

Prevalence and risk factors for low birth weight in Jordan and its association with under-five mortality: a population-based analysis

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Abstract

Background: Low birth weight (< 2.5 kg) is an important indicator of health and development of infants throughout their life.

Aims: This study aimed to determine the prevalence and risk factors for low birth weight in Jordan and its association with under-5 mortality.

Methods: In this secondary analysis, data were extracted from the 2012 Jordan Population and Family Health Survey for 9734 live births born in the 5 years preceding the survey and for which birth weight was reported. Data were collected on child and maternal characteristics. Multivariable regression analysis was used to determine the significant risk factors for low birth weight and mortality.

Results: Of the 9734 births analysed, 13.8% were low birth weight and 1.3% were very low birth weight. Mother's age (< 30 and ≥ 35 years), education (less than higher education), birth interval (< 24 months and first birth), unplanned pregnancy, household wealth status (poorest and richest), consanguinity, residence (central and south regions of Jordan), female sex, birth order (1 and ≥ 6), twin birth and maternal smoking during pregnancy were significant risk factors for low birth weight. The risk of death under 5 years of age was 4.8 times higher in children with low birth weight than children with normal birth weight.

Conclusions: The high rate of low birth weight and its increasing rate in Jordan is a challenge for public health. Preventing low birth weight neonates and increasing their survival need to be prioritized in the national health strategy. Special care needs to be taken for the high-risk groups identified in this study.

Keywords: low birth weight, risk factors, childhood mortality, Jordan

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Introduction

Low birth weight (LBW) has been defined by the World Health Organization (WHO) as a birth weight of less than 2500 g irrespective of gestational age (1,2). This definition is mainly based on epidemiological observations to serve for international comparative health statistics. For clinical care the preferred definition is: small for gestational age defined as a weight and/or length less than –2 standard deviations (SD). However, ascertaining small for gestational age is not straightforward as it requires accurate measurement of anthropometry at birth including weight, length and head circumference (3).

Birth weight has long been a subject of clinical and epidemiological investigation and a target for public health interventions. In particular, considerable attention has been focused on the causes of LBW in order to identify potentially modifiable factors. LBW is one of the most important predictors of nutrition, health and survival of infants (2). LBW is also an important biomarker of adverse health and development problems in early and later life, including delays in cognitive and behavioural development, growth retardation, neurological problems

in childhood, and many chronic diseases (2,4–7). Babies with LBW have a 5–30 times higher risk of dying during infancy than normal birth weight (≥ 2500 g) babies (2).

Globally, more than 20 million babies are born annually with LBW – about 15.5% of all live births (2). The incidence of LBW differs considerably between developed and developing countries. About 96% of newborns with LBW are born in developing countries – about 72% in Asia and 22% in Africa (2). The incidence of LBW in developing countries (17%) is more than double the incidence in developed regions (7%) (2). Thus, LBW is a particularly important public health problem in developing countries.

LBW can be a consequence of preterm birth (i.e. birth before 37 completed weeks of pregnancy), or intrauterine growth restriction, each of which is influenced by many factors related to the mother, the infant, the physical environment or genetics (2,4,5,7). However, the pattern of risk factors for LBW and their relative contribution vary from one setting to another. It is therefore important to identify population-specific factors affecting LBW so that appropriate policy interventions can be formulated to improve child health and survival.

While a considerable amount of research has been done on LBW – mostly in developed countries – LBW issues in developing countries, including Jordan, have not been adequately investigated. To fill this gap, we aimed to examine the prevalence, trends and determinants of LBW in Jordan. We also examined the effect of LBW on childhood mortality.

Methods

Study design and sample

This was a secondary analysis of data from the 2012 Jordan Population and Family Health Survey conducted as part of the Demographic and Health Survey (DHS) programme (8). The survey included a nationally representative sample of 11 352 ever-married women aged 15–49 years from 15 190 households. The fieldwork was carried out between 9 September and 20 December 2012.

The sample of the 2012 survey was designed to produce reliable estimates of major survey indicators for: the country as a whole; urban and rural areas; each of the 12 governorates; and two specific populations (people living in the Badia area and people living in refugee camps). The Badia area is where mostly Bedouin tribes, who used to lead a traditional nomadic life, live. This area includes both the arid and semi-arid area of Jordan which constitutes 80% of the total land area and 6.5% of the total population of the country lives there (9). Details of the survey methodology can be found in the final report of the 2012 Jordan Population and Family Health Survey (8).

Data collected

In the 2012 survey, all women interviewed were asked to provide a detailed history of all their live births in a chronological order, including birth weight of child born in the 5 years preceding the survey date, sex of child, date of birth, survival status and their own socioeconomic and demographic characteristics.

Our analysis was based on children born in the 5 years before the survey, whose birth weights were available. The 2012 Jordan Population and Family Health Survey provided birth weight records of 9734 such live births and these children were our study subjects.

