Larger than average [1] Smaller than average [2]	3181 616 927	67.4 13.0 19.6

The baseline characteristics of the selected factors for 24 developing countries are displayed in table 2. We calculated the prevalence of all 24 countries separately with the DHS's sampling weights. Table 3 demonstrates the different influential socio-economic and demographic determinants of infant mortality in Bangladesh. Infant mortality is associated with maternal education with an adjusted OR of 0.537 (95% CI 0.380 to 0.759: $p \leq 0.001$) for the secondary level of education. Individuals from poorer and middle-class households show a significant influence on infant mortality, where the ORs are 0.448 (95% CI 0.303 to 0.663; $p \leq 0.001$) and 0.408 (95% CI 0.254 to 0.654; $p \leq 0.001$) for poorer and middle-class household, respectively. Similarly, birth order number has a noticeable impact on infant mortality with an adjusted OR of 0.362 (95% CI 0.248 to 0.527: $p \leq 0.001$) with respect to 2^{nd} and above born infants. Mothers aged above 19 years significantly influence infant mortality with an adjusted OR 0.477 (95% CI 0.333 to 0.682: $p \leq 0.001$). The variable number of fetus shows a significant association with infant mortality, where the OR for the category' multiple fetus' is 6.634 (95% CI 3.247 to 13.555: $p \leq 0.001$). Likewise, taking ANC has a significant influence on infant mortality, with an OR of 0.271 (95% CI 0.192 to 0.382: $p \leq 0.001$) for the category' 1-4 visits'. The OR of taking PNC is 0.303 (95% CI 0.216 to 0.425; $p \leq 0.001$), which exhibits an association between infant mortality and taking PNC services. The sizes of children have a significant impact on infant mortality with an adjusted OR 0.578 (95% CI 0.400 to 0.834; p=0.003) regarding the category 'smaller than average'.

Variables Variables Variables Variables Variables Variables Variables Variables Variables Variables Variables Variables

Country Name	Infant mortality n (%)	Infant mortality n (%)	Type of Place of Residence n (%)	Type of Place of Residence n (%)	Maternal Education n (%)	Maternal Education n (%)	Father's Education n (%)	Father's Education n (%)	Living below Poverty Line n (%)	Living below Poverty Line n (%)	Maternal Current Working Status n (%)	Maternal Current Working Status n (%)	Birth Order Number n (%)	Birth Order Number n (%)	Maternal Age at Delivery n (%)	Maternal Age at Delivery n (%)	Num of Fetus n (%)
	No	Yes	Rural	Urban	Up to primary	Above primary	Up to primary	Above primary	No	Yes	Not working	Working	1^{st} born	2^{nd} & above	[?]19 years	Above 19	Sing
Sierra Leone 2013	9453 (92.4)	778 (7.6)	7424 (72.6)	2807 (27.4)	8879 (86.8)	1352 (13.2)	7659 (74.9)	2572 (25.1)	5590 (54.6)	4641 (45.4)	2416 (23.6)	7815 976.4)	1720 (16.8)	8511 (83.2)	1150 (11.2)	9081 (88.8)	9777 (95.6
Zambia 2013-14	11164 (96.0)	469 (4.0)	7425 (63.8)	4208 (36.2)	8061 (69.3)	3572 (30.7)	5748 (49.4)	5885 (50.6)	5997 (51.6)	5636 (48.4)	4761 (40.9)	6872 (59.1)	1880 (16.2)	9753 (83.8)	1233 (10.6)	10400 (89.4)	1123 (96.6
Bangladesh 2014	4561 (96.5)	163 (3.5)	3220 (68.2)	1504 (31.8)	1959 (41.5)	2765 (58.5)	2526 (53.5)	2198 (46.5)	2811 (59.5)	1913 (40.5)	3689 (78.1)	1035 (21.9)	1943 (41.1)	2781 (58.9)	1168 (24.7)	3556 (75.3)	4662 (98.7
Cambodia 2014	6913 (97.7)	164 (2.3)	5148 (72.7)	1929 (27.3)	4504 (63.6)	2573 (36.4)	3732 (52.7)	3345 (47.3)	4072 (57.5)	3005 (42.5)	2360 (33.3)	4717 (66.7)	2744 (38.8)	4333 (61.2)	491 (6.9)	6586 (93.1)	6945 (98.1
Egypt 2014	15432 (97.9)	335 (2.1)	9411 (59.7)	6356 (40.3)	4030 (25.6)	11737 (74.4)	3975 (25.2)	11792 (74.8)	9851 (62.5)	5916 (37.5)	13802 (87.5)	1965 (12.5)	4872 (30.9)	10895 (69.1)	783 (5.0)	14984 (95.0)	1515 (96.1
Kenya 2014	8886 (96.6)	311 (3.4)	6169 (67.1)	3028 (32.9)	6978 (75.9)	2219 (24.1)	6141 (66.8)	3056 (33.2)	4140 (45.0)	5057 (55.0)	3794 (41.3)	5403 (58.7)	1777 (19.3)	7420 (80.7)	780 (8.5)	8417 (91.5)	8960 (97.4
Lesotho 2014	2565 (94.0)	164 (6.0)	2071 (75.9)	658 (24.1)	1408 (51.6)	1321 (48.4)	1784 (65.4)	945 (34.6)	1426 (52.3)	1303 (47.7)	1913 (70.1)	816 (29.9)	953 (34.9)	1776 (65.1)	314 (11.5)	2415 (88.5)	2656 (97.3
Chad 2014-15	16027 (94.1)	1003 (5.9)	13495 (79.2)	3535 (20.8)	15627 (91.8)	1403 (8.2)	13975 (82.1)	3055 (17.9)	10366 (60.9)	6664 (39.1)	10340 (60.7)	6690 (39.3)	2476 (14.5)	14554 (85.5)	2610 (15.3)	14420 (84.7)	1656 (97.3
Afghanistan 2015	29618 (95.8)	1313 (4.2)	23501 (76.0)	7430 (24.0)	28632 (92.6)	2299 (7.4)	21959 (71.0)	8972 (29.0)	18238 (59.0)	12693 (41.0)	27695 (89.5)	3236 (10.5)	25215 (81.5)	5716 (18.5)	2831 (9.2)	28100 (90.8)	3036 (98.2
Zimbabwe 2015	4914 (95.8)	213 (4.2)	3218 (62.8)	1909 (37.2)	1554 (30.3)	3573 (69.7)	1137 (22.2)	3990 (77.8)	3145 (61.3)	1982 (38.7)	3073 (59.9)	2054 (40.1)	1250 (24.4)	3877 (75.6)	509 (9.9)	4618 (90.1)	4940 (96.4
Angola 2015-16	8788 (95.4)	423 (4.6)	4081 (44.3)	5130 (55.7)	6666 (72.4)	2545 (27.6)	4532 (49.2)	4679 (50.8)	4594 (49.9)	4617 (50.1)	2489 (27.0)	6722 (73.0)	1488 (16.2)	7723 (83.8)	1214 (13.2)	7997 (86.8)	8939 (97.0
Malawi 2015-16	13603 (96.3)	522 (3.7)	11892 (84.2)	2233 (15.8)	11176 (79.1)	2949 (20.9)	9132 (64.7)	4993 (35.3)	8115 (57.5)	6010 (42.5)	4878 (34.5)	9247 (65.5)	3330 (23.6)	10795 (76.4)	1891 (13.4)	12234 (86.6)	1359 (96.2
Tanzania 2015-16	8191 (96.3)	319 (3.7)	6668 (78.4)	1842 (21.6)	7033 (82.6)	1477 (17.4)	6798 (79.9)	1712 (20.1)	4707 (55.3)	3803 (44.7)	1962 (23.1)	6548 (76.9)	1733 (20.4)	6777 (79.6)	843 (9.9)	7667 (90.1)	8211 (96.5
India 2015-16	42170 (96.2)	1687 (3.8)	32883 (75.0)	10974 (25.0)	19010 (43.3)	24847 (56.7)	14102 (32.2)	29755 (67.8)	23059 (52.6)	20798 (47.4)	36328 (82.8)	7529 (17.2)	16449 (37.5)	27408 (62.5)	2832 (6.5)	41025 (93.5)	4309 (98.3

