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Prevalence and Risk Factors of Very Low Birth Weight in Infants Born at the Maternity and Children Hospitals in Jeddah, Saudi Arabia during 2012-2013

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Authors' contributions

This work was carried out in collaboration between all authors. Authors AYM and OB developed concept and designed the study. All three authors wrote the protocol, and wrote the first draft of the manuscript. Author NAQ managed the analyses of the study. All authors managed the literature searches. Author NAQ managed revision of this manuscript in accordance to reviewers' comments. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Background: The prevalence of low birth weight in infants which is associated with a large number of risk factors is increasing worldwide and is a major cause of infant morbidity and mortality.
Objective: This study aims to describe demographic, clinical and anthropometric profile of VLBW in infants, its prevalence, associated risk factors and maternal medical complications in three Maternity and Children Hospitals in Jeddah City, Saudi Arabia.
Methods: Two study designs used in this research selected two convenient samples of VLBW infants for collecting cross-sectional retrospective and prospective data. The clinical records of VLBW infants [n=387] were reviewed retrospectively for estimating the one year prevalence rate while for identifying the possible risk factors of VLBW infants, the medical files of actively admitted patients [n=61] were daily examined for a period of

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four months.
Results: Beside socio demographic, clinical and anthropometric characteristics of VLBW infants, this study estimated the prevalence of VLBW infants to be 3.3% along with underlying risk factors of VLBW, its comorbidities, and maternal medical complications.
Conclusion: The prevalence of VLBW infants is constantly increasing not only in Saudi Arabia but also worldwide and VLBW is associated with a variety of possible risk factors. There is a need to conduct a nationwide community-based study on the prevalence and risk factors of VLBW infants in Saudi Arabia.

Keywords: Very low birth weight infants; maternity and children hospitals; prevalence; risk factors; Jeddah; Saudi Arabia.

1. INTRODUCTION

There are two types of fetal programs in the Ministry of Health, Saudi Arabia. The first program that follows WHO guidelines [1] targets low-risk pregnancy at primary healthcare center (PHC). According to this program, pregnant mothers are required to make 2-4 antenatal visits. The second antenatal care (ANC) program is designed for moderate to high risk pregnant mothers with monthly visits or as and when need arises and are referred to Maternity and Children Hospitals (MCH). In addition, private and military healthcare sectors follow their own customized protocols. None the less VLBW (birth weight <1500g), is a major cause of infant mortality, morbidity and neuro developmental disability in Saudi Arabia [2]. Infant mortality rate (IMR) is defined as the number of death in children less than 1 year of age per 1000 live births in the same year. In Saudi Arabia, the IMR is 15.08 deaths/1000 live births [3]. A retrospective study estimated the incidence of neonatal morbidity and mortality of VLBW infants in Saudi Arabia. The records of 92 infants delivered between 1986 and 1996 at King Abdulaziz University Hospital (KAUH) were reviewed for relating gestational age with birth weight comparing those who delivered at gestational age (GA) 22-26 weeks (extremely LBW) with those delivered at GA 27-31 weeks (VLBW). The incidence of VLBW at KAUH was 0.52%. The neonatal mortality was 23.8% while the early neonatal mortality was 22.8%. The early neonatal mortality among ELBW infants was 75% compared to 13.7% among VLBW group. The immediate neonatal complications were higher among VLBW infants than ELBW group. According to this study, VLBW and ELBW babies are a major cause of neonatal mortality and morbidity [2]. In a Saudi Epidemiological Bulletin, the prevalence of LBW in a major hospital in Riyadh was reported to be 5.8% and distribution according to the BW was as follows: LBW (2500-1500g, 70.6%), VLBW (1500-1000g, 13.3%) and ELBW (<1000g, 16.1%) [4]. Infant mortality and morbidity are found to be 40 and 200 times more among low birth weight (LBW) infants (BW<2500g) and VLBW infants (BW=1000-1500g), respectively when compared to infants with normal birth weight [4].

Relevant literature from western world reported that VLBW infants account for one-third of infant mortality rate [IMR], which is an important sensitive indicator of health [5]. The VLBW infants related to a variety of aetiologies account for only 2.2% of live birth, however they contribute disproportionately to neonatal morbidity and the healthcare costs [6]. Despite the global consensus on the concept of VLBW infants, they represent a heterogeneous group of newborns; very premature with a gestational age<32 weeks and the more mature with intrauterine growth restriction (IUGR is a fetal weight<the 10th percentile of the normal for the gestational age) [7]. In USA, the reported prevalence of ELBW and LBW infants ranges from 0.1% (BW<500g) to 7.4% (BW≤ 2500g) [8].

The primary causes of VLBW are prematurity (<37 weeks gestation) and IUGR attributed to problems of placenta, poor maternal health and birth defects. The other risk factors of VLBW in infants include history of previous premature births [9-17]. Preterm babies are both physically small and physiologically immature and are vulnerable to short- and long-term complications including injury to fragile organ systems [8-10, 18-20]. The outcome studies of VLBW infants reported survival rates that ranged from 34% (BW<751g) to 93% (1251-1500g) and 23% (GA= 23weeks) to 54% (GA=25weeks) [21]; and 40% (<1000g) to 86.2% (1000g-1499g) [22].In a Japanese national survey, the neonatal mortality rate and mortality rate for VLBW (<1000g) infants admitted to NICU were 13.0% and 17.0%, respectively [23]. The scenario has been changing constantly and more infants are born with low birth weight around the globe [24].

1.1 Objectives

This study has the following objectives; 1) to describe demographic, anthropometrics and clinical profile of VLBW infants, and 2) to estimate the prevalence of VLBW infants and assess the possible risk factors associated with VLBW infants at the maternity and children hospitals (see below) and King Abdulaziz hospital in Jeddah city during the year 2012-2013.