Variables

We considered birth weight as the outcome variable and socioeconomic and demographic characteristics of mothers and the children as the explanatory variables. We used the WHO definition of LBW because direct measurement of birth weight was available in the 2012 Jordanian survey. Thus, a birth weight less than 2.5 kg was considered LBW and a birth weight less than 1.5 kg was considered very LBW (VLBW). A birth weight of 2.5 kg or more was considered normal birth weight (NBW). The explanatory variables were: mother's age at birth of the child (< 20, 20–29, 30–34 and ≥ 35 years), mother's education (no education, primary, secondary, higher), birth order of the child (1,2–3,4–5,6), child's sex (male, female), type of birth (twin, singleton), birth interval since the previous birth

(< 24 months, ≥ 24 months, first birth), planned pregnancy (yes, no), region of residence (central, north, south), consanguineous marriage (yes,no), smoking during pregnancy (yes, no), and wealth index (lowest, second, middle, fourth, and highest quintiles). The wealth index, which is used by DHS globally, is a composite indicator of the economic status of the family (10), and is based on analysis of household assets such as possession of a television, refrigerator, car and household construction material. Smoking includes both cigarettes and use of the *nargile* (water pipe). All the above-mentioned socioeconomic and demographic variables were selected based on literature review and the availability of the data in the survey.

Data analysis

We used numbers and percentages to describe the characteristics of all births, and NBW, LBW and VLBW births. We used the chi-squared test to assess the significance of differences in birth weight according to socioeconomic or demographic factor. A *P*-value less than 0.05 was considered statistically significant.

To examine the association of LBW with childhood mortality, we considered the probability of death based on survival status and age at death for children in the age range 0 to 59 months (i.e. under 5 years) as the outcome variable. We categorized deaths as neonatal, post-neonatal, infant and under-5 depending on age at death. Neonatal deaths were defined as those occurring within 28 days of birth among live births, post-neonatal deaths as those occurring between 28 days and < 12 months, infant deaths as those occurring between birth and 12 months and under-5 deaths as those occurring before 60 months of age. We estimated the neonatal, post-neonatal, infant and under-5 mortality rates for LBW babies and NBW babies by dividing the cumulative number of deaths in each age interval by the number of live births at the beginning of that interval. For example, the post-neonatal mortality rate was estimated by dividing the number of deaths occurring between 28 days and < 12 months by the number of live births minus the neonatal deaths, and then expressed per 1000 live births.

We used multiple logistic regression analysis to determine the factors associated with LBW and VLBW and also the risk of death in children with LBW compared with children with NBW. Socioeconomic and demographic variables that were significantly associated with LBW, VLBW and risk of death in children with LBW in the bivariate analysis (chi-squared test) were included in the logistic regression analysis. We calculated adjusted odds ratios (AOR) and 95% confidence intervals (CI), controlling for all other socioeconomic and demographic variables that were significant in chi-squared test analysis.

Ethical considerations

The data from the Jordan Population and Family Health Survey are public access data and were made available to us by MEASURE DHS upon request. Informed consent was obtained from the respondents prior to the survey

interview. Ethical clearance to conduct the Jordan Population and Family Health Survey was given by the Government of Jordan.

Results

Sample characteristics

More than half (56.4% (5485)) of the children included in the analysis had mothers aged less than 30 years at the time of their birth, while 1894 (19.4%) had mothers aged 35 years and older (Table 1). The mean (SD) age of mothers at the time of birth of the children was 28.8 (6.1) years. Most of the mothers had secondary education (60.0% (5842), and 3084 (31.7%) had higher education. This was similar with the fathers: 6119 (62.9%) of the fathers had secondary education and 2429 (25.0%) had higher education. As regards birth order, 2282 (23.4%) of the children were the first-born child and 3653 (37.5%) were the fourth-born or more. Only 952 (9.8%) of the pregnancies were unplanned, and the interval since the previous birth was less than 2 years for 2366 (24.3%) of the children. Parental consanguinity was reported for 3288 (33.8%) of the children, and 1412 mothers (14.5%) smoked during pregnancy.

Prevalence of and trends in LBW

The mean (SD) birth weight of the infants born in the 5 years preceding the survey was 3090.4 (663.8) g or 3.09 (0.664) kg. The prevalence of LBW (< 2500 g) was 13.8% (1348/9734) in 2012, which included 123 (1.3%) VLBW births (< 1500 g). Thus, the prevalence of VLBW among the total LBW births was 9.1% (Table 1).

Since 1990 there have been seven DHS conducted in Jordan. All these surveys followed the same methodology. The LBW rates estimated from these surveys show an increasing trend in LBW rates in Jordan (Figure 1). The prevalence of LBW increased from 8.8% in 1990 to 13.8% in 2012 – an increase of 57% over a period of 22 years ($t = 9.96, P < 0.001$) (8,11–14).