29Myanmar 2015-16	4353 (95.9)	187 (4.1)	3564 (78.5)	976 (21.5)	2791 (61.5)	1749 (38.5)	2603 (57.3)	1937 (42.7)	2156 (47.5)	2384 (52.5)	2133 (47.0)	2407 (53.0)	1475 (32.5)	3065 (67.5)	218 (4.8)	4322 (95.2)	4455 (98.1
South Africa 2016	1351 (96.7)	46 (3.3)	556 (39.8)	841 (60.2)	178 (12.7)	1219 (87.3)	225 (16.1)	1172 (83.9)	783 (56.0)	614 (44.0)	913 (65.4)	484 (34.6)	297 (21.3)	1100 (78.7)	58 (4.2)	1339 (95.8)	1358 (97.2
Ethiopia 2016	9372 (95.4)	455 (4.6)	8099 (82.4)	1728 (17.6)	8811 (89.7)	1016 (10.3)	8053 (81.9)	1774 (18.1)	4464 (45.4)	5363 (54.6)	7246 (73.7)	2581 (26.3)	1874 (19.1)	7953 (80.9)	866 (8.8)	8961 (91.2)	9563 (97.3
Nepal 2016	4821 (96.9)	155 (3.1)	2145 (43.1)	2831 (56.9)	2642 (53.1)	2334 (46.9)	1815 (36.5)	3161 (63.5)	2596 (52.2)	2380 (47.8)	2399 (48.2)	2577 (51.8)	1958 (39.3)	3018 (60.7)	760 (15.3)	4216 (84.7)	4909 (98.7
Timor-Leste 2016	5580 (97.3)	154 (2.7)	3801 (66.3)	1933 (33.7)	2229 (38.9)	3505 (61.1)	2290 (39.9)	3444 (60.1)	3697 (64.5)	2037 (35.5)	3604 (62.9)	2130 (37.1)	1453 (25.3)	4281 (74.7)	275 (4.8)	5459 (95.2)	5624 (98.1
Indonesia 2017	16487 (97.9)	347 (2.1)	8452 (50.2)	8382 (49.8)	4330 (25.7)	12504 (74.3)	4587 (27.2)	12247 (72.8)	9054 (53.8)	7780 (46.2)	9059 (53.8)	7775 (46.2)	5468 (32.5)	11366 (67.5)	803 (4.8)	16031 (95.2)	1659 (98.6
Benin 2017-18	11379 (95.4)	549 (4.6)	7326 (61.4)	4602 (38.6)	10066 (84.4)	1862 (16.6)	9110 (76.4)	2818 (23.6)	6716 (56.3)	5212 (43.7)	2292 (19.2)	9636 (80.8)	2387 (20.0)	9541 (80.0)	940 (7.9)	10988 (92.1)	1134 (95.1
Pakistan 2017-18	11845 (94.9)	638 (5.1)	6960 (55.8)	5523 (44.2)	8086 (64.8)	4397 (35.2)	5204 (41.7)	7279 (58.3)	6785 (54.4)	5698 (45.6)	11046 (88.5)	1437 (11.5)	2964 (23.7)	9519 (76.3)	786 (6.3)	11697 (93.7)	1216 (97.4
Guinea 2018	6854 (93.7)	462 (6.3)	5374 (73.5)	1942 (26.5)	6518 (89.1)	798 (10.9)	5931 (81.1)	1385 (18.9)	3817 (52.2)	3499 (47.8)	2340 (32.0)	4976 (68.0)	1267 (17.3)	6049 (82.7)	995 (13.6)	6321 (86.40	6983 (95.4
Nigeria 2018	29359 (93.8)	1950 (6.2)	20664 (66.0)	10645 (34.0)	19339 (61.8)	11970 (38.2)	15963 (51.0)	15346 (49.0)	16608 (53.0)	14701 (47.0)	10278 (32.8)	21031 (67.2)	5625 (18.0)	25684 (82.0)	2922 (9.3)	28387 (90.7)	3013 (96.3

Table 2 Baseline characteristics of selected covariates for 24 developing countries

Table 3 Results of the binary logistic regression model affecting socio-economic and demographic factors for infant mortality in Bangladesh.