1.2 Rational and Scope

To improve maternal health and reduce child mortality is to achieve the Millennium Developmental Goals (MDG-4-5) initiated by the United Nations in year 2000 [25]. Furthermore, there is scarcity of data on the prevalence and risk factors of VLBW infants in Saudi Arabia [2,4]. The evidence based information gathered from this study may help in improving the quality of healthcare services provided to maternal and infant population. The data may also help in planning and strategizing preventive approaches for reducing neonatal and infant mortality rate in the Kingdom of Saudi Arabia (KSA).

2. MATERIALS AND METHODS

Jeddah city is the second largest city in the Kingdom of Saudi Arabia representing its important western gateway known as “the Bride of the Red sea” with a population of about 4.3 million (as of 2012) [26]. The main Maternity and Children Hospitals (MCH) in Jeddah city are Al-Musaedia MCH with 63 NICU beds, Al-Aziziya MCH with 13 NICU beds and King Abdulaziz University Hospital (KAUH) with 32 NICU beds[27].These three hospitals (total NICU beds=108) were the study setting.

This is a hospital-based study and consists of two parts: 1) a retrospective cross-sectional design [Part 1] to estimate a period prevalence of VLBW infants admitted to three hospitals from 1st May, 2012 to 30thJune, 2013. All infants irrespective of nationality delivered with VLBW in the three hospitals were included in this study and 2) a prospective cross-sectional study of VLBW infants [Part 2] actively admitted to the NICU through1st January, 2013 to 30th April, 2013until their discharge, which assessed the risk factors of VLBW infants. All infants with VLBW, either preterm or term with IUGR admitted to NICU level I (basic) and level II (specialty care) were included in Part 2 study. The purposes of two study designs/methodologies are; 1) to estimate the prevalence of VLBW infants admitted in a year (one-year prevalence) and the source of relevant information was their unified admission files at the NICU and 2) to identify underlying risk factors in VLBW infants, this data was collected in actively admitted cases to avoid bias of going back to different records

for each case. The inclusion criterion for longitudinal study (Part 2) was; infant BW of ≤1500g taken at the time of birth in the delivery room or operating room and the exclusion criteria were; infants more than one month of age, those transferred from other hospitals; infants in level III care unit that provides care for newborns with birth defects, post-surgical cases and other categories of infants requiring intensive nursing care; and infants who require a higher level of observation for unstable or at-risk conditions including infants kept in isolation rooms. The sampling structure for two components of this study was as follows; one of the researchers (Munshi AY) selected a convenient sample of all VLBW infants delivered in the three hospitals over a specified period of one year. For Part 1 study, cases collected for the prevalence estimation were 387. For Part 2 study, a representative sample size was calculated using a specific formula; $n=Z^2p\ q/d^2$ whereas Z is the percentile of the standard normal distribution determined by specific confidence interval (1.96 for 95% CI), P is the prevalence of VLBW according to the literature, 1.7%, q: 1-p, and d is one half the width of the desired CI=0.05. Accordingly, the estimated sample size was: $(1.96)^2$ $0.015*0.983/(0.05)^2=25$. With the highest acceptable prevalence of VLBW infants in the literature (2.8%), a larger sample size was targeted to increase the validity of the results [3,8]. The re-estimated sample was: $(1.96)^2$ $0.028*0.972/(0.05)^2=42$. However, the total sample size collected by the researcher in study part 2 was 64but data was complete in the files of 61 VLBW infants.

2.1 Data Collection

To review and obtain the data related to the prevalence, case files of VLBW infants admitted to the NICU within a year from 1st May 2012 to 30th April 2013 were retrieved from the NICU admission registry. The number of total live birth for the same period was taken from the hospital vital registry for calculating the prevalence of VLBW infants. For identifying the risk factors, VLBW infants were followed up from 1st January 2013 to 30th April 2013 using a structured data collection sheet, which was designed after reviewing the literatures [2,9,28,29]. The data collection sheet was constituted of five domains; 1) data related to the hospital (name, status- charged or free, date of admission and discharge), 2) data related to the case (medical record number, gender, BW (kg), length (cm), head circumference (cm), and insurance status), 3) socio demographic data (parents' ages, nationalities, educational levels, occupation, income, housing & living area, and smoking behaviour), 4) maternal risk factors(GA, parity, previous abortions, pregnancy conceived by in vitro fertilization (IVF) or medication, multiple birth, smoking, alcohol and other drug abuse, chronic diseases, gestational diabetes, pregnancy induced hypertension, preeclampsia, antepartum haemorrhage, premature rupture of membrane (PROM), preterm labor, amnion infections, IUGR, breech presentation, delivery status) and 5) neonatal course from delivery to discharge (Apgar scores, medical intervention, resuscitation, ventilation, surfactant administration, weight (kg), breast milk intake (ml), formula milk intake (ml),total parenteral nutrition (TPN), partial parenteral nutrition (PPN), respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), retinopathy of prematurity (ROP), late onset sepsis (LOS), and hypo-or hyperglycaemia. Total weight gained (kg) was dependent variable whereas total breast milk fed (ml), total formula milk fed (ml) and other socio demographics were independent variables. We have not considered the impact of breast milk and formula milk on weight gain in this study (a separate paper is forthcoming soon) and hence advanced statistical modelling tests were not used in this semi-descriptive study. The data for study part 2 were collected from patient admission files and clinical flow charton daily basis.