Predictors of LBW and VLBW

In the bivariate analysis with the chi-squared test, all selected socioeconomic and demographic factors, except for urban/rural residence, were significantly associated with birth weight (Table 1). Young maternal age was significantly associated with LBW birth: 22.4% of LBW births were in mothers aged < 20 years compared with mothers aged 30–34 years (10.9%). VLBW births followed a similar maternal age pattern. Mothers' education showed a significant negative association with both LBW and VLBW: 18.3% of the LBW children were born to mothers with no education compared with 14.9% for mothers with a secondary education ($P < 0.001$). A greater proportion of LBW births were found in: first births than higher birth order ($P = 0.04$); females than males ($P < 0.001$); twins compared with singleton births ($P < 0.001$); mothers with a short birth interval (< 2 years) compared with longer birth interval (≥ 2 years; $P < 0.001$); unplanned pregnancy ($P = 0.002$); consanguineous marriage ($P = 0.043$); and

smoking ($P < 0.001$). Father's lack of education was also negatively associated with LBW ($P < 0.001$). Birth weight varied significantly across the three regions of Jordan: LBW was significantly higher in the South region than the North region ($P = 0.002$). Birth weight showed a significant but inconsistent pattern of association with the household wealth index. A greater proportion of mothers in the lowest and highest wealth quintiles had babies with LBW or VLBW than those with middle or fourth wealth quintiles.

To adjust for confounding of variables associated with LBW and VLBW, we used a multivariable logistic regression analysis (Table 2). Mother's age (< 30 and ≥ 35 years), education (less than higher education), birth interval (< 24 months), unplanned pregnancy, households with lowest and highest wealth quintiles, consanguinity, residence in central and south regions, female sex of baby, birth order 1 and ≥ 6 , twin birth and maternal smoking during pregnancy were all significant risk factors for LBW. For VLBW, the statistically significant risk factors were: maternal age 20–29 and ≥ 35 years, primary education and less, birth order 2–3 and ≥ 6 , female sex of baby, twin birth, unplanned pregnancy and residence in the central region.

LBW and childhood mortality

Of the 9734 live births with information on birth weight, 172 died during childhood (i.e. aged 0–59 months). Thus, the overall mortality rate was 17.67 deaths per 1000 live births under the age of 5 years. The corresponding rates for children with LBW and NBW were 57.86 per 1000 live births and 11.21 per 1000 live births, respectively (Table 3), a statistically significant difference ($P < 0.001$). Thus, children with LBW had a 5.16 times higher mortality rate in childhood than children with NBW.

Mortality rates of children with LBW were significantly higher than the mortality rates of children with NBW in all age ranges under the age of 5 years. For example, the infant mortality rate was 54.9 deaths per 1000 live births in infants born with LBW compared with 8.7 deaths per 1000 live births in infants born with NBW – a 6.3 times higher mortality for infants born with LBW ($P < 0.001$). It is worth mentioning here that most (76%) of the deaths under age 5 years of age had occurred in the neonatal period. This was true for both the LBW and NBW babies. However, this proportion (88.5%) for LBW babies was significantly higher than the proportion (64.9%) for NBW babies (95% CI for the difference: 0.116–0.355; $P < 0.001$), indicating a greater influence of LBW on death during the neonatal period. The neonatal mortality rate was 7.0 times higher in LBW babies than NBW babies (51.19 versus 7.27 deaths per 1000 live births) and the difference was statistically significant ($P < 0.001$).

The adjusted analysis using multiple logistic regression analysis showed LBW to be a strong predictor of childhood mortality (Table 3). The risk of all types of childhood death, except post-neonatal death, was significantly higher in children born with LBW than children born with NBW. The greatest effect of birth

Table 1 Distribution of all live births in the 5 years preceding the survey and birth weight according to background characteristics