	B^*	Odds Ratio	*p-value*	95% CI for OR
Type of place of residence Rural (Ref. Category) Urban	-0.101	0.904	0.606	[0.616;1.326]
Maternal Education Up to Primary (Ref. Category) Secondary Higher	-0.622 -0.723	0.537 0.485	0.002 0.000 0.116	[0.380;0.759] [0.197;1.196]
Father's Education Up to Primary (Ref. Category) Secondary Higher	-0.413 -1.067	0.662 0.344	0.017 0.040 0.014	[0.447;0.980] [0.147;0.807]
Wealth Index Poorest (Ref. Category) Poorer Middle Richer Richest	-0.802 -0.897 -0.209 -0.049	0.448 0.408 0.812 0.952	0.000 0.000 0.000 0.389 0.874	[0.303;0.663] [0.254;0.654] [0.505;1.305] [0.521;1.741]

	*B**	Odds Ratio	*p-value*	95% CI for OR
Maternal Current Working Status Not Working (Ref. Category) Working	0.027	1.027	0.883	[0.716;1.475]
Birth Order Number First Born (Ref. Category) Second and above	-1.016	0.362	0.000	[0.248,0.527]
Maternal Age at Delivery <=19(Ref. Category) Above 19	-0.741	0.477	0.000	[0.333;0.682]
Number of Fetus Single (Ref. Category) Multiple	1.892	6.634	0.000	[3.247;13.555]
Taking Antenatal Care No (Ref. Category) 1-4 Visits More than 4 Visits	-1.306 -0.758	0.271 0.468	0.000 0.000 0.003	[0.192;0.382] [0.286;0.768]
Taking Postnatal Care No (Ref. Category) Yes	-1.194	0.303	0.000	[0.216;0.425]
Size of Child Average (Ref. Category) Larger than Average Smaller than Average	0.366 -0.548	1.443 0.578	0.001 0.078 0.003	[0.960;2.167] [0.400;0.834]

* B=β, *OR=Odds Ratio, *CI=Confidence Interval

Table 4 Random-effects model estimation of OR for 24 developing countries.

Country Name	Type of Place of Residence	Maternal Education	Father's Education	Living below Poverty Line	Ma
	OR	OR	OR	OR	OR
Afghanistan	0.608	0.857	0.878	0.883	1.9
Angola	0.702	0.561	0.765	0.649	1.2
Bangladesh	0.974	0.640	0.575	0.715	1.3
Benin	0.801	0.849	0.831	0.824	1.1
Chad	1.098	0.867	0.944	0.950	1.1
Cambodia	0.451	0.596	0.525	0.406	1.2
Egypt	0.699	0.706	0.888	0.700	0.7
Ethiopia	0.553	0.759	0.790	0.692	0.9
Guinea	0.544	0.530	0.661	0.658	1.1
India	0.737	0.563	0.628	0.588	1.1

Country Name	Type of Place of Residence	Maternal Education	Father's Education	Living below Poverty Line	Ma
Indonesia	0.923	0.731	0.751	0.757	1.4
Kenya	1.055	0.999	0.980	1.084	1.1
Lesotho	0.814	0.892	0.978	1.119	0.5
Malawi	0.847	0.988	0.903	0.866	1.2
Myanmar	0.660	0.637	0.816	0.682	1.4
Nepal	0.803	0.727	0.768	0.690	0.9
Nigeria	0.716	0.678	0.683	0.696	0.9
Pakistan	0.765	0.644	0.755	0.729	1.4
Sierra Leone	1.046	0.978	0.996	1.063	1.1
South Africa	1.249	0.684	2.054	0.492	0.5
Tanzania	1.264	1.131	1.417	1.198	1.0
Timor-Leste	0.707	0.969	0.837	0.910	1.2
Zambia	1.114	1.119	1.007	1.029	0.8
Zimbabwe	0.575	0.557	0.650	0.730	0.8
I^2	79.3	77.2	75.9	82.9	82.
τ^2	0.043	0.043	0.031	0.041	0.0

$\hat{\tau}^{\mathbf{2}}$: Estimate of between-study variance

Table 5 Random-effects model estimation (summary effect) for various covariates in 24 developing countries

Variables	Random-effects model	Random-effects model	Random-effects model
	Overall OR	P-Value	95% Confidence Interval (CI)
Type of Place of Residence	0.796	0.0001	[0.721; 0.877]
Maternal Education	0.762	0.0001	[0.690; 0.842]
Father's Education	0.817	0.0001	[0.750; 0.891]
Living below Poverty Line	0.784	0.0001	[0.715; 0.861]
Maternal Current Working Status	1.117	0.0001	[1.008; 1.238]
Birth Order Number	0.909	0.0001	[0.835; 0.990]
Maternal Age at Delivery	0.689	0.0062	[0.636; 0.747]
Number of Fetus	0.193	0.0010	[0.176; 0.213]
Taking ANC	0.356	0.0001	[0.311; 0.407]
Taking PNC	0.302	0.0001	[0.243; 0.375]
Size of Child	0.653	0.0001	[0.588; 0.726]