2.3 Data Processing and Analysis

The data were entered into the computer, cleaned and analyzed using appropriate statistical tests. SPSS version 20.0 [30] was used for the purpose of data analysis. Chi square test was used for categorical variables and whenever possible means were compared by using t-test. Pearson correlation test was used to measure the strength of a linear relationship between two variables. It ranges from +1 to -1. A correlation of +1 reflects that there is a positive linear relationship between variables. A correlation of -1 means that one variable increases while the other decreases. Birth weight of infants was categorized into two; weight less than 999g and more than 1000g in order to find its associations with various socio demographic, clinical, anthropometric variables and some other risk factors of VLBW. This cut-off point was taken because only few infants were of weight less than 750g [1/2 of 1500g, ideal cut off point] (n=4) and this cut-off also divided BW into ELBW and VLBW. Exact p values were reported here, and p value less than .05was considered significant.

2.4 Ethical Consideration

One of the parents of VLBW infant was explained in nontechnical terms the nature objectives and benefits of this study. A written informed consent was designed and following clear explanation of the study objectives and other details either of the parents voluntarily signed the consent form. Thumb prints were taken from those who were illiterate and could not read and write. Confidentiality of the information obtained was guaranteed and the parents were informed that the data will be used only for research purpose. Research proposal was approved by the ethical committee of the King Abdulaziz University vide reference number: 1013-13.

3. RESULTS

Saudi infants with VLBW were 54.1% [n=33] (n=28, 45.9% non-Saudi) with a ratio of 1.2:1. Female infants with VLBW were 55.7% [n=34] (n=27, 43.7% males) with a ratio of 1.3:1. A significant trend for male infants was observed with less than 1000g VLBW(X^2=3.6, df=1, p=0.0576). Mean maternal age with standard deviation was 30.5±7.06 [range=27, minimum and maximum age was 18 years and 45 years]. Maternal age was negatively correlated with VLBW infants [Coefficient, *r*=-.087, p=.505, not significant (NS)] (Fig. 1).

Beside other parental demographics (Table 1), young mothers (<20 years) constituted 11.5% [n=7] and mean paternal age was 36.52±7.25 with a range of 31 years and minimum and maximum age was 22 and 53 years. Father's age was also negatively correlated with VLBW infants [Coefficient, *r* =-.165, p=0.204, NS]. Parental nationality was not significantly associated with VLBW (X^2=0.024, df=1, p=0.877). Illiteracy and secondary education were pooled with primary and PG education categories, respectively in relation to maternal education which was not significantly associated with VLBW of infants (X^2=1.68, df=1, p=0.195) and similarly pooled paternal education was also insignificantly associated with VLBW of infants (X^2=0.72, df=1, p=0.396). Maternal occupation-housewife versus employed-was not associated with VLBW infants (X^2=0.714, df=1, p=0.398) and similarly paternal occupation-skilled versus semiskilled-was not significantly associated with VLBW of infants (X^2=0.727, df=1, p=0.394).

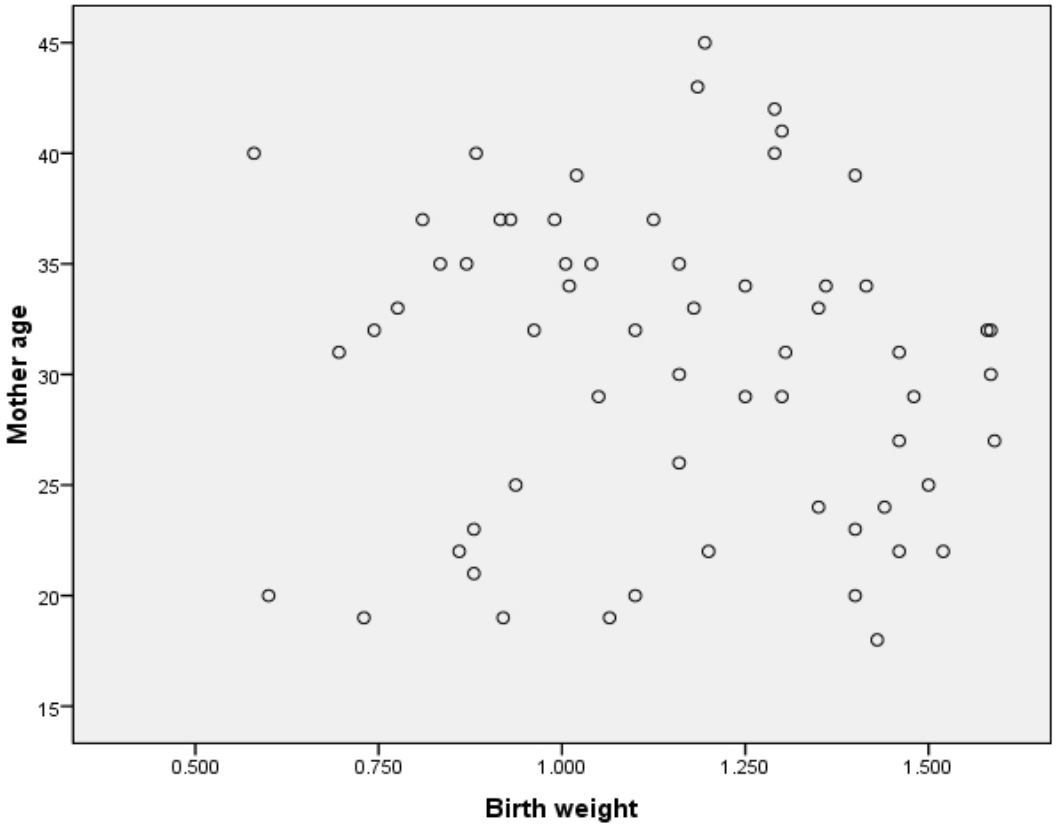

Fig. 1. Scatter plot (bivariate): shows no linear relationship between mother age and VLBW infants

