British Journal of Medicine & Medical Research
6(1): 114-125, 2015, Article no.BJMMR.2015.189
ISSN: 2231-0614

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Predictors of Weight Gain among Very Low Birth Weight Infants Born at the Maternity and Children Hospitals in Jeddah during 2012-2013

Amena Yahya Munshi[1], Omar Balbaid[2] and Naseem Akhtar Qureshi[3*]

[1]Department of Field Epidemiology, Public Health Administration, Ministry of Health, Riyadh, Saudi Arabia.
[2]Department of Higher Education, Postgraduate Studies Center for Family and Community Medicine, King Abdulaziz University, Jeddah, Saudi Arabia.
[3]General Administration of Research and Studies, Ministry of Health, Riyadh, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration between all authors. Authors AYM and OB designed the study and wrote the protocol. Author AYM collected the data and entered in the computer. Authors AYM and NAQ managed the literature searches, and analyzed the data. Author NAQ wrote the first draft of the manuscript and revised the paper a number of times. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2015/13920
Editor(s):
(1) Crispim Cerutti Junior, Department of Social Medicine, Federal University of Espirito Santo, Brazil.
Reviewers:
(1) Anonymous, University of São Paulo, Brazil.
(2) Lourdes Conceiçao Martins, Programa de Pós-graduação em Saúde Coletiva da Universidade Católica de Santos, Brazil.
(3) Anonymous, The Nebraska Medical Center, USA.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=720&id=12&aid=7236

Original Research Article

Received 10th September 2014
Accepted 7th November 2014
Published 15th December 2014

ABSTRACT

Background: Growth failure and restricted weight gain in very low birth weight (VLBW) infants remains extremely common despite advances in neonatal care. A majority of VLBW infants leave the hospital with weights below the 10th percentile for age. A variety of measures including nutritional interventions have been considered to achieve adequate weight gain in these infants for preventing short- and long-term lifetime complications.
Objective: This study aims to profile factors that impact weight gain among VLBW infants in three Maternity and Children Hospitals in Jeddah City, the Kingdom of Saudi Arabia [KSA].
Methods: A prospective study with short follow-up selected a nonrandom sample of infants for

**Corresponding author: Email: qureshinaseem@live.com;*

collecting data related to parents and admitted VLBW infants in three hospitals. The medical files of actively admitted VLBW infants [n=61] to the neonatal intensive care unit (NICU) were daily examined for a period of four months through 1st January, 2013 to 30th April, 2013 until their discharge.

Results: Within a variety of categorical and continuous parental and infants' variables, joint family income and total formula milk fed to VLBW infants significantly correlated with weight gain in VLBW infants. However, the most powerful predictor of weight gain in VLBW infants was total formula milk fed to them.

Conclusion: This study calls for further studies for identifying other predictors of weight gain in VLBW infants in Saudi Arabia.

Keywords: Very low birth weight infant; weight gain; breast feeding; Saudi Arabia.

1. INTRODUCTION

Infants continuing to be born at very low birth weights (VLBW) is considered a public health problem. Two types of fetal programs are in place in Ministry of Health [1-2]. Nonetheless, VLBW (birth weight <1500g) is a commonplace phenomenon and major cause of infant morbidity, mortality and neurodevelopmental disability in Saudi Arabia [3]. Infant mortality rate (IMR) is defined as the number of deaths in children less than 1 year of age per 1000 live births in the same year [4]. According to a retrospective study of 92 infants, the estimated incidence of VLBW at King Abdulaziz University Hospital (KAUH), Jeddah was 0.52%. The early neonatal mortality among extremely low birth weight (ELBW) infants was 75% compared to 13.7% among VLBW group. However, the immediate neonatal complications were higher among VLBW infants than ELBW group [3]. In a Saudi Epidemiological Bulletin, the prevalence of VLBW in a major hospital in Riyadh was reported to be 13.3% [5]. Infant mortality and morbidity are found to be 200 times higher among VLBW infants when compared to infants with normal birth weight [5].

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 [6]. The VLBW infants related to a variety of etiologies account for only 2.2% of live birth, however they contribute disproportionately to neonatal morbidity, the healthcare costs and increased length of stay in hospital attributed to several comorbid complications such as neonatal enterocolitis (NEC), late-onset sepsis (LOS) and feeding intolerance [7-8]. 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). IUGR is a fetal weight<the 10th percentile of the normal for the gestational age [9]. In the USA, the reported prevalence of ELBW and LBW infants ranges from 0.1% (BW<500g) to 7.4% (BW≤ 2500g [10].