The true treatment effect can estimate the average treatment effect that varies from study to study from the random-effects model, illustrated in tables 4 and 5. In this study, we intended to use the random-effects model as the study showed high between-study variations (heterogeneity). About 79.3% of the variation (I^2 = 79.3%) has been observed for the type of place of residence. The overall OR is 0.796 (95% CI 0.721 to 0.878), which means the individuals residing in urban areas have a 20.4% lower chance of experiencing infant deaths than their rural counterparts. About 77.2% of the variation (I^2 = 77.2%) has been found for maternal education. The overall OR is 0.762 (95% CI 0.690 to 0.842), meaning mothers who have above primary level education are 0.7622 times or 23.8 % less likely to confront infant death compared to the mothers who have up to primary education. Similarly, father's education shows about 75.9% of the variation with overall OR 0.817 (95% CI 0.750 to 0.891), which indicates, with an increment in education level, fathers have 0.817 times or 18.3% lower chance of experiencing infant death. For living below the poverty line, I^2 has been found to be 82.9%, where the overall OR is 0.784 (95% CI 0.715 to 0.861), which reveals the odds of infant mortality is 0.784 times or 21.6 % lower to the individuals who don't live below the poverty line compared to those who live below the poverty line. About 82.0% of the variation (I^2 = 82.0%) has been observed for maternal current working status. The overall OR is 1.117 (95% CI 1.008 to 1.238), which means the odds of infant mortality is 1.117 times or 11.7% higher in the women who are currently working compared to those who are not working currently. For birth order number I^2 has been found to be 71.4% with overall OR 0.909 (95% CI 0.835 to 0.990), indicating a 9.1% lower chance of infant mortality in the second and above-born child than those who are the firstborn child. The overall OR is 0.689 (95% CI 0.636 to 0.747) for maternal age at delivery with a 47.0% variation. This suggests that with the increment of a mother's age, the risk of infant death decreases. Again, the overall OR for the number of the fetus is 0.193 (95% CI 0.176 to 0.213) with 53.8% variation. This indicates that infant death occurs at a rate of 0.193 times or 80.7 % less likely in women carrying a single fetus than those who carry multiple fetuses. About 91.2% of the variation (I^2 = 91.2%) has been found for taking ANC. The overall OR is 0.356 (95% CI 0.311 to 0.407), which means infant death occurs at 0.356 times or 64.4% less likely in the women who took antenatal care than those who don't take it. For taking PNC I^2 has been found to be 92.5% with overall OR 0.302 (95% CI 0.243 to 0.375), expressing a lower chance of infant mortality in the respondents who are taken for postnatal check-ups. Size of child shows 86.6% variation (I^2 = 86.6%) with overall OR of 0.653 (95% CI 0.588 to 0.726). This indicates that infant death occurs 0.653 times or 34.7 % less likely in the average-sized child than those who are larger or smaller than average.

Estimation from the meta-analysis in Bangladesh's circumstance displayed in table 4 narrated that urban residents have 0.974 times or 2.6% of lower chance of confronting infant death compared to the rural residence. Similarly, maternal education, father's education, living below the poverty line, birth order number, and maternal age at delivery are positively associated with infant mortality, with ORs of 0.640, 0.575, 0.715, 0,814, and 0.830, respectively. Again, the number of fetus, taking ANC, PNC services, and the child's size is also positively associated with infant mortality, where OR are 0.113, 0.314, 0.323, and 0.543, respectively. We considered the treatment group (category) for the place of residence to be urban, above primary for parent's education level, no for living below the poverty line, yes for maternal working status, 2^{nd} and above born for birth order, above 19 years for maternal age, single for the number of fetus, yes for both of taking ANC, PNC services and the average for the size of the child. However, maternal working status has a noticeable negative influence on infant mortality with an OR of 1.332. Overall, the number of fetus, taking ANC and PNC services are the most significant factors that affect the risk of infant mortality for both methods; random-effects meta-analysis and binary logistic regression for BDHS.

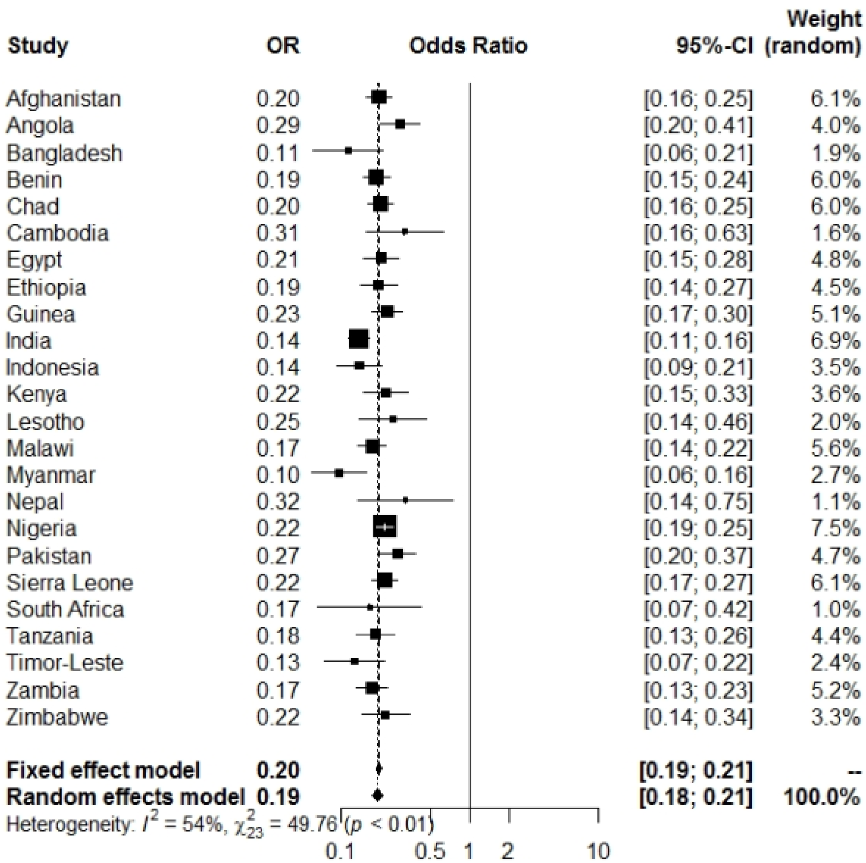

Figure 2 Forest plot for the number of fetus showing the weight of the study by the size of each box while each crossed line indicates 95% CI.

Figure 2 illustrates that the women of Myanmar carried single fetus have the highest lower chance of confronting infant deaths among all the countries, as the OR is 0.10 with 95% CI 0.06 to 0.16. On the other hand, women of Nepal have the lowest lower chance (OR 0.32 with 95% CI 0.14 to 0.75) of experiencing infant mortality with a single fetus. The overall estimate is statistically significant, with a p-value $\leq$0.01 at a 5% level of significance.

4. Discussion

Through the outcome of the logistic regression model, maternal education, father's education, wealth index, birth order number, maternal age at delivery, number of fetus, taking ANC, PNC, and child's size is found to have a significant influence on infant death for Bangladesh.

In this study, the odds of infant death are lower among births to mothers who have above primary level education than the mothers with up to primary level education for BDHS data. For instance, mothers who had secondary level education are 0.537 times or 46.3% less likely to confront infant death compared to the mothers who had up to primary education. Finding from the meta-analysis also supports this result. This finding is in line with the outcome of other research[23,24,26-29]. Maternal education may influence child health and mortality with the help of various pathways[39]. This could be, mothers having a secondary and above level of education resulted in better knowledge of health-related services. Besides, better education tends them to live in rich communities with better access to health services[26].

