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# Exploring the Paternal Socio-economic Factors Associated with Low Birth Weight: Evidence from A Country Data

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**ABSTRACT**

This research explored the paternal factors associated with low birth weight (LBW). The study's sample size (n = 7461) was derived from the Pakistan Demographic and Health Survey (PDHS) data collected in 2012-2013. The documented socio-economic factors pertained to the mothers who had delivered their last child within the past five years and participated in PDHS. In PDHS, 19.9% of the fathers were found to have infants with LBW. We employed a multivariate logistic regression analysis in SPSS to analyze the data. The findings showed that the risk of LBW was greater among fathers residing in small cities (aOR 1.39; 95% CI 1.14-1.71) and rural areas (aOR 1.79; 95% CI 1.51-2.13). The risk of SSB was higher for those fathers who had education up to the primary level (aOR 1.34; 95% 1.09, 1.64). Similarly, the risk of SSB was higher among unemployed fathers (aOR 1.20; 95% CI 1.00-1.44) as compared to the skilled ones. Additionally, the risk of LBW babies is higher in poor fathers (aOR 1.86; 95% -1.60-2.16) compared to the richer ones. However, the father's age is not associated with LBW. Based on the results, practical recommendations are proposed.

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## INTRODUCTION

Low birth weight (LBW), a prevalent issue in Pakistan, is a significant contributor to perinatal morbidity and mortality (Khan et al., 2018). According to the WHO, a baby is considered LBW if their weight is less than 2,500 grams at the time of birth (WHO, 2025). LBW has been recognized as a significant worldwide health concern, particularly in the South Asian region. Approximately 15% to 20% of global births are classified as low birth weight, accounting for over 20 million annually (WHO, 2025), with more than 40% occurring in South Asia (UNICEF, 2025). Similarly, LBW babies are a significant public health concern in poor and middle-income regions (Khan et al., 2018), since early childhood constitutes a critical period for physical and mental development, with LBW being a primary contributor to mortality and morbidity among infants during this stage of life.

Literature indicates that LBW accounts for 60 to 80% of overall mortality in infants under one month old and one-third of total fatalities in children under one year (Tessema et al., 2021; Gebregzabiherher et al., 2017). Similarly, the probability of death is 40 times higher in LBW babies than in those of ordinary weight (Gebregzabiherher et al., 2017). In addition to death, it impedes normal growth and increases the likelihood of chronic diseases, including diabetes, ischemic heart disease, dementia, hypertension, stroke, and osteoarthritis in later life (Manandhar et al., 2019; Shaikh et al., 2021). LBW raises the likelihood of acquiring psychiatric and behavioral problems, along with learning and sensory difficulties (Ahmed, 2022; Pal et al., 2020). Likewise, evidence indicates that infants born with LBW experience significantly higher risks of morbidity and death due to infectious diseases and exhibit underweight, stunted growth, or wasting throughout the neonatal period through childhood (Khan et al., 2018; Pojda & Kelley, 2000). Another study revealed that babies weighing 2000-2499 g at birth are four times more likely to die during the first 28 days of birth compared to those weighing 2500-2999 g, and ten times more likely than babies weighing 3000-3499 g. This LBW is also linked to inadequate cognitive development, deficient immune function, and greater risks of pneumonia, acute diarrhea, and cardiovascular disease (Raisi-Estabragh, 2023).

Prior literature shows that paternal factors positively influence the LBW of newborn babies (Mao et al., 2021; Dola & Valderrama, 2024; Berlin et al., 2025). Paternal characteristics, such as smoking habits (Berlin et al., 2025), consanguinity, unemployment, and occupation, are positively linked with the possibility of adverse birth outcomes (Zakar et al., 2015). This research can get the attention of the researchers and policymakers by addressing the following research gaps. First, previous literature on LBW has focused on maternal and domestic factors. In contrast,

there has been very limited literature on paternal traits such as age, education, work status, tobacco use, and occupational exposures as independent contributors to LBW. Particularly in Pakistan, paternal factors addressing LBW are outdated, such as secondary analyses of PDHS 2006–07 utilizing restricted paternal variables. Similarly, recent studies conducted in various hospital settings in Pakistan consistently highlight maternal effects, whereas paternal influences remain inadequately represented. Simultaneously, data from various regions associate paternal age, education, unemployment, and smoking with low birth weight (LBW), highlighting potential, policy-relevant impacts that are not yet quantified in Pakistan's health policy. Therefore, in the given context above, we assume that LBW is a prominent global social issue, particularly in South Asia. However, the major focus of this research was to explore the paternal factors associated with LBW. For this purpose, data were taken from the PDHS 2012-13. However, small birth weight was used as a proxy variable for LBW infants.