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 premature births, poor prenatal care, inadequate weight gain during pregnancy, malnutrition, ethnicity, and less than 20 years or more than 35 years of age [11-21]. Women need education on the importance of preconception care, prenatal care, and adequate pregnancy weight gain to reduce the odds of having a VLBW infant [21]. Notably, teenagers with second birth often have a LBW infants or a preterm birth [22]. Preterm babies are both physically small and physiologically immature and are vulnerable to several complications including injury to fragile organ systems [10-11,23-25]. The outcome studies of VLBW infants reported survival rates that ranged from 34% (BW<751g) to 93% (1251-1500g) and 23% (gestational age [GA]=23weeks) to 54% (GA=25 weeks) [26]; and 40% (<1000g) to 86.2% (1000g-1499g) [27]. In a Japanese national survey, the neonatal mortality rate and mortality rate for VLBW (<1000g) infants admitted to NICU were 13% and 17%, respectively [28]. The scenario has been changing constantly and more infants are born with low birth weight around the globe [29]. We raise a question, which is the goal of this study: do factors related both to parents and VLBW infants influence weight gain in this population?

The sociodemographics of parents and anthropometrics of infants contribute to low birth weight infants but have less impact on weight

gain in VLBW infants. However, feeding practices have an evidence-based role in promoting adequate weight gain in VLBW infants. The benefits of human milk over formula milk (premature or term types) to term and preterm/VLBW infants include unique healing properties, nutritional, a great bioavailability of trace elements, faster gastric emptying, feed tolerance, immunological and antimicrobial protection, and transfers of beneficial milk hormones and growth factors [13-14,30]. Other advantages of human milk to VLBW infants are development of maternal bondage, antioxidant effects through inositol, vitamin A and beta-carotene, reduction in retinopathy of prematurity (ROP), lower risk of NEC and LOS, and shorter hospitalization [13-14,31-33]. Furthermore, lack of chronic gastrointestinal diseases, infections, allergies, and higher psychomotor developmental index [PDI] and behavior rating scale percentile score were associated with human milk intake by ELBW infants at 18 months of corrected age [9,14,30,34-35]. The cognitive effects persisted when similar cohort of 1035 ELBW infants fed human milk in the NICU were assessed at 30 months of corrected age [36]. However, the results of these studies [34-36] were not fully consistent with another study. A study from Canada found small but consistent advantage of human milk on neurodevelopment of VLBW infants compared to infants fed with formula milk [37]. Other study found no effect of maternal milk on Bayley Mental Development Index (MDI) or Psychomotor Development Index (PDI) and also rates of cerebral palsy (CP) remained unaffected in VLBW infants. However, neurodevelopmental outcomes were influenced significantly by social and neonatal factors [38]. In a related development, intensive lactation counseling to mothers of VLBW infants is reported to increase initiation of lactation and breast feeding to infants [7,39]. However, breastfeeding to VLBW infants is associated with some challenges; provision of adequate caloric and nutritional intake; establishing and maintaining a good milk supply, and transitioning from tube feeding to breastfeeding. Furthermore, mothers of VLBW infants are often required to pump their milk for 2 to 3 months until their infants are physiologically stable enough to attempt sucking at the breast. Additionally, adequate milk supply to VLBW infant is reduced due to mother's protracted hospitalization, separation, and associated stress and fatigue [15]. On the other hand, the human milk to preterm infants is not always beneficial. VLBW infants fed unfortified human milk are reported to have slower growth rates, inadequate nutrient and protein intakes, and insufficient supply of calcium and phosphorus that result in bone resorption, osteopenia, and metabolic bone disease [15]. Hence VLBW infants on receiving human milk need additional nutrients [15]. Although fortification of preterm human milk remains controversial in certain countries, the American Academy of Pediatrics and the Canadian Pediatric Society recommend the use of fortifiers containing protein, minerals, and vitamins to ensure that infants fed preterm human milk receive their estimated nutritional need. Studies that performed on unfortified human milk intake and in-hospital growth of VLBW infants when compared with formula milk demonstrated poorer growth in human milk fed infants than formula milk, and their results were attributed to the mixture of maternal milk with donor milk [16]. Formula milk fed to VLBW infants has also some disadvantages; increased risk for NEC, delayed brainstem maturation and visual development, and decreased cognitive development [40]. The data on factors that impact weight gain in VLBW infants is limited in Jeddah; therefore this issue is addressed in this study.