Both of the logistic regression models for BDHS data and meta-analysis for 24 developing countries revealed that as similar to maternal education, the father's higher education reduces the risk of infant mortality. Infant mortality is 0.344 times or 65.6% less likely to the higher educated fathers than those who have up to primary education (Ref. category) for Bangladesh. From the overall estimate of meta-analysis, it is found that fathers who had above primary level education are 0.8174 times or 18.26% less likely to experience infant death compared to the fathers who had up to primary education. Some other study supports this finding[26,27,29]. In our social orders, the father is the fundamental pay worker and chief of a family. In this way, the father's education assumes a significant job in earning, which guarantees nutrition, clothing, housing, and so forth. In other words, there might be a direct connection between a father's education and access to youngster wellbeing facilities[29].

Both the outcome of the logistic regression model for BDHS data and meta-analysis revealed that individuals whose ages are above 19 years could reduce infants' death compared to those who are 19 years or less in Bangladesh, holding the other covariates at a controlled level. From the outcome of BDHS data, we know that the women whose ages were above 19 are 0.477 times or 52.3% less likely to experience infant mortality than the women whose ages were 19 or less than 19. In a meta-analysis, the overall random effect for maternal age at delivery as treatment expressed about 31% lower chance of infant death when the individuals are above 19 years old. This result is supported by other findings[14,23,24,29]. Lack of childbearing knowledge might be responsible for the higher risk of infant mortality to the younger mother[15]. Additionally, children born to young mothers were more likely to be premature, have low birth weights, and experiencing complexity at the time of delivery[40].

The number of fetuses shows a highly significant impact on infant mortality for Bangladesh as the odds ratio is 6.634 for multiple fetuses, which means the risk of infant mortality is 6.634 times higher in cases of women who carried multiple fetuses compared to those who carried a single fetus (Ref. category). Again, from the outcome of the overall meta-analysis estimate, infant death occurs 0.1934 times or 80.66% less likely in the women who carried a single fetus than those women who carried multiple fetuses. Thus, the odds of infant death were higher among twin births compared with singleton births. This study is supported by a study conducted in Indonesia[41]. The possible explanation for this finding could be pregnant with twin fetuses usually lead to prematurity, which is the most common cause of infant death. Besides, twin to twin transfusion syndrome may occur, which further leads to death[4250]. Also, a twin pregnancy normally ends up with low birth weight, which expands kid weakness to contamination and diminishes their resistance[43]. As a result, child survival is decreased. This investigation was likewise predictable with an examination done by a researcher in Burkina Faso[44].

Mothers with at least one ANC visit decrease infant death odds compared to mothers with no ANC visits in both cases for Bangladesh and 24 other developing countries. The overall estimate from the meta-analysis uncovered that infant death occurs 0.3560 times or 64.4% less likely in women who took antenatal care than those who didn't take it. This result is supported by other studies[45-47]. The conceivable explanation could be women having ANC visits get an opportunity of prompt detection of complications and early inception of breastfeeding, which help the invulnerability of a youngster[48]. Likewise, women who had total ANC follow up had expanded the likelihood of conceiving an offspring by the skilled birth attendant, which lessens the chances of infant death[49]. In addition, follow-up with ANC usually leads to having quality essential newborn care, which increases infant survival[50].

PNC has a higher impact on infant mortality, which indicates the risk of infant mortality is lower in the children who are taken for the postnatal check-ups. The study uncovered that a lower risk of infant death is found in the children who were taken for postnatal care in Bangladesh, holding the other covariates at a controlled level. That is, infant mortality occurs 0.303 times or 69.7% less likely to the child who was taken for a postnatal check-up than those who did not go for a postnatal check-up. In a meta-analysis, the overall random effect for taking PNC as treatment expressed about a 70% lower chance of infant death to the children who were taken for postnatal care than those who were not taken for the check-ups. Another finding supports this outcome[51].

We confronted several limitations while conducting the research. The primary constraint is that we had limited access to avail the DHS data because of authorized permission. For this reason, we could only collect data from 24 of the 91 countries from the DHS database. Another limitation is that a bias selection may add to our study as DHS data utilized in this study covered a wider range and different time points. For estimating OR from random-effects meta-analysis, we had to create 2×2 cross-tabulation for which each variable was categorized into two categories only. Moreover, a wide number of factors that could influence infant mortality could not be included in our study because of the unavailability of those variables in some DHS data.

The study has some strengths despite of these constraints. We combined two methods: binary logistic regression of BDHS data and meta-analysis of 24 DHS data. The integrated findings enlarged the validity of the outcome of the research. We unfolded a new research approach by introducing this special mixed-method design. Because of its extensive and acute quality, better knowledge and insights could be generated.

5. Conclusion

Undoubtedly infant mortality as a significant part of under-five child mortality is the most grounded pointer of a nation's prosperity, as it reflects social, monetary, and ecological conditions. Thus, it explicates the standard of life. This study evidently acknowledged the most significant influential factors of infant mortality. The number of fetus, taking ANC and PNC are the dominating factors of infant mortality. Mothers with multiple fetuses should take under proper surveillance. Besides, modernized health care services should be provided to both of rural and urban regions with free medical facilities for unprivileged counterparts. If the required scheme can be implemented, then the destined reduction of infant mortality of the Sustainable Development Goals by 2030 can be met.