Table 1. Demographics of the VLBW infants' (n=61) parents

Variable	Mother N (%)	Father N (%)
Nationali		
-Saudi	33(54.1)	33(54.1)
-Non-Saudi	28(45.9)	28(45.9)
Education		
Illiterate	7(11.5)	5(8.2)
Primary-intermediate	23(37.7)	16(26.2)
Secondary-diploma	13(21.3)	27(44.3)
University–postgraduate	18(29.5)	13(21.3)
Employment		
Housewife	42(68.9)	----
Government	13(21.3)	19(31.3)
Private	4(6.6)	24(39.3)
Military	----	15(24.6)
Labourer/driver	----	3(4.9)
Housemaid	2(3.3)	----

The proportions of VLBW infants admitted to three hospitals were varied in accordance to the number of NICU beds and level of care. The largest proportion of 57.4% [n=35] was from KAUH (Fig. 2). All infants except 17.2% [n=11] received free medical services and those who paid were non-Saudis. From all VLBW infants, 9.8% of infants with medical insurance [n=6] were referred form other hospitals.

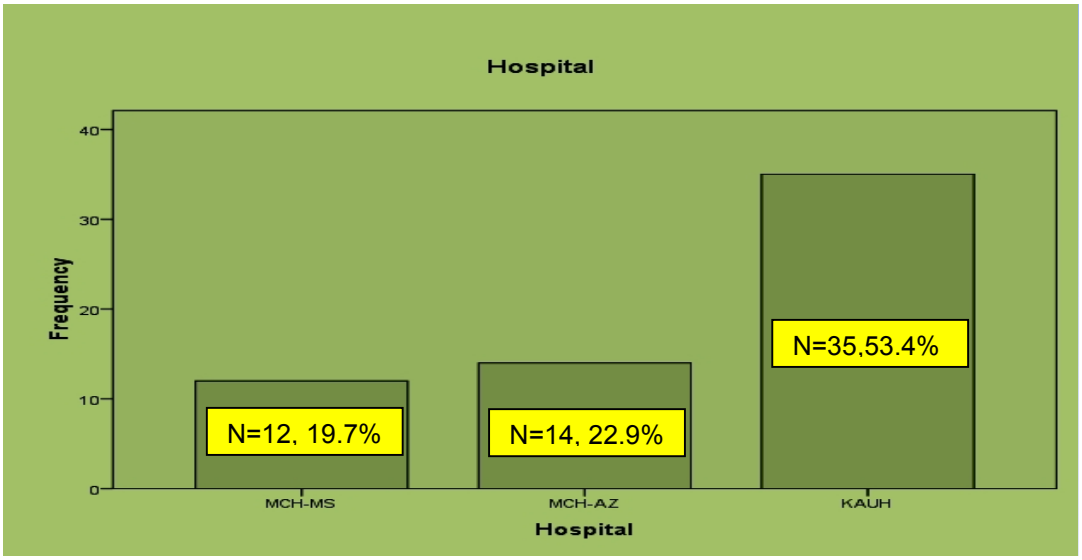

Fig. 2. Distribution of studied VLBW infants in part 2 study by hospitals

There was a large variability in the total income of families of VLBW infants. The larger proportion of VLBW infants (52.5%, n=32) was from the middle income group and 24.6% of VLBW infants [n=15] have families with monthly income lower than 3,000 SAR (Fig. 3). The fathers' monthly salaries ranged from 800 to 16,000 SAR [range=15200] with the mean of 5,396.7±3808.4, while mothers' monthly salaries were from no salary to 11,000 SAR [range=11000] with the mean of 1,790.16±2992.25. No significant association was found between joint income less than 10,000 SR [income less than 3000SR was pooled with less than 10,000SR income] and more than 10,000SR with VLBW infants (X^2=1.162, df=1, p=0.28). No drug or alcohol exposure was reported among the parents of the VLBW infants; however, 41% [n=25] and 16.4% [n=10] of the fathers were current smokers and ex-smokers (those who stopped smoking for the last 6 months), respectively and 13% [n=8] and 14.8% [n=9] of the mothers were current smokers and ex-smokers, respectively. No signification association was found between female current smokers [no smokers pooled with ex-smokers] and VLBW infants (X^2=0.51, df=1, p=0.477). Conversely, paternal smoking (pooled no smokers and ex-smokers versus current smokers) was significantly associated with VBLW infants (X^2=5.25, df=1, p=0.0218).

Various anthropometric and clinical variables measured were birth weight to discharge weight (Table 2). Period of hospitalization ranged from a minimum of 12 days to 91 days [range=79] with a mean of 38±19.4. Hospital stay of infants was negatively correlated with VLBW (Pearson *r*=-.626, p=0.0001 [significant at the .01 level]) (Fig. 4).