**METHODOLOGY**

In this research, we utilized relevant data from the third PDHS, conducted in 2012-13. This large-scale national survey covered all the provinces of Pakistan (NIPS, 2013). This research was carried out with a sample size of 7461, based on fathers who had at least one child during the previous five years. Following the ethics of research, verbal informed consent was taken from the respondents.

To fulfill the objective of this study, the selection of variables for analysis (Table 1) was informed by the literature and their availability in the PDHS dataset. In this research, paternal factors were considered as independent variables: de facto place of residence, place of residence, place of residence, father's education, age, nature of employment, and wealth index. Similarly, LBW was considered a dependent variable in this research. In PDHS, the response rate regarding birth weight was insufficient to fulfill the requirements of the statistical analysis. To overcome this problem, we considered the "length of the child at the time of birth" as an alternative variable for LBW. In PDHS, the length of the child was available in different categories (very small, smaller than average, average, large, and very large); however, in our research, we considered the children who had length "smaller than average" or "very small" as low-birth-weight children, and the rest of the children were considered as normal-weight children. Finally, the total sample size was 7436, from which 5948 (79.7%) infants were born with normal length (NL) and 1488 (19.9%) infants were born with length below the average (LBA).

We used binary logistic regression to check the net relationship between paternal factors and LBW. As an outcome variable, LBW was dichotomous (0 = birth with normal weight, and 1 = below normal). Fathers who had at least one baby during the past five years were selected in our study. Data analysis was performed using SPSS version 21. The model estimates are presented in odds and adjusted odds ratios, along with the associated p-values, for ease of interpretation.

**RESULTS AND DISCUSSION**

Table 1 shows the paternal factors of the respondents. Findings indicate that the more than half (56.1%) of the respondents were living in a countryside area, and more than half (56.1%) of the respondents were living in a rural area, A majority (32.7%) of the fathers had secondary education, more than half (56.8%) of the fathers were engaged with skilled work, a majority (70%) of the fathers belonged to the age group of 30-50 years, the majority (41.6%) of the fathers belonged to the poor wealth index and more than half (56.1%) of the fathers were belonged to the rural areas. Similarly, Table 1 also shows that 19.9% of children reported below the normal length.

Table 1: Paternal characteristics based upon the women who are aged between 15-49 years and delivered a child in the five years before PDHS (n=7461)

| Paternal Factors | Categories | N (%) |
|---|---|---|
| De Facto Place of Residence | Large City | 1501(20.1) |
| | Small City | 1777(23.8) |
| | Countryside | 4183(56.1) |
| Type of place of residence | Urban | 3278(43.9) |
| | Rural | 4183(56.1) |
| Father's Education | No Education | 2293 (30.7) |
| | Primary | 1014 (13.6) |
| | Secondary | 2441 (32.7) |
| | Higher | 1689 (22.6) |

| | | |
|---|---|---|
| Father's Nature of Employment | Unemployed | 1967 (26.4) |
| | Unskilled | 4241 (56.8) |
| | Skilled | 1251 (16.8) |
| Father's Age In years | 15-29 | 1893 (25.4) |
| | 30-50 | 5225 (70.0) |
| | 51 > | 236 (3.2) |
| Wealth Index | Poor | 3106(41.6) |
| | Middle | 1429(19.9) |
| | Rich | 2926(39.2) |
| Child's size at the time of birth | Normal | 5948(79.7) |
| | Below the Normal | 1488(19.9) |

Table 2 shows the cross-tabulation between territorial factors and SSB. The findings indicate that all paternal factors, such as de facto place of residence and place of residence, are significantly associated with SSB.