Characteristic	All live births	Normal birth weight	Low birth weight ^a	Very low birth weight	P-value ^b
	No. (%)	No. (%)	No. (%)	No. (%)	
Total	9734 (100)	8386 (86.2)	1348 (13.8)	123 (1.3)	
Mother's age at birth of child (years)					< 0.001
< 20	424 (4.4)	329 (77.6)	95 (22.4)	9 (2.1)	
20–29	5061 (52.0)	4327 (85.5)	734 (14.5)	79 (1.6)	
30–34	2355 (24.2)	2099 (89.1)	256 (10.9)	15 (0.6)	
≥ 35	1894 (19.5)	1631 (86.1)	263 (13.9)	20 (1.1)	
Mean (SD)	28.8 (6.1)	29.0 (6.0)	28.2 (6.4)	27.8 (5.9)	
Mother's education					< 0.001
No education	190 (2.0)	155 (81.2)	35 (18.3)	6 (3.1)	
Primary	618 (6.3)	508 (82.2)	110 (17.8)	9 (1.5)	
Secondary	5842 (60.0)	4972 (85.1)	870 (14.9)	77 (1.3)	
Higher	3084 (31.7)	2751 (89.2)	333 (10.8)	31 (1.0)	
Birth order					0.004
1	2282 (23.4)	1914 (83.9)	368 (16.1)	43 (1.9)	
2–3	3799 (39.0)	3286 (86.5)	513 (13.5)	52 (1.4)	
4–5	2347 (24.1)	2056 (87.6)	291 (12.4)	18 (0.8)	
≥ 6	1306 (13.4)	1130 (86.5)	176 (13.5)	10 (0.8)	
Mean (SD)	3.22 (2.1)	3.24 (2.1)	3.11 (2.0)	2.57(1.8)	
Child's sex					< 0.001
Male	5074 (52.1)	4493 (88.5)	581 (11.5)	41 (0.8)	
Female	4660 (47.9)	3893 (83.5)	767 (16.5)	82 (1.8)	
Type of birth					< 0.001
Singleton	9391 (96.5)	8234 (87.7)	1157 (12.3)	87 (0.9)	
Twin	343 (3.5)	152 (44.3)	191 (55.7)	36 (10.5)	
Planned pregnancy					0.002
Yes	8781 (90.2)	7601 (86.6)	1180 (13.4)	104 (1.2)	
No	952 (9.8)	785 (82.4)	167 (17.5)	19 (2.0)	
Birth interval					< 0.001
< 24 months	2366 (24.3)	2030 (85.8)	336 (14.2)	21 (0.9)	
≥ 24 months	5032 (51.7)	4398 (87.3)	636 (12.6)	49 (1.0)	
First birth	2332 (24.0)	1958 (84.0)	374 (16.0)	53 (2.3)	
Father's education					< 0.001
No education	99 (1.0)	80 (80.8)	19 (19.2)	1 (1.0)	
Primary	1087 (11.2)	883 (81.2)	204 (18.8)	12 (1.1)	
Secondary	6119 (62.9)	5317 (86.9)	802 (13.1)	86 (1.4)	
Higher	2429 (25.0)	2106 (86.7)	323 (13.3)	24 (1.0)	
Region					0.002
Central	5950 (61.1)	5102 (85.7)	848 (14.3)	60 (1.0)	
North	2843 (29.2)	2482 (87.3)	361 (12.7)	48 (1.7)	
South	941 (9.7)	802 (85.2)	139 (14.8)	15 (1.6)	
Place of residence					0.564
Urban	7926 (81.4)	6822 (86.1)	1104 (13.9)	97 (1.2)	
Rural	1808 (18.6)	1564 (86.5)	244 (13.5)	26 (1.4)	

Table 1 Distribution of all live births in the 5 years preceding the survey and birth weight according to background characteristics (Concluded)

Characteristic	All live births	Normal birth weight	Low birth weight ^a	Very low birth weight	P-value ^b
	No. (%)	No. (%)	No. (%)	No. (%)	
Wealth index (centile)					0.046
Lowest	2230 (22.9)	1879 (84.3)	351 (15.7)	29 (1.3)	
Second	2166 (22.3)	1860 (85.9)	306 (14.1)	33 (1.5)	
Middle	2103 (21.6)	1846 (87.8)	257 (12.2)	22 (1.0)	
Fourth	1880 (19.3)	1637 (87.1)	243 (12.9)	21 (1.1)	
Highest	1354 (13.9)	1163 (85.9)	191 (14.1)	18 (1.3)	
Consanguinity					0.043
Yes	3288 (33.8)	2809 (85.4)	479 (14.6)	43 (1.3)	
No	6446 (66.2)	5577 (86.5)	869 (13.5)	80 (1.2)	
Smoking during pregnancy					< 0.001
No	8322 (85.5)	7232 (86.9)	1090 (13.1)	96 (1.2)	
Yes	1412 (14.5)	1154 (81.7)	258 (18.3)	27 (1.9)	

SD: standard deviation.
^aLow birth weight includes very low birth weight also.
^bChi-squared test.
 The number of missing values may vary for each variable.
 Source: Jordan Population and Family Health Survey, 2012 (9).

weight on death was in the neonatal (age 0–1 month) period: neonatal deaths were 6 times higher in babies born with LBW than those born with NBW (OR = 6.09, 95% CI: 4.17–8.91).

Discussion

It is encouraging to note that birth weight data from Jordan Population and Family Health Survey were available for 99% of births occurring in the 5 years preceding the survey. The availability of birth weight data for almost all infants in Jordan is not surprising because most deliveries in the country take place in health facilities, where health personnel usually weigh the newborn and record the weight on a health card.

The mean (SD) birth weight of the children in our analysis was 3.09 (0.66) kg, which is lower than the newborns on the United States of America (3.45 kg) on whom WHO’s reference standard is based (15).

The estimated prevalence of LBW in Jordan was 13.8% in 2012, which is higher than the average incidence of LBW of 7.0% in developed countries, but lower than the average incidence of LBW of about 17.0% in developing countries (2). Although, 2019 LBW estimates indicated that the global estimate of LBW had declined since 2000 (16), our results show an increasing trend in LBW in Jordan from 8.8% in 1990 to 13.8% in 2012, a 57% increase. Various reasons have been put forward to explain increasing trends in LBW, which include epidemiological transition, change in lifestyle and food habits, improvement in medical technology, and increasing trends in premature and twin births (17–20). During pregnancy, mothers’ metabolic demands increase due to modifications in mothers’ physiology and the requirements of a growing fetus (21).