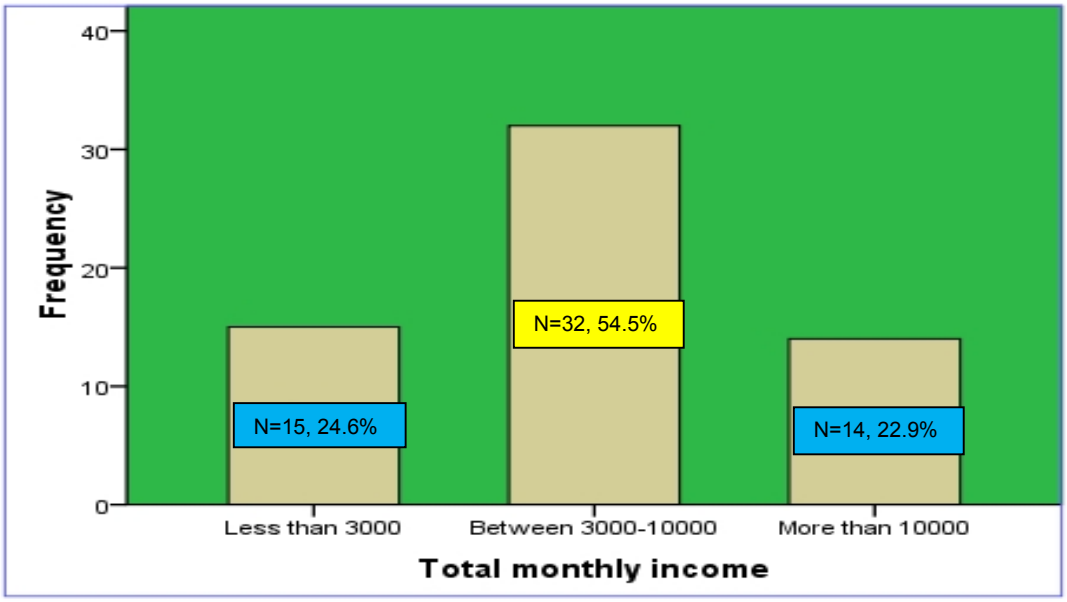

Fig. 3. Distribution of the VLBW infants by total monthly income of their families

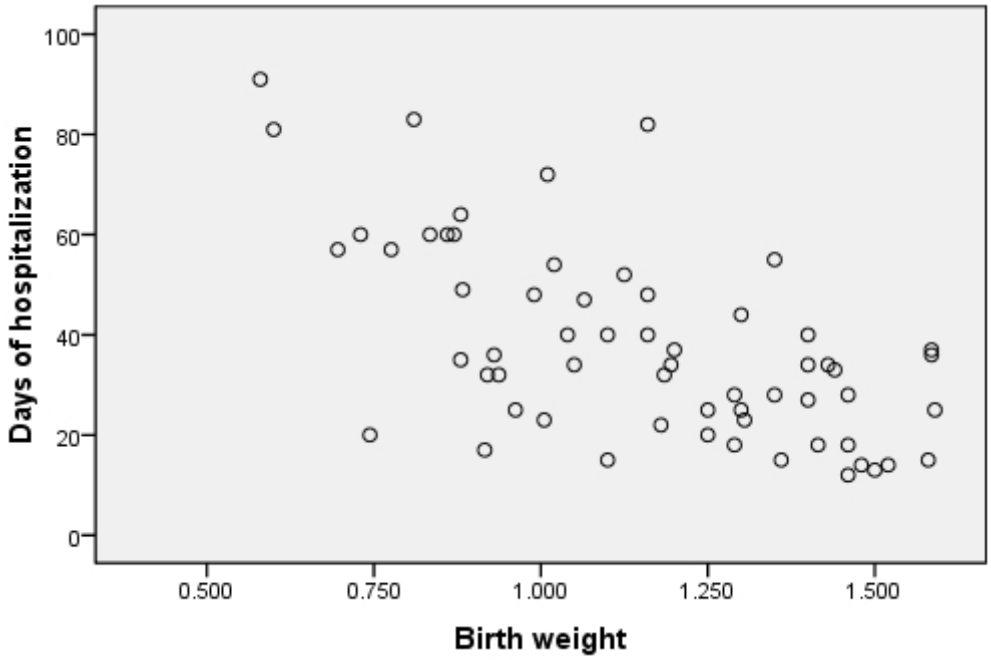

Fig. 4. Scatter plot (bivariate) showing negative linear relationship between birth weight and days of hospitalization

Total weight gain by infants was not significantly correlated with VLBW infants (Pearson *r*=-.054, p=0.679) but infant weight at the time of discharge was positively correlated with

VLBW of infants (Pearson *r*=.2796, p=0.030]. Furthermore height of infants was correlated with VLBW infants (Pearson, *r*=.369, p=.003) and head circumference of infants was also correlated with VLBW infants (Pearson, *r*=.275, p=.032).

Table 2. Anthropometric measurements and clinical variables of the VLBW infants (n=61)

VLBW infants variable	Minimum to maximum	Range	Mean±SD
Birth weight (Kg)	.580-1.590	1.01	1.15±.27
Birth height (cm)	27–46	19	38.2±4.1
Head circumference (cm)	21–41	20	27.9±4.2
Gestational age (weeks)	24–37	13	30.2±2.9
Period of hospitalization (days)	12–91	79	38±19.4
Total weight gained (Kg)	.250-1.100	.850	.606±.27
Discharge weight (Kg)	1.1-2.15	1.05	1.64±.24

The median Apgar score for the VLBW infants at the first and fifth minute of the delivery was 6.15±2.16 [range 9, minimum and maximum=0 and 9] and 8.4±1.7 [range 10, minimum and maximum= 0 and 10], respectively. Accordingly, the medical interventions provided to VLBW infants at the time of delivery and admission to the NICU were as follows; resuscitation (n=10, 15.8%); ventilation (n=33, 54.4%); surfactant administration (n=41, 66.7%); total parenteral nutrition (n=36, 58.9%) and partial parenteral nutrition (n=21, 34.5%). The major VLBW infants' complications observed were: respiratory distress syndrome (n=33, 54%); necrotizing enterocolitis (n=12, 18.9%); patent ductus arteriosus (n=8, 13%); retinopathy of prematurity (n=6, 9.4%) and diagnosed late onset sepsis (n=2, 3.8%).

3.1 Prevalence of VLBW Infants

The prevalence of VLBW infants ranged from 2.5% to 3.9% with the average of 3.3%. The prevalence of VLBW infants in the three hospitals was variable (Table 3).