1.1 Objectives

Factors that contribute to weight gain in VLBW infants have not been explored in the Kingdom of Saudi Arabia. Therefore, this study aims to profile possible predictive factors of weight gain in VLBW infants born at the maternity and children hospitals and King Abdulaziz Hospital in Jeddah city during the year 2012-2013. We hypothesize that the factors related to parents and VLBW infants will influence weight gain in this population.

1.2 Rational and Scope

To improve maternal health and reduce infant/child mortality is to achieve the Millennium Developmental Goals (MDG-4-5) initiated by the United Nations in year 2000 [41]. Furthermore, there is scarcity of data related to the impact of parental and VLBW infant factors and breast milk and formula milk on gain weight in VLBW infants in Saudi Arabia. This study will help in developing strategies for providing adequate weight gain in the VLBW infant. The data may also help in strategizing preventive approaches for reducing VLBW neonatal and infant mortality rate in the KSA. Perhaps there are many other advantages of gaining optimal weight in VLBW infants.

2. MATERIALS AND METHODS

Details of methods are described elsewhere [2]; however brief description of pertinent information will be in place here.

2.1 Setting

Jeddah city is the second largest city in the KSA representing its important western gateway known as "the Bride of the Red sea" with a population of about 3.4 million [42]. 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 [43]. These three Hospitals (total NICU beds = 108) were the study setting.

2.2 Design

This is a hospital-based, observational study with a prospective longitudinal/concurrent cohort design that recruited VLBW infants who were actively admitted to the NICU through1st January, 2013 to 30th April, 2013 until their discharge. All infants with VLBW, either preterm or term with IUGR admitted to NICU level I (basic) and level II (specialty care) were included in this study. The relevant data were collected prospectively from parents and records of actively admitted cases of VLBW to NICU on daily basis. The inclusion criterion for longitudinal study was; infant BW of ≤1500 g 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 or in other words infants were not recruited initially at the start of the study if they were over a month old, 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 high risk conditions including infants kept in isolation rooms.

2.3 Sampling

The sampling structure for this study was as follows; 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 [4,10]. 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 was 64 but data was complete in the files of 61 VLBW infants.

2.4 Data Collection

For assessing the influence of various factors related to parents, VLBW infants, breast milk, and formula milk, VLBW infants [n=61] were followed up from 1st January 2013 to 30th April 2013 using a structured data collection sheet, which was designed after reviewing the literatures [3,11,34,36]. 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) sociodemographic data (parents' ages, nationalities, educational levels, occupation, income, housing and living area, and smoking behaviour), 4) maternal 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 hemorrhage, 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 in kg, breast milk intake in ml, formula milk intake in ml, total parenteral nutrition -TPN, partial parenteral nutrition -PPN, respiratory distress syndrome -RDS, NEC, ROP, LOS, and hypo- or hyperglycemia).Total weight gained (kg) was the dependent variable whereas total breast milk fed (ml), total formula milk fed (ml) to infants and other factors were independent variables. Beside other factors, the impact of breast milk and formula milk on weight gain among VLBW infants was assessed using appropriate statistical tests. The data for this study [n=61] were collected from patient admission files and clinical flow chart on daily basis.

2.5 Data Processing and Analysis

The data were entered into the computer, cleaned and analyzed using appropriate tests. SPSS version 20.0 [44] 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. Total weight gain among VLBW infants [n=61] during their NICU hospitalization was arbitrarily categorized into; weight gain≤600g and >600g in order to find its associations with various sociodemographic, clinical and anthropometric categorical dichotomous variables related to parents and VLBW infants. Arbitrary cutoff point is an individual decision and divides more or less equally the variable in question such as total weight gain. Two-way contingency tables were used for this purpose. Multiple logistic regression modeling was used to find out predictors of dichotomous outcome measure, that is weight gain ≤600g and >600g. The possible predictors included in the modeling were dichotomous variables related to parents and VLBW infants. Multiple linear regression modeling was used to assess the effects of independent continuous variables on the dependent continuous outcome measure in terms of total weight gain among VLBW infants. Pearson product moment coefficient correlation test (bivariate) was used to measure the strength of a linear relationship between two continuous variables. It ranges from +1 to -1. A correlation of +1 reflects that there is a positive linear relationship between two variables. A correlation of -1 means that one variable increases while the other decreases. Exact p values were reported here, and p value less than .05 was considered significant.