Epidemiological transition, change in lifestyle and food habits or nutritional intake have many dimensions that affect maternal metabolism. Epidemiological transition such as increased cardiovascular disease, type 2 diabetes, blood pressure and osteoporosis are associated with adverse pregnancy outcomes including LBW (20–22). Lifestyle behaviours such as cigarette smoking, alcohol and drug use, weight gain during pregnancy, physical activity and stress play important roles in determining fetal growth (23,24). There is much evidence supporting the link between inadequate maternal nutritional status and adverse pregnancy outcomes (25–28). Detailed

Figure 1 Trends in low birth weight in Jordan, 1990–2012
 Source: Calculated using data from Jordan Population and Family Health Surveys, 1990–2012 (8,11–14)

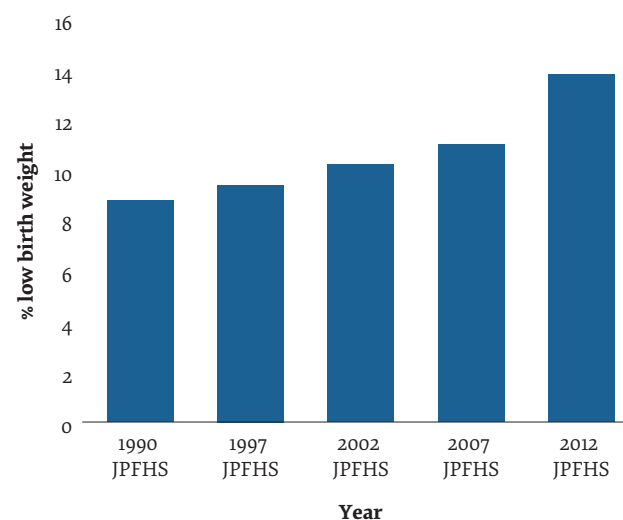


Table 2 Risk factors for low birth weight and very low birth weight, Jordan, 2012: logistic regression analysis

Variable	Low birth weight			Very low birth weight		
	β coefficient	P-value	Adjusted OR ^a (95% CI)	β coefficient	P-value	Adjusted OR ^a (95% CI)
Mother's age at birth of child (years)						
< 20	0.726	< 0.001	2.07 (1.52–2.81)	0.767	0.107	2.15 (0.85–5.47)
20–29	0.331	< 0.001	1.39 (1.17–1.66)	0.715	0.024	2.04 (1.10–3.80)
30–34 (ref)			1.00			1.00
≥ 35	0.326	0.002	1.38 (1.13–1.71)	0.963	0.012	2.62 (1.24–5.53)
Mother's education						
No education	0.675	0.002	1.97 (1.28–3.03)	1.564	0.003	4.78 (1.70–13.41)
Primary	0.592	< 0.001	1.81 (1.38–2.37)	0.845	0.045	2.33 (1.02–5.32)
Secondary	0.411	< 0.001	1.51 (1.29–1.77)	0.454	0.064	1.57 (0.97–2.54)
Higher (ref)			1.00			1.00
Father's education						
No education	0.170	0.142	1.18 (0.94–1.49)	0.165	0.535	1.18 (0.70–1.98)
Primary	–0.190	0.081	0.83 (0.70–1.15)	–0.113	0.783	0.89 (0.40–1.99)
Secondary	–0.287	0.379	0.75 (0.39–1.42)	–0.806	0.441	0.44 (0.06–3.47)
Higher (ref)			1.00			1.00
Birth order						
1	0.304	0.027	1.36 (1.08–3.01)	0.630	0.272	1.88 (0.61–5.78)
2–3	–0.685	0.066	0.50 (0.24–1.05)	0.716	0.028	2.05 (1.08–3.87)
4–5 (ref)			1.00			1.00
≥ 6	0.243	0.009	1.28 (1.10–2.92)	–0.889	0.048	0.41 (0.17–0.99)
Child's sex						
Male (ref)			1.00			1.00
Female	0.415	< 0.001	1.51 (1.34–1.71)	0.773	< 0.001	2.16 (1.46–3.20)
Type of birth						
Singleton (ref)			1.00			1.00
Twin	2.226	< 0.001	9.26 (7.22–11.88)	2.660	< 0.001	14.30 (8.68–23.54)
Planned pregnancy						
Yes (ref)			1.00			1.00
No	0.419	< 0.001	1.52 (1.23–1.88)	1.186	< 0.001	3.27 (1.74–6.16)
Birth interval						
< 24 months	0.196	0.047	1.22 (1.06–1.54)	0.082	0.776	1.08 (0.62–1.91)
≥ 24 months (ref)			1.00			1.00
First birth	1.071	0.003	2.92 (1.45–4.68)	0.572	0.213	1.77 (0.72–4.36)
Wealth index (quintiles)						
Lowest	0.178	0.047	1.19 (1.07–1.78)	0.121	0.700	1.12 (0.61–2.08)
Second	0.044	0.644	1.05 (0.87–1.26)	0.310	0.286	1.36 (0.77–2.41)
Middle (ref)			1.00			1.00
Fourth	0.067	0.512	1.07 (0.88–1.31)	0.255	0.426	1.29 (0.69–2.42)
Highest	0.221	0.035	1.25 (1.06–1.61)	0.532	0.138	1.70 (0.84–3.44)
Region						
Central	0.148	0.043	1.16 (1.00–1.34)	–0.502	0.018	0.61 (0.40–0.92)
South	0.285	0.012	1.33 (1.07–1.66)	0.116	0.713	1.12 (0.61–2.08)
North (ref)			1.00			1.00
Consanguinity						
Yes	0.149	0.024	1.16 (1.02–1.32)	0.280	0.174	1.32 (0.88–1.98)
No (ref)			1.00			1.00