Table 3. Prevalence of VLBW infants in three hospitals

Hospital name	No. of VLBW infants	No. of live birth	No. of VLBW infants/No. of live birth %
MCH-Musaediya	197	6077	3.2
MCH-Aziziya	45	1788	2.5
KAUH	145	3653	3.9
Total	387	11518	3.3

3.2 Risk Factors of VLBW Infants

In this study, 96.8% of VLBW infants [n=59] were premature and preterm born, i.e., they were born before 37 weeks of pregnancy or three weeks before due date of delivery. IUGR was observed in 36% of VLBW infants [n=22]. Within all cases, 29.6% [n=18] had both prematurity and IUGR. The gestational age associated with the delivery of VLBW infants ranged from a minimum of 24 weeks to 37 weeks [range=13] with the mean of 30.2±2.9. Gestational age of infants was positively correlated with VLBW of infants (Pearson *r*=.643, p=0.0001 [significant at the .01 level] (Fig. 5).

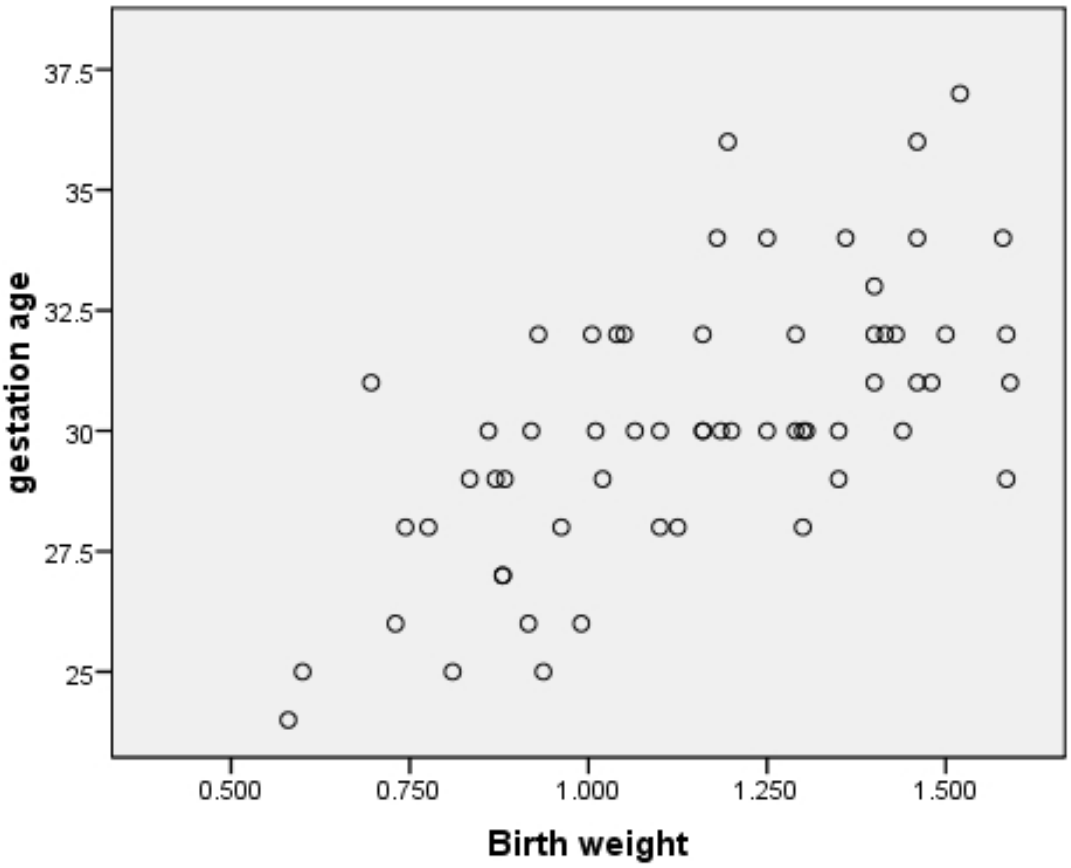

Fig. 5. Scatter plot (bivariate) shows significant positive linear relationship between VLBW and gestational age

Forty nine percent [n=30] of the mothers were primigravida and multipara was represented by 28% of mothers [n=17] (Fig. 6). There was no significant association between VLBW infants and gravid [Primigravida versus p1, 2 and multipara] (X^2= 2.157, df=1, p=0.142). About 67% of mother [n=41] reported no previous abortion and those who aborted once, twice, or more were 18% [n=12], 5% [n=3] and 8% [=5], respectively. No significant association was observed between abortion and no abortion and VLBW infants (X^2=1.087, df=1, p=0.297).

The rate of pregnancy with multiple birth pregnancy was 37.7% [n=23] including twins and triplets. No significant association was observed between multiple birth pregnancies and VLBW infants (X^2=0.026, df=1, p=0.871). Mothers who were conceived by IVF were 10.2% [n=6] and those who used Clomiphene (Clomid) were 6.9% [n=4]. There were significant association between use of medications for conception and VLBW infants (X^2=4.019, df =1, p=0.045). Delivery modes in terms of caesarean section (CS), spontaneous vaginal delivery and assisted breech delivery were noted in 61% [n=37], 37.7% [n=23] and 1.6% [n=1] of pregnancies. There was significant association between VLBW infants and assisted deliveries including CS (X^2=18.93, df=1, p=0.0001). Emergency delivery was done in 85%of VLBW infants' mother [n=52] (versus elective delivery 15% [n=9]). There was no significant association between status of delivery (emergency versus elective) and VLBW infants

(X^2=0.651 df=1, p=0.419). Distribution of maternal medical risk factors associated with deliveries of VLBW infants are shown in (Table 4).