2.6 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 AKUH.

3. RESULTS

Parental variables and characteristics of VLBW infants are described elsewhere [2]. The mean of total weight gain of VLBW infants during their NICU hospitalization was 0.606±0.273 (range =0.250-1.100 kg). According to chi square statistics, none of the dichotomous variable had statistically significant association with dichotomous total weight gain outcome measure of VLBW infants Table 1. These fourteen independent variables related to parents and VLBW infants were entered in the multiple logistic regression model. Total weight gain was the dependent binary outcome measure. According to this modeling, none of the included dichotomous variables survived the model as expected and hence no significant predictor of total weight gain among VLBW infants was observed.

According to Pearson bivariate correlation statistics Table 2, 10 variables were positively correlated with total weight gain in VLBW infants. However, none of them was significantly correlated. Furthermore, four variables were negatively correlated with total weight gain in VLBW infants but none of them was significantly correlated. Only two variables in terms of joint family income and formula milk were significantly, positively correlated with total weight gain in VLBW infants Fig. 1.

These sixteen independent continuous variables related to parents and VLBW infants were entered in the multiple linear regression modeling and total weight gained was the dependent continuous outcome measure. The only variable that significantly predicted the total weight gain among VLBW infants was the total formula milk fed to VLBW infants (B=2.858E-5, SE=0.000, Beta=0.468, t=3.693, p=0.001) during their stay in the NICU. Here B/b, SE and Beta represent unstandardized coefficient, standard error and standardized or beta coefficient in regression analysis, respectively. Beta coefficients are the estimates resulting from an analysis performed on standardized variables with variances of 1. This is to answer the question of which of the independent variables has greater effect on the dependent variable, when the variables are measured in different units of measurement. The significance value (p) is the probability of a result of this magnitude/or greater in the data, given that the null hypothesis is false.

Table 1. Parental and VLBW infants' (n=61) variables and Total gain weight

Variable- maternal	No.	≤ 600g	> 600g	χ^2 with 1 df	P value
Nationality					
-Saudi	33	16	17		
-Non-Saudi	28	17	11	0.912	0.339
Education					
≤10 grade	28	18	10		
>11 grade	33	15	18	2.163	0.141
Occupation					
-housewife	43	25	18		
-employed	18	8	10	0.958	0.328
Smoking status					
-Smokers	7	3	4		
-Non-Smokers	54	30	24	0.402	0.526
Variable-paternal					
Education					
≤10 grade	20	13	7		
>11 grade	41	20	21	1.424	0.234
Occupation					
-Public sector	43	24	19		
-Private sector	18	9	9	0.173	0.678
Smoking status					
-Smokers	26	14	12		
-Non-Smokers	35	19	16	0.001	0.973
Variables-VLBW infants					
Gender					
-Male	27	16	11		
-Female	34	17	17	0.519	0.471
Infants born to mother					
-Primigravida (+p1&p2)	43	24	19		
-Multipara	18	9	9	0.173	0.678
Infants were					
-Multiple birth	20	11	9		
-Single birth	41	22	19	0.010	0.921
Infants born to mothers					
-Conceived-IVF	9	5	4		
-Conceived- No IVF	52	28	24	0.009	0.924
Infants born by					
-SVD	24	12	12		
-C/S & ABD	37	21	16	0.268	0.605
Infants born by					
-Emergency delivery	54	29	25		
-Elective delivery	7	4	3	0.030	0.864
Infants born to mothers					
-H/O multiple abortions	4	3	1		
-No h/o abortions	57	30	27	0.753	0.385
Hospital settings					
-KAUH	35	16	19		
-Other hospitals	26	17	9	2.325	0.127

Certain variables related to maternal and infant disease and treatment that may impact weight gain and postnatal growth failure among VLBW infants [45] were not considered in the analysis. The medical interventions in terms of resuscitation (n=10, 15.8%), ventilation (n=33, 54.4%), and surfactant administration (n=41, 66.7%) were provided to all VLBW infants, therefore this variable was also not considered for association with total weight gain in VLBW infants. Likewise, the major VLBW infants' complications such as RDS (n=33, 54%), NEC

(n=12, 18.9%), patent ductus arteriosus (n=8, 13%), ROP (n=6, 9.4%) and diagnosed late onset sepsis (LOS) were not considered for statistical association with total gained weight. Most of VLBW infants were born premature and preterm (n=59, 96.8%) and hence this variable was also not accepted for statistical association with total weight gain. We have not considered major medical complications in mothers who delivered VLBW infants. These variables were not considered because of lack of normal infants control group. The mean discharge weight in kilograms of VLBW infants was 1.64±0.24 (range = 1.1- 2.15 kg).