Table 2 Risk factors for low birth weight and very low birth weight, Jordan, 2012: logistic regression analysis (Concluded)

Variable	Low birth weight			Very low birth weight		
	β coefficient	P-value	Adjusted OR ^a (95% CI)	β coefficient	P-value	Adjusted OR ^a (95% CI)
Smoking during pregnancy						
No (ref)			1.00			1.00
Yes	0.312	< 0.001	1.37 (1.16–1.64)	0.364	0.134	1.44 (0.89–2.32)

OR: Odds ratio; CI: confidence interval; ref: reference category.

^aAdjusted for socioeconomic, demographic and behavioural characteristics.

discussion on these issues is beyond the scope of our study. However, more research is needed to ascertain the underlying factors responsible for this increasing trend in LBW in Jordan. At the same time, appropriate interventions aimed at preventing LBW need to be taken immediately.

An important objective of our study was to identify the factors significantly associated with LBW in Jordan. We identified maternal age, maternal education, birth interval, consanguinity of the parents, maternal smoking, household wealth status, region of residence, birth order, sex of child and type of birth (twin/singleton) as significantly associated with LBW in Jordan. In agreement with many earlier studies, we found an increased risk of having a LBW baby in mothers younger than 20 years of age (29–31). This result is consistent with the finding of a study in North Jordan (32). The risk of LBW, however, showed a U-shaped pattern in relation to maternal age. A number of studies have noted that LBW increases at the two extremes of women’s reproductive life, that is, < 20 years and ≥ 35 years (29–31). As with maternal age, birth order also showed a U-shaped relationship with the risk of LBW, which is consistent with the finding of others studies (33,34). The higher risk of LBW in mothers aged < 20 years or with first births, and older mothers or with higher order births might be due to reproductive and anatomical problems, lack of proper knowledge and use

of antenatal care, low socioeconomic status, unplanned pregnancies and more pregnancy complications (29,35).

Mother’s education might affect birth weight directly or indirectly through acquired knowledge of health processes such as antenatal care and nutrition. The results of our analysis are also similar to previous studies that showed that illiterate mothers were at a higher risk of delivering LBW babies than literate mothers (7,17,36). We did not find father’s illiteracy a risk for LBW as compared with higher educated fathers which is contrary to earlier research (37).

Our results showed that mother’s low economic status was an important risk factor for LBW. This finding is in agreement with previous studies which showed that poor economic status increased the risk of delivering a LBW baby (36,38). The effect of low economic status may be the sum of many unfavourable conditions that increase the risk of adverse pregnancy outcomes. Contrary to the findings of most other studies, our analysis also found a higher risk of having a LBW baby among the richest group of mothers compared with the middle-income group. It is possible that smoking and bearing children when 35 years or older are more prevalent among mothers in the higher economic group, which increase their risk of having LBW babies. Furthermore, contrary to the developed societies, mothers in developing and transitional societies who are of higher socioeconomic status are more likely to lead a sedentary life and consume high-calorie foods,

Table 3 Mortality rates for all, LBW and NBW children, and risk of death of LBW children (logistic regression analysis) at different ages

Age period at death ^a	Death rate per 1000 live births ^b			Risk of death		
	LBW (n = 1348)	NBW (n = 8386)	All (n = 9734)	P-value ^c	Adjusted OR ^d (95% CI)	P-value
Neonatal	51.19 (69)	7.27 (61)	13.36 (130)	< 0.001	6.09 (4.17–8.91)	< 0.001
Post-neonatal	3.91 (5)	1.44 (12)	1.77 (17)	0.051	2.41 (0.79–7.35)	0.123
Infant	54.90 (74)	8.70 (73)	15.10 (147)	< 0.001	5.57 (3.89–7.97)	< 0.001
Under-5	57.86 (78)	11.21 (94)	17.67 (172)	< 0.001	4.83 (3.45–6.77)	< 0.001

LBW: low birth weight; NBW: normal birth weight; OR: odds ratio; CI: confidence interval.

^aNeonatal deaths occurred within 28 days of birth; post-neonatal deaths occurred between 28 days and < 12 months; infant deaths occurred between birth and 12 months; and under-5 deaths occurred before 60 months of age.

^bFigures in parenthesis are the number of deaths reported.