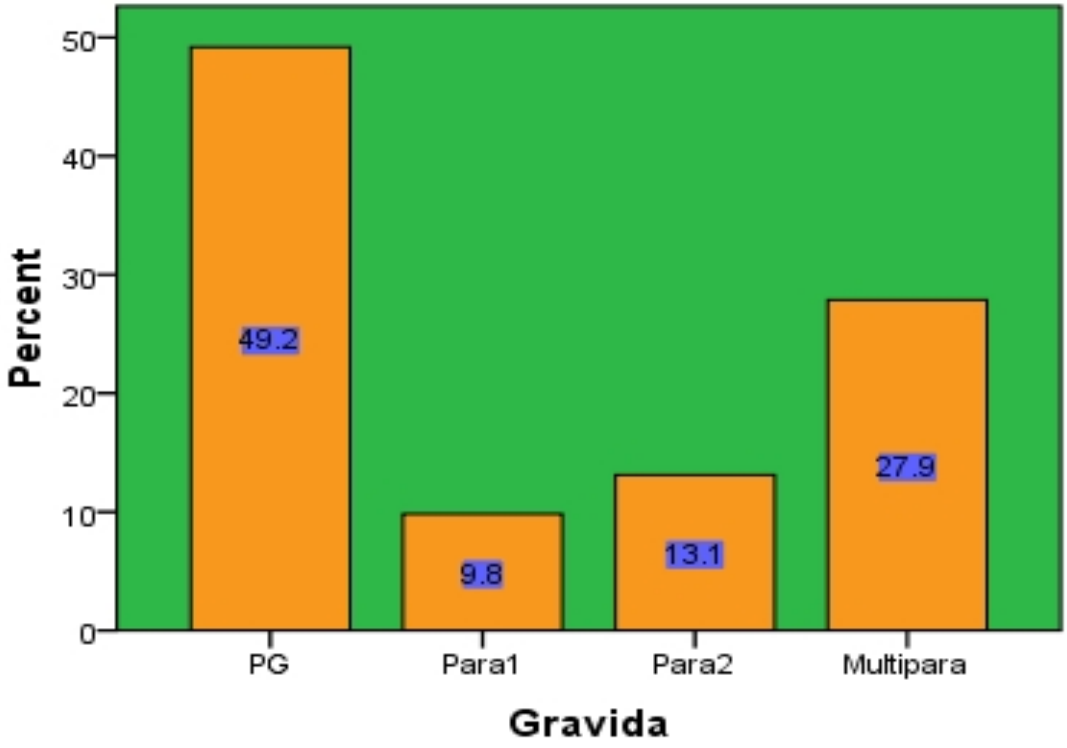

Fig. 6. Distribution of the VLBW infants by their mothers' status of pregnancy

Table 4. Maternal complications associated with deliveries of VLBW infants (n=61)

Medical risk	Frequency (%)
Intrauterine growth restriction	22(36)
Pregnancy induced hypertension	15(24.6)
Preeclampsia	13(21)
Preterm premature rupture of membrane	11(18)
Breech presentation	11(18)
Hyperactive active airway diseases	3(4.9)
Abruptio placenta	3(4.9)
Hypothyroidism	3(4.9)
Premature rupture of membrane	2(3.3)
Gestational diabetes	2(3.3)
Amnion infection	2(3.3)
Placenta previa	1(1.7)

4. DISCUSSION

This study with cross sectional and longitudinal follow up describes demographic, clinical, and anthropometric metrics of VLBW infants in three hospital settings in Jeddah city. This

study also estimated the prevalence and explored the associated risk factors of VLBW infants. According to this study, the maternal age that ranged from 18 to 45 years is consistent with the reproductive age reported by World Health Organization (WHO, 15-44 years) [31]. However, parental age, one of the possible risk factors for VLBW infant was negatively correlated with VLBW which is incompatible with the results of other study [13].

Parental illiteracy and VLBW infants have a complex relationship. Maternal education was not associated with VLBW infants [32] and similarly no association between maternal and paternal education with VLBW of infants was found in this study. It is debatable as to whether education enters the birth weight production function directly or indirectly through the other parameters. For instance, Rosenzweig and Schultzargue that parental education affects the choice of health inputs but has no direct effect on birth weight [33]. Contrary to this, Joyce found that education belongs to both the input demand function and the birth weight production function [34]. More details of maternal education on birth weight could be found here [35].

Approximately three quarters of mothers were house wives and the rest of working mothers were holding different jobs in public and private sectors. However, all fathers were employed and one quarter of them is semiskilled workers. Although Saudi Arabia is pushing UN MDG agenda of women empowerment, yet 67% women in this study are engaged exclusively household chords. Whether or not parental occupation contributes to VLBW infants is not clear, however this study find no association between the two. Unlike western world, being house wife without any external job responsibility is largely compatible with cultural values of Saudi Arabia. According to this study, there was a large variation in the total income of the families with slightly more than 50% belonging to the middle income group and a quarter of families are from lower income group. The fathers' average monthly salaries were about three times more than that of mothers' average salaries. Parental joint income tends to substantially change the socioeconomic status of families that may have an impact on infant BW. VLBW infants are reported to be as high as 2.5 times in poor population [15]. In addition, researchers compared different population groups within countries and found that the differences in education level, income and living conditions influence LBW infants [24] and this study is short of supporting these findings. This might be due to small sample size, methodological differences and measurement errors.

