BREAST-FEEDING AND INSULIN LEVELS IN LOW BIRTH WEIGHT NEONATES

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ABSTRACT

BACKGROUND

This study compared breast-feeding with or without supplemental feeding on short-term growth patterns and fasting insulin levels in low birth weight neonates.

MATERIALS AND METHODS

This study was conducted in Department of Paediatrics and it was approved by institutional review board. 100 low birth weight neonates who were less than 2.5 kgs who were born at >38 weeks of gestation, less than 10 days of age were enrolled in the study. 50 children's parents provided informed consent (50%) and assured followup were included in the study.

RESULTS

In the present study, birth weight was 2.00 ± 0.58 in group I and it was 1.88 ± 0.35 kgs in group II; birth length was 43.5 ± 2.5 in group I and it was 43.8 ± 2.8 cms in group II; head circumference was 31.2 ± 1.4 in group I and it was 30.25 ± 8.7 cms in group II; chest circumference was 29.1 ± 2.8 in group I and it was 28.7 ± 5.8 in group II. Haemoglobin levels, glucose fasting levels were lesser in group II compared to group I and insulin levels and IQR levels were more in group II compared to group I.

CONCLUSION

Those low birth weight neonates who had exclusive breast-feeding had lesser fasting insulin levels when compared to those who were fed with fortified breast milk.

KEYWORDS

(VLBW), (ELBW), Type 2 Diabetes.

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BACKGROUND

Low Birth Weight (LBW) is defined by the World Health Organization as a birth weight of an infant of 2,499 g or less, regardless of gestational age. Subcategories include Very Low Birth Weight (VLBW), which is less than 1500 g (3 pounds 5 ounces) and Extremely Low Birth Weight (ELBW), which is less than 1000 g (2 pounds 3 ounces).[1] Normal weight at term delivery is 2500-4200 g (5 pounds 8 ounces - 9 pounds 4 ounces). Low birth is caused mainly due to diabetes and cardiovascular diseases in adults.[2] In these adults, there is presence of lower beta cells pancreatic function, insulin resistance, central obesity, hypertension, lipid abnormalities and diabetes. Insulin resistance starts in early infancy, forwards through childhood and results in type 2 diabetes in early stages of adulthood. Lower incidence of impaired glucose tolerance is associated with steady weight gain in childhood. Influence of excess of nutrients in early infancy is quite conflicting, i.e. growing faster in premature children was not linked to mortality from cardiovascular disease, but was associated with cardiovascular risk factors such as dysfunction of endothelium, resistance of insulin, dyslipidaemia in preterm infants.[3,4] In infants born with upward percentile, weight crossing was linked with high blood pressure and resistance of insulin and risk of obesity. Using nutritional supplements for promoting growth in infants is also a determining factor cardiovascular risk later.[5] For example, dried milk powder, which is used as a nutritional supplement has been shown to have an adverse long-term effect on glucose tolerance, diabetes and high blood pressure. This study compared breast-feeding with or without supplemental feeding on short-term growth patterns and fasting insulin levels in low birth weight neonates.

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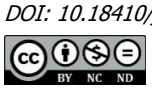

MATERIALS AND METHODS

This study was conducted in Department of Paediatrics and it was approved by institutional review board. 100 low birth weight neonates who were less than 2.5 kgs who were born at >38 weeks of gestation, less than 10 days of age were enrolled in the study. 50 children's parents provided

informed consent (50%) and assured followup were included in the study.

Inclusion Criteria

Children born after 38 weeks of gestation, low birth weight having no intercurrent illnesses such as acute infections or congenital malfunctions. These children were randomly divided into two groups, group I consisted of 25 were made to receive breast-feeding, group II consisted of 25 received fortified meal along with breast-feeding. Measurements of length, weight, head, chest and abdomen circumference was performed. General evaluation of health status was performed. For estimation of glucose and insulin levels, a 4-hour fasting blood sample was obtained. The mothers of both the groups were advised to give breast-feeding for the study duration. In group II, a commercially available human milk fortifier was used, which contains 0.2 g protein, 0.1 g fat and 1.5 g carbohydrates with additional vitamins and minerals. Every 15 days to three months, follow up was taken and at end of the three months, fasting glucose and insulin levels were recorded.