Table 2: Cross tabulation between selected paternal territorial characteristics based upon women who are aged between 15-49 years and delivered a child in the five years before PDHS (n=7461)

| Territorial Factors | Length at the time of birth | | p-value |
|---|---|---|---|
| | Normal length of the child | Below the Normal length of the child | |
| | F (%) | F (%) | |
| De Facto Place of Residence | | | |
| Large City | 1290(21.7) | 206(18.8) | 0.000 |
| Small City | 1427(24) | 243(23.1) | |
| Countryside | 3231(54.3) | 939(63.1) | |
| Place of Residence | | | |
| Rural | 2717(45.7) | 549(36.9) | 0.000 |
| Urban | 3231(54.3) | 939(63.1) | |

Table 3 shows the cross-tabulation between paternal factors and small-size birth (SSB). The findings revealed that fathers' education, the nature of employment, and wealth index are significantly associated with SSB. However, father's age is not associated with SSB.

Table 3: Cross tabulation between selected paternal characteristics based upon the women who are aged between 15-49 years and delivered a child in the five years before PDHS (n=7461)

| Parental Factors | Length at the time of birth | | Total | p-value |
|---|---|---|---|---|
| | Normal length of the child | Below the Normal length of the child | | |
| | F (%) | F (%) | | |
| Father education | | | | |
| No education | 1784(30.1) | 502(33.8) | 2286 | 0.000 |
| Primary | 759(12.8) | 252(17) | 1011 | |
| Secondary | 1973(33.3) | 463(31.2) | 2436 | |

| | | | | |
|---|---|---|---|---|
| High | 1415(23.9) | 267(18) | 1682 | |
| Father Nature of employment | | | | |
| Unemployed | 1513(25.4) | 447(30) | 447 | 0.001 |
| Unskilled | 3410(57.3) | 815(54.8) | 815 | |
| skilled | 1023(17.2) | 226(15.2) | 226 | |
| Father's Age in years | | | | |
| 15-29 | 1484(25.3) | 405(27.5) | 1889 | 0.122 |
| 30-50 | 4193(71.6) | 1014(68.9) | 5207 | |
| 51 or > | 183(3.1) | 53(3.6) | 236 | |
| Wealth Index | | | | |
| Poor | 2311(38.9) | 785(52.8) | 3096 | 0.000 |
| Middle | 1150(19.3) | 276(18.5) | 1426 | |
| Rich | 2487(41.8) | 427(28.7) | 2914 | |
| Place of Residence | | | | |
| Rural | 2717(45.7) | 549(36.9) | 5948 | 0.000 |
| Urban | 3231(54.3) | 939(63.1) | 1488 | |

Table 4 shows the analysis of LBW based on bivariate logistic regression. The results indicate that, compared to big cities, the risk of SSB is higher for fathers who live in small cities (odds ratio, 1.50; 95% CI, 1.24-1.81) and the countryside (odds ratio, 1.82; 95% CI, 1.54-2.14). However, in the multivariate logistic analysis, fathers residing in small cities still had a significant risk of SSB (aOR 1.39; 95% CL 1.14-1.71). The findings in Table 4 further show that the place of residence is also associated with SSB. However, compared to the urban area, the risk of SSB is 1.79 times higher (95% CI: 1.51-2.13) for fathers who belong to rural areas. However, in the multivariate binary logistic regression, the risk of SSB for the village area fathers still exists (aOR 1.79; 95% CL 1.51, 2.13)

Table 4: Association between selected territorial factors based upon the women who are aged between 15-49 years and delivered a child in the five years before PDHS (n=7461)

| Territorial Factors | Length at the time of birth | | Odds Ratio (95% CI) a | Adjusted Odd Ratio (95% CI) b |
|---|---|---|---|---|
| | Normal length of the child F (%) | Below the Normal length of the child F (%) | | |
| De Facto Place of Residence | | | | |
| Small City | 1427(24) | 243(23.1) | 1.50(1.24-1.81) *** | 1.39(1.14-1.71) ** |
| Countryside | 3231(54.3) | 939(63.1) | 1.82(1.54-2.14) *** | - |
| Large City | 1290(21.7) | 206(18.8) | Reference | Reference |
| Place of Residence | | | | |
| Rural | 2717(45.7) | 549(36.9) | 1.43(1.27-1.61) | 1.79(1.51-2.13) *** |
| Urban | 3231(54.3) | 939(63.1) | Reference | Reference |