In this study, the average birth weight of VLBW infants was1.15±.27kg. Several studies of VLBW infants have reported more or less the same mean birth weight; 1.007kg in USA [8]; 1.202kg in Turkey [22] and 0.985kg in Pakistan [15]. The mean period of the NICU hospitalization for the VLBW infants was 38±19.4 [range=12-91, 79 days] which largely varies attributable to multiple factors including NICU setting. In one USA study, the duration of hospitalization ranged from 16 to 59 days [17]. In a study from low-income country, the median of hospitalization stay is 17 days [13]. Furthermore, the discharge weights of the VLBW infants also vary from 1.100kg to 2.100kg attributable to weight at the time of admission and clinical complications associated with VLBW infants. According to this study, one of the major complications most frequently found in VLBW infants was respiratory distress syndrome [54%]. This serious complication tends to vary in other studies; 89% in Turkey [22]; 67% in USA [21] and 42.1% in Pakistan [15]. Another second common complication found in this study is necrotizing enterocolitis (18.9%), which is higher than the rate reported in the relevant literature (upto7%) and this may be attributed to the stages of the disease [10,11,14,21,22]. These studies included only late stage NEC. Conversely, this research takes into account both late and early stage of NEC, which might explain the relatively higher proportion of NEC. Congenital heart diseases including patent duct us

arteries us were found in13% of VLBW infants, which is lower than what is reported in other, studies [14,21,22]. The low rate of late onset sepsis found in this study varies with other reports [10,13,22] which could be due to hospital admission policies, criteria of reporting sepsis in each centres and the infection control guidelines deployed in different settings and its efficacy.

According to this study, the prevalence of VLBW infants in three hospitals ranged from 2.5% to 3.9% with an average of 3.3%, which is higher than 1.7% estimated from a major hospital registry in Saudi Arabia. A sample of 148 VLBW infants born from January to June 1999[6-month prevalence] was considered in this research [4]. In year 2001, King Abdulaziz University Hospital retrospectively reported the incidence of VLBW infants. The records of 92 infants delivered between 1986 and 1996 were reviewed for comparing those who delivered at gestational age (GA) 22-26 weeks (extremely VLBW) with those delivered at GA 27-31 weeks (VLBW). The incidence of VLBW at KAUH was 0.52% [2]. In USA, the prevalence of VLBW infants was reported to be 2.8% in year 2004 [8]. The variable prevalence rates of VLBW infants might be due to different methods used, sample size, inclusion and exclusion criteria and settings' characteristics.

The main documented causes of VLBW infants are prematurity and IUGR [7]. In this study, a high proportion of VLBW infants (96.8%) were premature, another 36% had IUGR and 29.6% were premature with IUGR. In addition, the observed gestational age significantly associated with the delivery of VLBW infants, which is consistent with other studies [13-15, 22]. Although history of multiple abortions is a recognized risk for VLBW infants [9], this is not supported by the present study. A pregnancy with multiple births is strongly related to increase rate of VLBW infants as it is associated with preterm labor, PROM, and IUGR [36] and this finding is not congruous with our study. In Nepal, a study reported similar rate of twin pregnancy (24.3%) among VLBW infants' mother [13]. According to this study, both the use of assisted reproductive technique (ART)in terms of IVF and Clomid are significant risk factors for VLBW infants, which is compatible with other study [16]. As also found in this study, caesarean and assisted delivery is another possible risk factor associated with VLBW infants [22], which may be due to inadequate or non availability of antenatal care, and low detection rate of high risk pregnancy with improper management [13]. There are a variety of maternal risk factors associated with the delivery of VLBW infants and these are preterm labor, pregnancy induced hypertension, preeclampsia, premature rupture of membrane, infections, and antepartum haemorrhage due to placenta previa and abruptio placenta and smoking [11,13,14,24]. According to this study, maternal smoking is not found as a risk factor of VLBW infants; however, paternal smoking is significantly associated with VLBW infants. It is reported that the risk of VLBW infants' increases by 1.3 times with preterm labor [11]. Furthermore, pregnancy-induced hypertension contributes to VLBW infants due to 10 times increase in the rate of IUGR [15]. Low occurrence of other individual maternal risk factors and small sample size precluded the use statistical tests in this study. However, similar maternal risk factors are identified that might have collectively contributed to VLBW infants.

This study has some limitations. The results of this study are not generalizable to the general population because it is a hospital-based study. A short duration of follow-up [4 months] of limited number of included participants [n=61] for identifying the risk factors of VLBW infants possibly is not sufficient for achieving this objective. The identified risk factors of VLBW infants in this study are tentative; however they match with international data on VLBW infants but which factors contribute most to VLBW is not understood in this study. Because of the same reasons including low frequency of maternal medical risk factors, no advanced

statistical modeling, i.e., logistic regression was carried out for identifying which risk factors contributed differentially to the VLBW infants in this research. Notably, no eligible parents declined to participate in the study because the three settings are public-cum-educational hospitals and the study is purely non-interventional. However, the research team explained to the parents about the significance of VLBW infants, which is globally on the increase and hence almost all parents showed keen interest in this study. At least one parent gave written consent for participation in this study. Therefore, no comparison between parents who declined and who agreed for participation was considered in the study. Similarly, no comparison was made between VLBW and normal infants because in NICU no normal babies are admitted and moreover ethical approval was taken for the study of NICU low birth babies. To do so, another ethical approval for recruiting normal birth babies from three hospitals other than NICU for comparison with VLBW infants is needed together with extended study timeline (more than 6 months) which is out of scope of this research. The strength of this semi-descriptive study is that the results are robust but tentative despite short timeline of the study. This mix-method study calls for a community-based nationwide research that might estimate prevalence and also identify significant risk factors of VLBW infants in Saudi Arabia.

5. CONCLUSION

In summary, paternal smoking, gestational age, assisted deliveries including cesarean section (CS) and medications used for conception are significant risk factors for VLBW infants. The studied VLBW infants suffered from a variety of comorbidities especially respiratory distress syndrome and necrotizing enterocolitis. The estimated prevalence of VLBW infants of 3.3% is higher than what is reported in other studies. Overall, the results of this study are tentative and calling for a nationwide survey of VLBW infants in Saudi Arabia.

CONSENT

All authors declare that ‘written informed consent was obtained from the parent of very low birth weight infants for publication of this paper.

ETHICAL APPROVAL

All authors hereby declare that ethics committee of King Abdulaziz University, Jeddah examined and approved the research proposal and gave permission to conduct this study, which have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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