^cP-values are based on t-test comparing proportion of deaths between LBW and NBW.

^dAdjusted for maternal age, education, household wealth status, birth order, sex of child, birth type (singleton/twin), region of residence and place of residence (urban/rural).

Source: Jordan Population and Family Health Survey, 2012 (9).

which increase their likelihood of becoming obese and suffering from chronic diseases (39,40), and consequently having LBW babies.

Female babies had a higher risk of LBW than male babies, which is in agreement with other studies (41,42). Globally, it is well known that birth weight in boys is higher than in girls in the general population, but the underlying mechanisms are poorly understood. Some studies have suggested that the gender difference in birth weight is partly because of prenatal androgen action (43,44). Cell divisions in male embryos have been observed to occur more rapidly than those of female embryos and this may play a role in gender difference in birth weight (45). During pregnancy, if a mother knows the sex of her baby before birth, maternal discriminatory behaviour could also make a difference in birth weight. This has been observed in a previous study in Jordan where the mother's pre-birth knowledge of the sex of her baby influenced her diet and psychological well-being in favour of a male fetus (46). Consanguineous marriage, which is prevalent in Jordan (35%) (47), was a significant risk factor for LBW. Some research has also reported a higher risk of LBW in mothers in a consanguineous marriage (48), while other research has found no significant association (49).

Our finding that a short birth interval was an important risk factor for LBW is consistent with the findings of previous studies (50,51). In addition, twin pregnancies had an almost 10 times higher risk of resulting in LBW in our analysis. It is likely that many of the twins were premature births. A recent study showed that the rate twin pregnancies has increased in Jordan, from 2.4% in 1990 to 3.5% in 2012 (52), which may partly explain the reason for increasing trends in LBW in Jordan.

A substantial proportion of mothers (14.5%) included in our analysis smoked during pregnancy. This rate is comparable to the prevalence of smoking in pregnant women in developed countries, for example, 10.7% in the United States (53), 18.0% in Spain (54) and 19.9% in Poland (55). The prevention of smoking and exposure to smoking during pregnancy is an important global issue and requires further research. Maternal smoking was associated with LBW in our study, which concurs with the findings of many previous studies about the adverse effects of smoking exposure on pregnancy outcomes (56–58).

Our analysis identified LBW as a very strong predictor of childhood mortality. Children born with LBW had a 4.8 times higher mortality rate during their first 5 years compared with children born with NBW. The greatest effect of birth weight on mortality was in the neonatal period. The risk of death of LBW babies in the neonatal period was 6 times higher than NBW babies. Although LBW babies comprise about 14% of all children born in Jordan, they account for more than half (53%) of neonatal deaths in the country. With advances in modern obstetric and neonatal care and technological development across the world including in Jordan, doctors today are able

to keep smaller premature babies alive (19). Because of this, more and more LBW babies are being reported as live births. However, these new survivors remain at a higher risk of health and developmental problems, and these babies may not survive to their first birthday and through their childhood period, resulting a higher mortality among LBW babies.

Our study has some limitations. We could not control for several important variables, such as maternal weight gain during pregnancy, health status, food consumption, diet and lifestyle, as the survey did not collect information on these variables. Some other important variables, such as antenatal care use, maternal body mass index, could not be used because data were missing for very many women. Nevertheless, the study has several strengths. It is based on data from a national survey that used sound methodology and validated questionnaires. The survey covered a large number of socioeconomic, demographic and health-related variables. The findings of the study are generalizable to the whole country as the analysis is based on nationally representative survey data. The findings of our analysis may help identify vulnerable groups of the population at risk of having LBW babies and in need of support to prevent adverse pregnancy outcomes. Our findings may also be used to guide policy for reduction of LBW and improved survival of LBW babies.

Conclusion

The high rate of LBW and its increasing rate in Jordan is a new challenge for public health in the country. Our finding of very high neonatal mortality in LBW babies deserves attention by the national child health care programme. The causes of high neonatal mortality in infants in general, and LBW infants in particular, need to be identified to help direct appropriate interventions to reduce neonatal mortality in Jordan. Prevention of LBW and the development of strategies to increase the survival of LBW neonates are the two important tasks for the government of Jordan. The first task includes efforts to develop early risk-assessment programmes through prenatal care services, health education, counselling and proper management of peripartum complications. Services should also be provided for mothers with a high risk of having a LBW baby such as young (age < 20 years) and primiparous mothers, mothers with twin pregnancy or no education or mothers who smoke. The second task to increase the survival of LBW infants requires clinicians to develop new management strategies including setting up neonatal intensive care units, and applying kangaroo techniques and intensive breastfeeding for LBW babies. The significantly higher prevalence of LBW in the South region of Jordan underscores the need for special attention to this region to find solutions to reduce this disparity.

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Prévalence et facteurs de risque pour l'insuffisance pondérale à la naissance en Jordanie et son lien avec la mortalité des moins de cinq ans : une analyse populationnelle

Résumé

Contexte : Un faible poids de naissance (poids inférieur à 2,5kg) est un indicateur majeur de santé et de développement du nourrisson tout au long de sa vie.