NSNot Significant; * p<0.05; ***p=0.000; ** p<0.01,

Table 5 illustrates the relationship between paternal factors and LBW. In the bivariate logistic regression findings show that, the risk of SSB is higher for those fathers who had no education (odds 1.49; 95% CL 1.27, 1.76), primary education (odds 1.76; 95% CL 1.45, 2.14), and secondary education (odds 1.24; 95% CL 1.05, 1.47) as compared to those who had higher education. As evidence is available in Table 5, in the outcome of multivariate binary logistic regression, the risk of SSB was lost for those fathers who had no education or a secondary level of education, but surprisingly not for those fathers who had education up to the primary level (aOR 1.34; 95% 1.09, 1.64). The risk of SSB is higher in unemployed fathers (odds 1.34; 95% CI 1.12-1.60) compared to skilled ones. However, this relationship became consistent in multivariate binary logistic regression (aOR 1.20; 95% 1.00, 1.44). The findings of Table 5 show that the age of the father is not associated with SSB. Similarly, the risk of SSB is higher in fathers from poor (odds ratio 1.98, 95% CI 1.74, 2.26) and middle (odds ratio 1.40, 95% CI 1.83, 1.65) wealth-ranked backgrounds compared to those from rich backgrounds. However, this relationship became consistent in multivariate binary logistic regression.

Table 5: Association between selected paternal characteristics based upon the women who are aged between 15-49 years and delivered child in the five years before PDHS (n=7461)

| Paternal Factors | Length at the time of birth | | Odds Ratio (95% CI) a | Adjusted Odd Ratio (95% CI) b |
|---|---|---|---|---|
| | Normal Length of the child N (%) | Below the Normal length of the child N (%) | | |
| Father education | | | | |
| No education | 1784(30.1) | 502(33.8) | 1.49(1.27-1.76) *** | 1.04(1.86-1.26) NS |
| Primary | 759(12.8) | 252(17) | 1.76(1.45-2.14) *** | 1.34(1.09-1.64) ** |
| Secondary | 1973(33.3) | 463(31.2) | 1.24(1.05-1.47) ** | 1.06(0.89-1.25)NS |
| High | 1415(23.9) | 267(18) | Reference | Reference |
| Father Nature of employment | | | | |
| Unemployed | 1513(25.4) | 447(30) | 1.34(1.12-1.60) ** | 1.20(1.00-1.44) * |
| Unskilled | 3410(57.3) | 815(54.8) | 1.08(0.92-1.27) NS | 1.0(0.90-1.26) NS |
| skilled | 1023(17.2) | 226(15.2) | Reference | Reference |
| Father's Age in years | | | | |
| 15-29 | 1484(25.3) | 405(27.5) | 0.94(0.68-1.30) NS | 0.99(0.71-1.38) NS |
| 30-50 | 4193(71.6) | 1014(68.9) | 0.84(0.61-1.14) NS | 0.91(0.66-1.26) NS |
| 51 or > | 183(3.1) | 53(3.6) | Reference | Reference |
| Wealth Index | | | | |
| Poor | 2311(38.9) | 785(52.8) | 1.98(1.74-2.26) *** | 1.86(-1.60-2.16) *** |
| Middle | 1150(19.3) | 276(18.5) | 1.40(1.83-1.65) *** | 1.32(1.11-1.57) ** |
| Rich | 2487(41.8) | 427(28.7) | Reference | Reference |