RESULTS

Variable	Group I (n=25)	Group II (n=25)
Birth weight (kg)	2.00 ± 0.58	1.88 ± 0.35
Birth length (cm)	43.5 ± 2.5	43.8 ± 2.8
Head circumference (cm)	31.2 ± 1.4	30.25 ± 8.7
Chest circumference (cm)	29.1 ± 2.8	28.7 ± 5.8
Table 1. Shows Baseline Clinical Characteristics		

Table 1 shows that birth weight was 2.00 ± 0.58 in group I, and it was, 1.88 ± 0.35 kgs in group II; birth length was 43.5 ± 2.5 in group I, and it was, 43.8 ± 2.8 cms in group II; head circumference was 31.2 ± 1.4 in group I, and it was, 30.25 ± 8.7 cms in group II; chest circumference was 29.1 ± 2.8 in group I, and it was, 28.7 ± 5.8 in group II.

Variable	Group I (n=25)	Group II (n=25)
Haemoglobin (g/dL)	16.8 ± 1.9	15.5 ± 1.7
Glucose fasting (mg/dL)	65.7 ± 9.7	64.9 ± 7.4
Insulin mean (µU/mL)	1.38 ± 1.17	1.89 ± 1.29
Insulin mean and IQR (µU/mL)	1.20	1.65
Table 2. Shows Biochemical Characteristics		

Table 2 shows that haemoglobin levels and glucose fasting levels were lesser in group II compared to group I and insulin levels and IQR levels were more in group II compared to group I.

DISCUSSION

In the present study, birth weight was 2.00 ± 0.58 in group I, and it was, 1.88 ± 0.35 kgs in group II; birth length was 43.5 ± 2.5 in group I, and it was, 43.8 ± 2.8 cms in group II; head circumference was 31.2 ± 1.4 in group I, and it was, 30.25 ± 8.7 cms in group II; chest circumference was 29.1 ± 2.8 in group I, and it was, 28.7 ± 5.8 in group II. Haemoglobin levels and glucose fasting levels were lesser in group II compared to group I and insulin levels and IQR levels were more in group II compared to group I. In a study conducted by Mukesh Gupta et al[6] evaluated the influence of early infancy feeding practices on fasting insulin levels as marker of insulin resistance in low birth weight neonates. Eighty successive low birth weight (<2.5 kg) neonates <10 days of age born at >38 weeks of gestation at this tertiary care centre were successively invited for participation in the study; parents of 52 (65%) consented to participate. Group 1 children (n=26) were randomised to receive only breast-feeding and group 2 (n=26) received fortified breast-feeding with a commercially available human milk fortifier. Routine anthropometry and evaluation of health status was performed. The babies were followed up every 15 days up to 3 months. Four-hour fasting glucose and insulin levels were measured at baseline and at 3 months. Statistical analyses were performed using t-test and Mann-Whitney test. In exclusively breast-fed group 1 neonates vs. group 2, the mean birth weight was similar (1.99 ± 0.23 vs. 1.87 ± 0.30 kg). There was no difference in body length, head circumference and chest circumference. Mean haemoglobin levels, fasting glucose (63.9 ± 9.8 vs. 64.3 ± 8.0 mg/dL) and fasting insulin levels (1.44 ± 1.19 vs. 1.73 ± 1.38 µU/mL) were also similar. At three-month followup in Group 1 children receiving exclusive breast-feeding, there was significantly lower weight as compared to Group 2 (3.40 ± 0.3 vs. 4.75 ± 0.5 kg, p<0.01). This was associated with significantly lower fasting glucose (79.0 ± 9.4 vs. 85.6 ± 8.4 mg/dL) and fasting insulin levels (6.95 ± 4.27 vs. 15.73 ± 3.29 µU/mL) (p<0.001). The difference persisted even after adjustment for weight gain in group 2 (weight adjusted insulin 11.26 ± 3.3 µU/mL; p<0.001). Low birth weight neonates fed fortified breast milk had greater fasting insulin levels compared to those with exclusive breast-feeding at 3 months of age. The difference persisted after adjustment for excessive gain in fortified milk fed neonates and suggests adverse glucometabolic programming. Fewtrell MS et al,[7] this study tested the hypothesis that balanced addition of Long-Chain Polyunsaturated Fatty Acid (LCPUFA) to preterm formula during the first weeks of life would confer long-term neurodevelopmental advantage in a double-blind, randomised, controlled trial of preterm formula with and without preformed LCPUFA. The participants were 195 formula-fed preterm infants (birth weight <1750 g, gestation <37 weeks) from 2 UK neonatal units and 88 breast milk-fed infants. Main outcome measures were Bayley Mental Developmental Index (MDI) and Psychomotor Developmental Index (PDI) at 18 months and Knobloch, Passamanick and Sherrard's Developmental Screening Inventory at 9 months' corrected age. Safety outcome measures were anthropometry at 9 and 18 months tolerance, infection, necrotising enterocolitis and death. There were no significant differences in developmental scores between randomised groups, although infants who were fed LCPUFA-supplemented formula showed a nonsignificant 2.6-point (0.25 standard