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Table 1 Baseline characteristics of different variables with levels for BDHS data

Variable	Levels of the variables with code	Frequency	Percentage
Dependent variable Infant mortality	No [0] Yes [1]	4561 163	96.5 3.5
Covariates Type of place of residence	Rural [0] Urban [1]	3220 1504	68.2 31.8
Maternal education	Up to primary [0] Secondary [1] Higher [2]	1959 2224 541	41.5 47.0 11.5
Father's education	Up to primary [0] Secondary [1] Higher [2]	2526 1478 720	53.5 31.3 15.2
Wealth index	Poorest [0] Poorer [1] Middle [2] Richer [3] Richest [4]	1011 902 901 980 930	21.4 19.1 19.1 20.7 19.7
Maternal current working status	No [0] Yes [1]	3689 1035	78.1 21.9
Birth order number	First born [0] Second and above [1]	1943 2781	41.1 58.9
Maternal age at delivery	<=19 [0] Above 19 [1]	1168 3556	24.7 75.3
Number of fetus	Single [0] Multiple [1]	4662 62	98.7 1.3
Taking ANC	No [0] 1-4 visits [1] More than 4 visits [2]	1204 2573 947	25.5 54.5 20.0
Taking PNC	No [0] Yes [1]	1816 2908	38.4 61.6
Size of child	Average [0] Larger than average [1] Smaller than average [2]	3181 616 927	67.4 13.0 19.6

Country Name	Variables Infant mortality n (%)	Variables Infant mortality n (%)	Variables Type of Place of Residence n (%)	Variables Type of Place of Residence n (%)	Variables Maternal Education n (%)	Variables Maternal Education n (%)	Variables Father's Education n (%)	Variables Father's Education n (%)	Variables Living below Poverty Line n (%)	Variables Living below Poverty Line n (%)	Variables Maternal Current Working Status n (%)	Variables Maternal Current Working Status n (%)	Birth Order Number n (%)	Birth Order Number n (%)	Maternal Age at Delivery n (%)	Maternal Age at Delivery n (%)	Num of Fetus n (%)
	No	Yes	Rural	Urban	Up to primary	Above primary	Up to primary	Above primary	No	Yes	Not working	Working	1st born	2nd & above	[?]19 years	Above 19	Sing
Sierra Leone 2013	9453 (92.4)	778 (7.6)	7424 (72.6)	2807 (27.4)	8879 (86.8)	1352 (13.2)	7659 (74.9)	2572 (25.1)	5590 (54.6)	4641 (45.4)	2416 (23.6)	7815 976.4)	1720 (16.8)	8511 (83.2)	1150 (11.2)	9081 (88.8)	9777 (95.6

Zambia	11164	469	7425	4208	8061	3572	5748	5885	5997	5636	4761	6872	1880	9753	1233	10400	1123
2013-14	(96.0)	(4.0)	(63.8)	(36.2)	(69.3)	(30.7)	(49.4)	(50.6)	(51.6)	(48.4)	(40.9)	(59.1)	(16.2)	(83.8)	(10.6)	(89.4)	(96.6
Bangladesh	4561	163	3220	1504	1959	2765	2526	2198	2811	1913	3689	1035	1943	2781	1168	3556	4662
2014	(96.5)	(3.5)	(68.2)	(31.8)	(41.5)	(58.5)	(53.5)	(46.5)	(59.5)	(40.5)	(78.1)	(21.9)	(41.1)	(58.9)	(24.7)	(75.3)	(98.7
Cambodia	6913	164	5148	1929	4504	2573	3732	3345	4072	3005	2360	4717	2744	4333	491	6586	6945
2014	(97.7)	(2.3)	(72.7)	(27.3)	(63.6)	(36.4)	(52.7)	(47.3)	(57.5)	(42.5)	(33.3)	(66.7)	(38.8)	(61.2)	(6.9)	(93.1)	(98.1
Egypt	15432	335	9411	6356	4030	11737	3975	11792	9851	5916	13802	1965	4872	10895	783	14984	1515
2014	(97.9)	(2.1)	(59.7)	(40.3)	(25.6)	(74.4)	(25.2)	(74.8)	(62.5)	(37.5)	(87.5)	(12.5)	(30.9)	(69.1)	(5.0)	(95.0)	(96.1
Kenya	8886	311	6169	3028	6978	2219	6141	3056	4140	5057	3794	5403	1777	7420	780	8417	8960
2014	(96.6)	(3.4)	(67.1)	(32.9)	(75.9)	(24.1)	(66.8)	(33.2)	(45.0)	(55.0)	(41.3)	(58.7)	(19.3)	(80.7)	(8.5)	(91.5)	(97.4
Lesotho	2565	164	2071	658	1408	1321	1784	945	1426	1303	1913	816	953	1776	314	2415	2656
2014	(94.0)	(6.0)	(75.9)	(24.1)	(51.6)	(48.4)	(65.4)	(34.6)	(52.3)	(47.7)	(70.1)	(29.9)	(34.9)	(65.1)	(11.5)	(88.5)	(97.3
Chad	16027	1003	13495	3535	15627	1403	13975	3055	10366	6664	10340	6690	2476	14554	2610	14420	1656
2014-15	(94.1)	(5.9)	(79.2)	(20.8)	(91.8)	(8.2)	(82.1)	(17.9)	(60.9)	(39.1)	(60.7)	(39.3)	(14.5)	(85.5)	(15.3)	(84.7)	(97.3
Afghanistan	29618	1313	23501	7430	28632	2299	21959	8972	18238	12693	27695	3236	25215	5716	2831	28100	3036
2015	(95.8)	(4.2)	(76.0)	(24.0)	(92.6)	(7.4)	(71.0)	(29.0)	(59.0)	(41.0)	(89.5)	(10.5)	(81.5)	(18.5)	(9.2)	(90.8)	(98.2
Zimbabwe	4914	213	3218	1909	1554	3573	1137	3990	3145	1982	3073	2054	1250	3877	509	4618	4940
2015	(95.8)	(4.2)	(62.8)	(37.2)	(30.3)	(69.7)	(22.2)	(77.8)	(61.3)	(38.7)	(59.9)	(40.1)	(24.4)	(75.6)	(9.9)	(90.1)	(96.4
Angola	8788	423	4081	5130	6666	2545	4532	4679	4594	4617	2489	6722	1488	7723	1214	7997	8939
2015-16	(95.4)	(4.6)	(44.3)	(55.7)	(72.4)	(27.6)	(49.2)	(50.8)	(49.9)	(50.1)	(27.0)	(73.0)	(16.2)	(83.8)	(13.2)	(86.8)	(97.0
Malawi	13603	522	11892	2233	11176	2949	9132	4993	8115	6010	4878	9247	3330	10795	1891	12234	1359
2015-16	(96.3)	(3.7)	(84.2)	(15.8)	(79.1)	(20.9)	(64.7)	(35.3)	(57.5)	(42.5)	(34.5)	(65.5)	(23.6)	(76.4)	(13.4)	(86.6)	(96.2
Tanzania	8191	319	6668	1842	7033	1477	6798	1712	4707	3803	1962	6548	1733	6777	843	7667	8211
2015-16	(96.3)	(3.7)	(78.4)	(21.6)	(82.6)	(17.4)	(79.9)	(20.1)	(55.3)	(44.7)	(23.1)	(76.9)	(20.4)	(79.6)	(9.9)	(90.1)	(96.5
India	42170	1687	32883	10974	19010	24847	14102	29755	23059	20798	36328	7529	16449	27408	2832	41025	4309
2015-16	(96.2)	(3.8)	(75.0)	(25.0)	(43.3)	(56.7)	(32.2)	(67.8)	(52.6)	(47.4)	(82.8)	(17.2)	(37.5)	(62.5)	(6.5)	(93.5)	(98.3
29Myanmar	4353	187	3564	976	2791	1749	2603	1937	2156	2384	2133	2407	1475	3065	218	4322	4455
2015-16	(95.9)	(4.1)	(78.5)	(21.5)	(61.5)	(38.5)	(57.3)	(42.7)	(47.5)	(52.5)	(47.0)	(53.0)	(32.5)	(67.5)	(4.8)	(95.2)	(98.1
South Africa	1351	46	556	841	178	1219	225	1172	783	614	913	484	297	1100	58	1339	1358
2016	(96.7)	(3.3)	(39.8)	(60.2)	(12.7)	(87.3)	(16.1)	(83.9)	(56.0)	(44.0)	(65.4)	(34.6)	(21.3)	(78.7)	(4.2)	(95.8)	(97.2
Ethiopia	9372	455	8099	1728	8811	1016	8053	1774	4464	5363	7246	2581	1874	7953	866	8961	9563
2016	(95.4)	(4.6)	(82.4)	(17.6)	(89.7)	(10.3)	(81.9)	(18.1)	(45.4)	(54.6)	(73.7)	(26.3)	(19.1)	(80.9)	(8.8)	(91.2)	(97.3
Nepal	4821	155	2145	2831	2642	2334	1815	3161	2596	2380	2399	2577	1958	3018	760	4216	4909
2016	(96.9)	(3.1)	(43.1)	(56.9)	(53.1)	(46.9)	(36.5)	(63.5)	(52.2)	(47.8)	(48.2)	(51.8)	(39.3)	(60.7)	(15.3)	(84.7)	(98.7
Timor-Leste	5580	154	3801	1933	2229	3505	2290	3444	3697	2037	3604	2130	1453	4281	275	5459	5624
2016	(97.3)	(2.7)	(66.3)	(33.7)	(38.9)	(61.1)	(39.9)	(60.1)	(64.5)	(35.5)	(62.9)	(37.1)	(25.3)	(74.7)	(4.8)	(95.2)	(98.1
Indonesia	16487	347	8452	8382	4330	12504	4587	12247	9054	7780	9059	7775	5468	11366	803	16031	1659
2017	(97.9)	(2.1)	(50.2)	(49.8)	(25.7)	(74.3)	(27.2)	(72.8)	(53.8)	(46.2)	(53.8)	(46.2)	(32.5)	(67.5)	(4.8)	(95.2)	(98.6
Benin	11379	549	7326	4602	10066	1862	9110	2818	6716	5212	2292	9636	2387	9541	940	10988	1134
2017-18	(95.4)	(4.6)	(61.4)	(38.6)	(84.4)	(16.6)	(76.4)	(23.6)	(56.3)	(43.7)	(19.2)	(80.8)	(20.0)	(80.0)	(7.9)	(92.1)	(95.1