NS Not Significant; * p<0.05; ** p<0.01, ***p=0.000

**Discussion**

This research was extracted from the PDHS, which was conducted in Pakistan. We selected the paternal factors, such as place of residence, education, age, nature of employment, and wealth index, to predict LBW. LBW variable used as a proxy variable extracted from the small size birth variable used in PDHS 2012-13. LBW is a significant health issue in Asia and other developed and developing countries (WHO, 2025). Progress in reducing low birthweight has been slow since 2000. More than 90 percent of countries are off track to meet the 2030 low-birthweight target (UNICEF, 2025). Only 14 countries are on track to achieve the World Health Assembly's global target on low birthweight, with 10 of them located in North America, Europe, and Australia and New Zealand. Across all regions, most countries are

showing no progress. However, data used in this research show that 19.9% of fathers had infants with SSBs. It was seen that SSBs had decreased compared to the previous data. As PDHS (2006-07) reported an overall 34% of SSBs. This improvement may be attributed to modest achievements in Millennium Development Goals (MDGs), later converted into Sustainable Development Goals (SDGs), reproductive health, and child mortality. According to the Pakistan Millennium Development Goals Report (2013), the number of infant deaths decreased from 102 to 77 deaths per 1,000 between 1990/91 and 2001/02. However, in the decade since then, it has only reduced to 74 deaths per 1,000 live births in 2012/13. Further improvements indicate that the infant mortality rate has been reduced to 51 in 2022-23, largely due to the implementation of sustainable development goals related to reproductive health (UNICEF, 2025). These statistics show that the infant mortality rate has been controlled in Pakistan, but twice as compared to neighboring countries such as India and Bangladesh (UNICEF, 2025). Despite this decline, various regions such as southern Punjab and northern Baluchistan still have a high risk of child mortality due to inadequate maternity services (Burstein et al., 2019). Pakistan has an estimated 860,000 preterm births every year, resulting in roughly 102,000 child fatalities from complications. Pakistan ranks second among the top 10 nations, causing two-thirds of preterm birth deaths (UNICEF, 2017)

Importantly, paternal factors play a crucial role in enhancing healthcare services for the family. Previous literature has concluded that Place of residence has a significant influence on people's healthcare choices. Therefore, in this research, we examined the relationship between fathers' place of residence and LBW. Our findings indicate that fathers living in small cities or rural areas had a greater risk of consuming SSBs than those in large cities. Findings further revealed that fathers residing in rural areas had a higher risk of SSB compared to those living in urban areas. The findings of our study are in line with prior literature; for example, previous research concluded that fathers who were residing in rural areas had a greater risk of infants with LBW when compared with those fathers who were living in the capital city (Kebede et al., 2021; Fan et al., 2015). However, another study found that the prevalence of LBW babies was higher in rural regions than in urban regions (Kundu et al., 2023; Dahlui et al., 2016). These variations may be attributed to various factors, such as women belonging to rural areas experiencing pregnancy-infections related to pregnancy, inadequate food intake, and absence of antenatal care (Jayant et al., 2011; Kebede et al., 2021; Alam et al., 2022; Kundu et al., 2023). Similarly, the parents residing in small urban, less developed, and rural areas of Pakistan are reportedly deprived of basic childcare and reproductive health facilities (Shaeen et al., 2022; Asim et al., 2022).

Several studies have shown that LBW is associated with socioeconomic status and parental factors (Alsayeed et al., 2023; Fan et al., 2015). Increasing involvement and support from men can also be beneficial in tackling other significant problems addressed by health care services, such as preterm birth, low birth weight, and fetal harm (Abute et al., 2025; Dudgeon & Inborn, 2004).

Education is considered a key determinant of paternal socio-economic status. However, the findings of our research indicate that the education of fathers is highly associated with the SSBs. Fathers who were illiterate or had primary or secondary education had a higher risk of low birth weight compared to those who had a higher education level. These findings are consistent with the existing literature. For example, research suggests that a husband's literacy level is associated with the timely utilization of health services (Wulandari et al., 2022; Raina et al., 2000). Similarly, research conducted in Pakistan found that, fathers with a lower level of education had a greater risk of infant's low birth weight in various regions of Pakistan, such as Karachi (Ahmed et al., 2012), Peshawar (Badshah et al., 2008), Chitral (Shaikh et al., 2011), and Lahore (Zahra et al., 2022). Similar findings can be observed in various regions of Asia, such as Indonesia (Kusrini et al., 2021), Bangladesh, and India (Sathi et al., 2022). In conclusion, paternal education decreased the risk of birth with low weight among the children. To overcome this issue, mandatory reproductive education should be given to the male counterparts. In this context, corner meetings can be helpful. Similarly, in various South Asian regions, particularly Pakistan and India, couples cannot visit the maternity centers to discuss the reproductive complications; this facility should also be provided.