Objectifs : La présente étude visait à déterminer la prévalence et les facteurs de risque de l'insuffisance pondérale à la naissance en Jordanie et son association avec la mortalité des moins de cinq ans.

Méthodes : Dans cette analyse secondaire, les données ont été extraites de l'Enquête jordanienne de 2012 sur la population et la santé de la famille, pour 9734 naissances vivantes au cours des cinq années précédant l'enquête, et pour lesquelles le poids de naissance était indiqué. Les données ont été recueillies au sujet des caractéristiques maternelles et infantiles. Une analyse de régression multivariée a été utilisée pour déterminer les facteurs de risques significatifs d'une insuffisance pondérale à la naissance.

Résultats : Parmi les 9734 naissances analysées, 13,8 % présentaient un poids de naissance faible et 1,3 % un poids de naissance très faible. L'âge de la mère (inférieur à 30 ans et supérieur ou égal à 35 ans), le niveau d'instruction (moins que l'enseignement supérieur), l'intervalle entre les naissances (moins de 24 mois après la première naissance), la grossesse non planifiée, le niveau de richesse du ménage (pauvre ou riche), la consanguinité, le lieu de résidence (régions centrale et sud de la Jordanie), le sexe féminin, l'ordre de naissance de 1 à 6 ou plus, la naissance gémellaire et le tabagisme maternel pendant la grossesse étaient des facteurs de risque significatifs de l'insuffisance pondérale à la naissance. Le risque de mortalité des moins de cinq ans était 4,8 fois plus élevé chez les enfants ayant eu un faible poids de naissance que chez ceux ayant eu un poids de naissance normal.

Conclusions : Le taux élevé d'insuffisance pondérale à la naissance et son augmentation constituent un problème de santé publique en Jordanie. Il est nécessaire de mettre en place en urgence une stratégie sanitaire nationale assurant aux nouveau-nés un poids de naissance normal et ainsi leur survie. Les groupes à hauts risques tels que définis par la présente étude doivent faire l'objet d'une attention particulière.

معدل انتشار انخفاض الوزن عند الولادة وعوامل الخطر المرتبطة به في الأردن، وارتباطه بوفيات الأطفال دون سن الخامسة: تحليل مستند إلى السكان

مظهرول إسلام، فيصل أبابنيه، تهmina أكتي، هاسينور خان

الخلاصة

الخلفية: يُعد انخفاض الوزن عند الولادة (أقل من 2.5 كجم) مؤشراً مهماً على صحة الرضع ونموهم طوال حياتهم.

الأهداف: هدفت هذه الدراسة إلى تحديد معدل انتشار انخفاض الوزن عند الولادة، وعوامل الخطر المرتبطة به في الأردن، وارتباطه بوفيات الأطفال دون سن الخامسة.

طرق البحث: استُخلصت البيانات، في هذا التحليل الثانوي، من مسح السكان والصحة الأسرية في الأردن لعام 2012 بشأن 9734 مولوداً حياً في السنوات الخمس السابقة للمسح الذي أُبلغ فيه عن وزن المواليد. وجمعت بيانات عن خصائص الأطفال والأمهات. واستُخدم تحليل الانحدار المتعدد المتغيرات لتحديد عوامل الخطر المهمة لانخفاض معدل المواليد.

النتائج: من بين 9734 مولوداً خضعوا للتحليل كان 13.8٪ منهم يعانون من انخفاض الوزن عند الولادة و1.3٪ منهم لديهم وزن منخفض جداً عند الولادة. وكان سن الأم (أقل من 30 سنة و≤ 35 سنة)، والتعليم (درجة أقل من التعليم العالي)، والفواصل الزمنية بين مرات الولادة (أقل من 24 شهراً وأول ولادة)، والحمل غير المخطط له، والحالة المادية للأسرة (الأكثر فقراً والأكثر ثراءً)، وزواج الأقارب، والإقامة (في المناطق الوسطى والجنوبية من الأردن)، والجنس الأنثوي، وترتيب الولادة (الأولى، السادسة أو أكثر)، وولادة التوائم، وتدخين الأمهات أثناء الحمل، من عوامل الخطر المهمة لانخفاض الوزن عند الولادة. وكان خطر وفاة الأطفال دون سن الخامسة أعلى بمقدار 4.8 مرات لدى الأطفال ذوي الوزن المنخفض عند الولادة مقارنةً بالأطفال ذوي الوزن الطبيعي عند الولادة.

الاستنتاجات: يُمثّل المعدل المرتفع لانخفاض الوزن عند الولادة في الأردن أحد تحديات الصحة العامة. وينبغي إيلاء الأولوية في الاستراتيجية الصحية الوطنية للوقاية من انخفاض وزن حديثي الولادة وزيادة فرصة بقائهم على قيد الحياة. ويجب إيلاء عناية خاصة للفئات الشديدة التعرّض للخطر المحدّدة في هذه الدراسة.

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