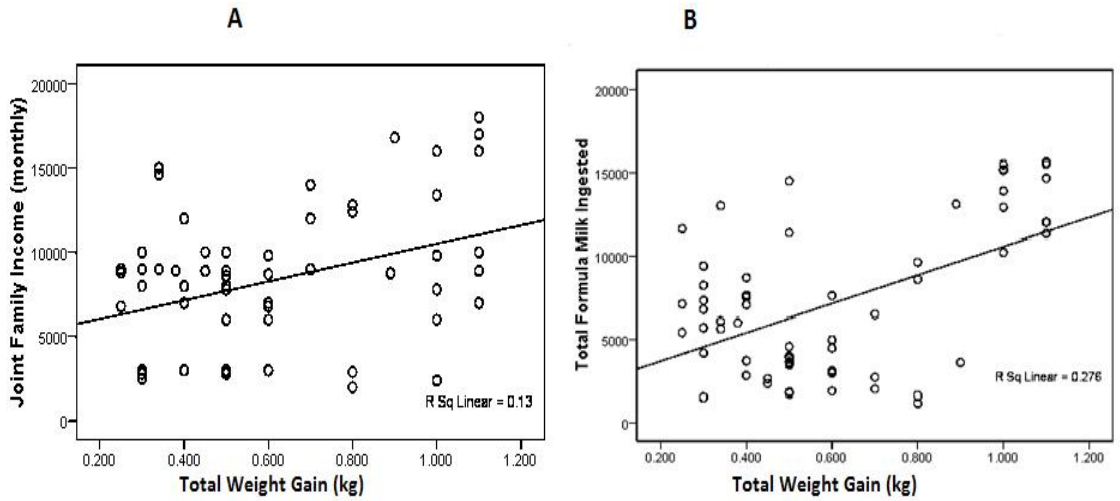

Fig. 1. Pearson correlation between joint family income (A) or total formula milk (B) and total weight gain in VLBW infants

Table 2. Parental and VLBW infants factors and the total gain weight

Variable-maternal	Pearson correlation value	Significance (2-tailed)
Age	0.178	0.169*
Monthly salary	0.227	0.078*
Variable-Paternal		
Age	0.231	0.073*
Monthly salary	0.156	0.231*
Family Joint income	0.360	0.004***
Variable- Infant		
Gestation Age	-0.110	0.399**
Apgar Score at birth1	0.148	0.254*
Apgar Score at birth5	0.117	0.368*
Birth Weight	-0.054	0.679**
Birth Height	0.076	0.561*
Birth Head Circumference	0.231	0.073*
Hospital Stay	-0.045	0.732**
Total Parenteral Nutrition	.0241	0.062*
Partial Parenteral Nutrition	-0.165	0.203**
Total amount of breast Milk fed	0.049	0.709*
Total amount of formula Milk fed	0.525	0.000***

**Positive insignificant correlation, **Negative insignificant correlation, ***Correlation significant at the 0.01 level (2-tailed), Notably, 22% and 78% of the total weight gained by VLBW infants was due to breast milk and formula milk, respectively. The proportion of breast milk fed to the total amount of milk fed by VLBW infants in the NICU was calculated as following: Total amount of breast milk/(total breast milk +total formula milk) and it was 17.5%*

4. DISCUSSION

This study with short longitudinal follow-up identified possible predictors of total weight gain in VLBW infants born at three hospital settings in Jeddah city. According to this study, none of the dichotomous variables related to parents' sociodemographics and VLBW infants' characteristics were associated with total weight gain in VLBW infants. However, only two continuous variables were significantly correlated with total weight gain among VLBW infants. Furthermore, only formula milk was the most powerful predictor of total weight gain among VLBW infants in this study. These results are more or less consistent with other studies discussed below, though these western studies have different objectives, methods and a variable number of heterogeneous participants.