However, one of the findings of our research is consistent with the existing literature, which indicates that fathers' employment has a positive association with LBW in infants. The nature of a father's employment, a significant paternal socioeconomic indicator, plays a crucial role in the family's health, as job displacements partially affect LBW and fertility (Gailey et al., 2022; Lindo, 2010). Similarly, women whose husbands held white-collar occupations utilized antenatal care significantly more than women whose husbands held blue-collar occupations (Fatmi & Avan, 2002). Our research findings also showed that unemployed fathers had a greater risk of LBW than skilled ones. Prior studies from various regions also revealed similar results. For example, cross-sectional studies in India (Singh et al., 2023), Pakistan (Zakar et al., 2015), Bangladesh (Chowdhury et al., 2021), and Tanzania (Sabas et al., 2021) found that unstable employment was associated with increased risk of LBW, largely due to reduced family income and limited access to healthcare. Unemployed fathers had a greater risk of SSBs than skilled ones (Lindo 2010; Zakar et al., 2015).

Paternal age may contribute to the increasing rate of LBW infants, which may indirectly result in a higher incidence of infant mortality and childhood morbidity (Mao et al., 2021). Recent studies have consistently shown that paternal age significantly impacts birth outcomes. For example, some studies in Pakistan found that younger fathers are at great risk of SSBs (Zakar et al., 2015; Shah, 2010). Conversely, some studies revealed that fathers above 34 had a greater risk of infants with LBW than younger ones (Goisis et al., 2018; Reichman & Teitler, 2006). In contrast, our study's findings contradict prior literature. Our findings revealed that the father's age is not associated with SSBs. This change may be due to increased awareness about healthcare facilities or improvements in the fertility behaviors of husbands and wives. However, these findings should be revised in future research.

The family's wealth is also associated with health outcomes. Couples who are economically empowered may have access to quality healthcare facilities, including reproductive health services (Shanto et al., 2023; Muhajarine et al., 2025). In line with these studies, our research also found that the risk of SSBs is higher in poor and middle wealth-ranked fathers as compared to those who were rich. Similar findings were revealed in the Nigerian (Dahlui et al., 2016) and Pakistan Demographic and Health survey data (Zakar et al., 2015). Households located in Urban and rural areas with a poor wealth index organized their pregnancies at home. A similar trend has been found in the studies from sub-Saharan Africa, Ethiopia, India, and Bangladesh (Kebede et al., 2021; Alam et al., 2022; Kundu et al., 2023).

However, this research has the following limitations. Firstly, the findings are limited to the country's data and may not cover the ground realities. In the future, both cross-sectional and longitudinal research should be conducted. Secondly, this research is limited to the paternal factors mentioned in the DHS. Future research should also consider various other factors, such as paternal reproductive literacy, smoking habits, and the nature of the family. For a more in-depth understanding, qualitative research can become more beneficial.

**CONCLUSIONS AND RECOMMENDATIONS**

In this PDHS, 19.9% of the fathers were reported with infants having LBW. The findings revealed that the risk of SSB was greater among fathers residing in small cities and village areas. Similarly, the risk of SSB was also higher for those fathers who were less educated, unemployed, and poor. However, the father's age is not associated with SSB. Further research is needed to critically evaluate this issue.

This research has the following practical implications. The factors associated with low birth weight (LBW) are omitted in the PDHS and other country-level surveys, resulting in unexplored LBW cases. These factors should be included in the forthcoming surveys. It should also be mandatory to register the LBW cases to understand the actual tendencies. Secondly, although Pakistan is adhering to the roadmap for implementing the SDGs, policies concerning LBW are overlooked due to structural deficiencies and constrained economic resources. The government of Pakistan and policymakers should overcome these barriers and provide access to free medications, prenatal care, and antenatal checkup facilities at the grassroots level. Policy makers should also initiate reproductive health literacy programs for men to assist their partners during pregnancy.

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