Pakistan 2017-18	11845 (94.9)	638 (5.1)	6960 (55.8)	5523 (44.2)	8086 (64.8)	4397 (35.2)	5204 (41.7)	7279 (58.3)	6785 (54.4)	5698 (45.6)	11046 (88.5)	1437 (11.5)	2964 (23.7)	9519 (76.3)	786 (6.3)	11697 (93.7)	1216 (97.4
Guinea 2018	6854 (93.7)	462 (6.3)	5374 (73.5)	1942 (26.5)	6518 (89.1)	798 (10.9)	5931 (81.1)	1385 (18.9)	3817 (52.2)	3499 (47.8)	2340 (32.0)	4976 (68.0)	1267 (17.3)	6049 (82.7)	995 (13.6)	6321 (86.40	6983 (95.4
Nigeria 2018	29359 (93.8)	1950 (6.2)	20664 (66.0)	10645 (34.0)	19339 (61.8)	11970 (38.2)	15963 (51.0)	15346 (49.0)	16608 (53.0)	14701 (47.0)	10278 (32.8)	21031 (67.2)	5625 (18.0)	25684 (82.0)	2922 (9.3)	28387 (90.7)	3013 (96.3

Table 2 Baseline characteristics of selected covariates for 24 developing countries

Table 3 Results of the binary logistic regression model affecting socio-economic and demographic factors for infant mortality in Bangladesh.

	B^*	Odds Ratio	*p-value*	95% CI for OR
Type of place of residence Rural(Ref. Category) Urban	-0.101	0.904	0.606	[0.616;1.326]
Maternal Education Up to Primary (Ref. Category) Secondary Higher	-0.622 -0.723	0.537 0.485	0.002 0.000 0.116	[0.380;0.759] [0.197;1.196]
Father's Education Up to Primary (Ref. Category) Secondary Higher	-0.413 -1.067	0.662 0.344	0.017 0.040 0.014	[0.447;0.980] [0.147;0.807]
Wealth Index Poorest (Ref. Category) Poorer Middle Richer Richest	-0.802 -0.897 -0.209 -0.049	0.448 0.408 0.812 0.952	0.000 0.000 0.000 0.389 0.874	[0.303;0.663] [0.254;0.654] [0.505;1.305] [0.521;1.741]
Maternal Current Working Status Not Working (Ref. Category) Working	0.027	1.027	0.883	[0.716;1.475]
Birth Order Number First Born (Ref. Category) Second and above	-1.016	0.362	0.000	[0.248,0.527]
Maternal Age at Delivery <=19(Ref. Category) Above 19	-0.741	0.477	0.000	[0.333;0.682]
Number of Fetus Single (Ref. Category) Multiple	1.892	6.634	0.000	[3.247;13.555]

	B^*	Odds Ratio	*p-value*	95% CI for OR
Taking Antenatal Care No (Ref. Category) 1-4 Visits More than 4 Visits	-1.306 -0.758	0.271 0.468	0.000 0.000 0.003	[0.192;0.382] [0.286;0.768]
Taking Postnatal Care No (Ref. Category) Yes	-1.194	0.303	0.000	[0.216;0.425]
Size of Child Average (Ref. Category) Larger than Average Smaller than Average	0.366 -0.548	1.443 0.578	0.001 0.078 0.003	[0.960;2.167] [0.400;0.834]

* B=β, *OR=Odds Ratio, *CI=Confidence Interval

Table 4 Random-effects model estimation of OR for 24 developing countries.