In a cross sectional study of 175 neonatal survivors with VLBW, Were and Bwibo reported that preterm formula feeding to infants and absence of neonatal morbidity at term were associated with better growth [46].In another study, Pinelli and colleagues [37] reported that neither breastfeeding nor formula milk influenced mental developmental index of VLBW infants at 12 months corrected age, which is not consistent with a meta-analytic review [47]. This meta-analysis reported that breast feeding was significantly associated with higher scores for cognitive development compared with formula feeding. However, birth weight significantly predicted neurodevelopmental growth of VLBW infants at 6 and 12 months corrected age [37].Other study of 98 VLBW infants found no effect of maternal milk on Bayley Mental Development Index (MDI), Psychomotor Development Index (PDI) and also rates of cerebral palsy (CP) remained unaffected in VLBW infants at 20 months corrected age. However, neurodevelopmental outcomes were influenced significantly by social and neonatal factors [38]. In a Norway study of 127 VLBW infants, Henricksen and colleagues reported that reduced energy intake ($p = 0.002$), non-Caucasian ethnicity ($p = 0.04$) and weight at birth ($p = 0.004$) were negatively associated with growth restriction [48]. Thus, the results suggest that adequate energy intake through fortified milk feeding, weight at birth, and Caucasian ethnicity are strong predictors of extra-uterine growth among VLBW infants at discharge from hospital.

In a retrospective population-based study of extremely low gestational age (ELGA) infants (<27 weeks), Stoltz Sajöström and associates reported that lower energy intake correlated with lower gain in weight, length, and head circumference ($p=0.001$). Furthermore, protein and fat intake predicted growth in all anthropometric outcomes and head circumference, respectively. This study suggested that optimized energy and macronutrient intake may impact early growth failure in ELGA infants [49]. According to some researchers, infants receiving formula may have had improved growth as shown in the present study because the formula contained more calories and/or protein. Consequently, a 24 calorie/ounce formula fed to preterm infants should associate with more weight gain compared to 20 calorie/ounce formula. Additionally, breast milk contains roughly 10 grams protein/liter. Formula contains relatively more proteins than human milk that might improve the weight gain in VLBW infants. Our study has limited information about such details.

Notably intense breast feeding and bottle-emptying behaviors and overweight related to healthy infants may lead to childhood obesity and adiposity [50-51]. This feeding strategy if applies to VLBW infants would result in excessive weight gain is not explored, however should remain a concern in neonatal care. Term newborn length is reported to predict early growth retardation and high weight gain [52]. It should also guide neonatal caretakers in NICU.

Low income/poverty during pregnancy is linked with preterm birth, IUGR, low birth weight infants and other neonatal complications including neonatal or infant death [53]. In addition, researchers compared different population groups within countries and found that the differences in social determinants of health in the form of education level, income and living conditions and others influence LBW infants, infant mortality (IM)and birth outcomes, and postnatal growth of VLBW infants [29,53,54]. Family poverty and lack of family problem-solving processes negatively tend to predict maternal feeding competencies [55] and thus may negatively affect the weight gain in and growth of VLBW infants. Conversely higher family income and good social capital have reverse effects on VLBW infants [55]. The results of this study that found joint family income association with weight gain in VLBW infants are consistent with above studies [53,55].

This study has some limitations. The results of this study are not generalized to the NICU of other hospitals and general population because it is a non-community based study in three hospitals in Jeddah. A short duration of follow-up [4 months] and a small number of included participants [n=61] for identifying the possible predictors of total weight gain in VLBW infants possibly are not sufficient for achieving this objective. Furthermore, no standard definitions of breast feeding recommended by WHO [32] were used in this research, allow comparing breastfeeding among different NICUs and ratings of quality improvement programs. This study has some strength. According to correlation analysis, the two identified predictors, i.e., joint family income (higher income) and formula milk, of total weight gain in VLBW infants support international data on total weight gain in VLBW infants. However, according to multiple regression analysis, the most powerful factor that contributed to total weight gain in VLBW infants is total formula milk fed by VLBW infants during their NICU stay in three hospitals in Jeddah. Overall, the results are robust yet tentative despite small sample size and the short timeline of the study. This preliminary study calls for a community-based nationwide research that might identify more predictors of total weight gain significantly related to VLBW infants in Saudi Arabia.

5. CONCLUSION

In summary, parental joint family income and total formula milk fed to VLBW infants are significant predictive factors of total weight gain in VLBW infants. Overall, the results of this study are tentative and calling for a nationwide survey for identifying more predictive variables underlying total weight gain in VLBW infants in Saudi Arabia.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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