Country Name	Type of Place of Residence	Maternal Education	Father's Education	Living below Poverty Line	Ma
	OR	OR	OR	OR	OR
Afghanistan	0.608	0.857	0.878	0.883	1.9
Angola	0.702	0.561	0.765	0.649	1.2
Bangladesh	0.974	0.640	0.575	0.715	1.3
Benin	0.801	0.849	0.831	0.824	1.1
Chad	1.098	0.867	0.944	0.950	1.1
Cambodia	0.451	0.596	0.525	0.406	1.2
Egypt	0.699	0.706	0.888	0.700	0.7
Ethiopia	0.553	0.759	0.790	0.692	0.9
Guinea	0.544	0.530	0.661	0.658	1.1
India	0.737	0.563	0.628	0.588	1.1
Indonesia	0.923	0.731	0.751	0.757	1.4
Kenya	1.055	0.999	0.980	1.084	1.1
Lesotho	0.814	0.892	0.978	1.119	0.5
Malawi	0.847	0.988	0.903	0.866	1.2
Myanmar	0.660	0.637	0.816	0.682	1.4
Nepal	0.803	0.727	0.768	0.690	0.9
Nigeria	0.716	0.678	0.683	0.696	0.9
Pakistan	0.765	0.644	0.755	0.729	1.4
Sierra Leone	1.046	0.978	0.996	1.063	1.1
South Africa	1.249	0.684	2.054	0.492	0.5
Tanzania	1.264	1.131	1.417	1.198	1.0
Timor-Leste	0.707	0.969	0.837	0.910	1.2
Zambia	1.114	1.119	1.007	1.029	0.8
Zimbabwe	0.575	0.557	0.650	0.730	0.8
I^2	79.3	77.2	75.9	82.9	82.
τ^2	0.043	0.043	0.031	0.041	0.0

$\hat{\tau}^{\mathbf{2}}$: Estimate of between-study variance

Table 5 Random-effects model estimation (summary effect) for various covariates in 24 developing countries

Variables	Random-effects model	Random-effects model	Random-effects model
	Overall OR	P-Value	95% Confidence Interval (CI)
Type of Place of Residence	0.796	0.0001	[0.721; 0.877]
Maternal Education	0.762	0.0001	[0.690; 0.842]
Father's Education	0.817	0.0001	[0.750; 0.891]
Living below Poverty Line	0.784	0.0001	[0.715; 0.861]
Maternal Current Working Status	1.117	0.0001	[1.008; 1.238]
Birth Order Number	0.909	0.0001	[0.835; 0.990]
Maternal Age at Delivery	0.689	0.0062	[0.636; 0.747]
Number of Fetus	0.193	0.0010	[0.176; 0.213]
Taking ANC	0.356	0.0001	[0.311; 0.407]
Taking PNC	0.302	0.0001	[0.243; 0.375]
Size of Child	0.653	0.0001	[0.588; 0.726]

Figures

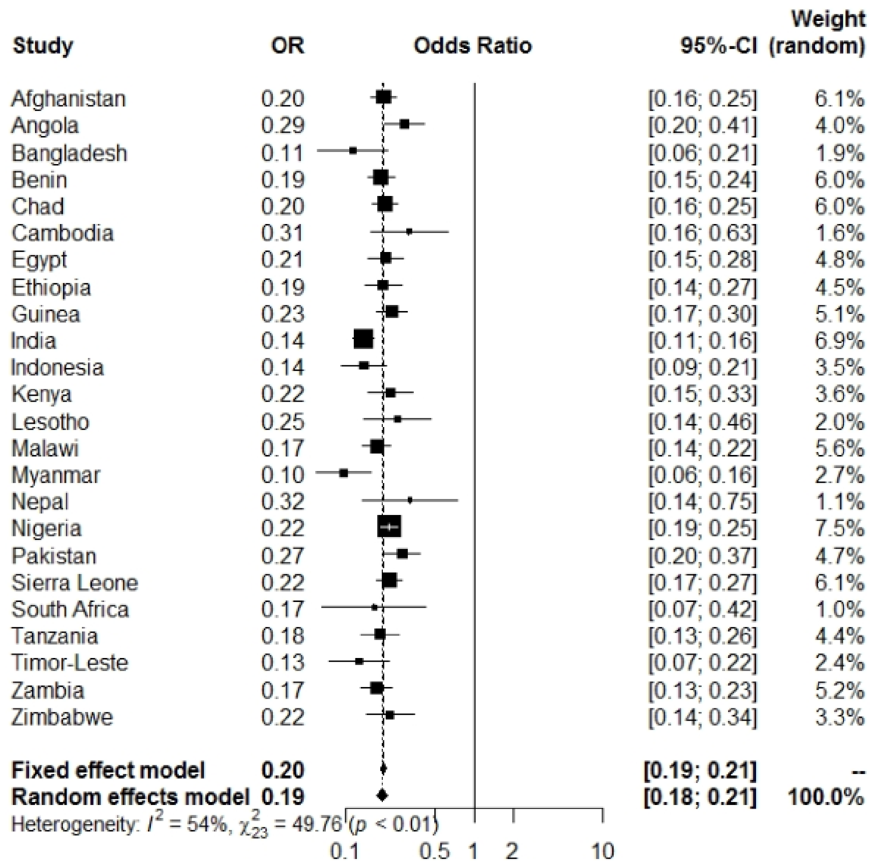

Figure 2 Forest plot for the number of fetus showing the weight of the study by the size of each box while each crossed line indicates 95% CI.