deviation) advantage in MDI and PDI at 18 months with a greater (nonsignificant) advantage (MDI- 4.5 points; PDI- 5.8 points) in infants below 30 weeks' gestation. LCPUFA-supplemented infants were shorter than control infants at 18 months (difference in length standard deviation score- 0.44; 95%, confidence interval- 0.08-0.8). No other significant short- or long-term differences in safety outcomes were observed. Breast-fed infants had significantly higher developmental scores at 9 and 18 months than both formula groups and were significantly heavier and longer at 18 months than LCPUFA-supplemented, but not control infants. With the dose, duration and preparation of LCPUFA used, efficacy was not demonstrated, although an advantage in later neurodevelopment cannot be excluded by global tests of development up to 18 months particularly in infants below 30 weeks' gestation. The surprising effect of LCPUFA-supplemented formula on growth 18 months beyond the intervention period needs to be confirmed in other studies using similar supplementation strategies. Additional follow-up of this cohort is critical at an age when more specific tests of cognitive function are possible. Martin RM et al[8] conducted a study to investigate the association of breast-feeding with all-cause, cardiovascular and ischaemic heart disease mortality. A long-term followup of 4999 children originally surveyed from 1937 to 1939 was undertaken (Boyd Orr cohort). 4,379 subjects (88%) were traced in adulthood and 3,555 (71%) had complete data on all covariates. The results were combined with a meta-analysis of the published literature. In the Boyd Orr study, there was little evidence that breast-feeding was associated with all-cause (hazard ratio- 1.04 (95%, CI- 0.90-1.20)), cardiovascular (1.04 (0.83-1.30)) or ischaemic heart disease (1.02 (0.77-1.36)) mortality compared with bottle feeding. Meta-analyses of observational studies showed little evidence of an association of breast-feeding with all-cause (pooled rate ratio- 1.01 (95%, CI- 0.91-1.13)) or cardiovascular (1.06 (0.94-1.20)) mortality. There was a moderate-to-high degree of between-study heterogeneity for the association between breast-feeding and ischaemic heart disease mortality (I2 value-indicating the degree of between-study variation attributable to heterogeneity-66%) and estimates were consistent with both an important beneficial or adverse effect of breast-feeding. There is little consistent evidence that breast-feeding influences subsequent all-cause or cardiovascular disease mortality. Results from other well-designed cohorts may clarify residual uncertainty. Owen CG et al[9] conducted a study to examine the influence of infant feeding method on serum Total Cholesterol (TC) and Low-Density Lipoprotein (LDL) cholesterol. A cross-sectional study of 13- to 16-year-olds and a systematic review of studies (all observational) on the effects of infant feeding on cholesterol in infancy (<1 year), childhood or adolescence (1-16 years) and adulthood (> or = 17 years) were conducted using random effect models. Differences are presented as breast-fed, bottle-fed. A total of 1532 individuals (92% white; 55% male; mean age- 15.1 years) in 10 British towns were studied and 37 studies with 52 observations on TC (26 in infancy, 17 in childhood or adolescence, and 9 in adulthood corresponding figures for LDL were 7, 4 and 6) were reviewed. Mean TC in childhood or adolescence (including the new study) was not related to infant feeding pattern (mean TC difference = 0.00; 95% Confidence Interval (CI)- -0.07 to 0.07 mmol/L). However, in infancy, mean TC was higher among those breast-fed (mean TC difference = 0.64; 95% CI- 0.50-0.79 mmol/L), whereas in adults, mean TC was lower among those breast-fed (mean TC difference = -0.18; 95%, CI- -0.30 to -0.06 mmol/L). Patterns for LDL were similar to those for TC throughout.

Breast-feeding is associated with increased mean TC and LDL levels in infancy, but lower levels in adulthood/adult life. These results suggest that breast-feeding may have long-term benefits for cardiovascular health and may have implications for the content of formula feed milks. Stettler N et al[10] conducted a study to determine whether a rapid rate of weight gain in early infancy is associated with overweight status in childhood. It is a prospective study, which was conducted across United States in twelve sites. It is a cohort study from birth to age 7 years, twenty seven thousand eight hundred ninety nine (27,899) eligible participants born at full term between 1959 and 1965. Overweight status at age 7 years defined by a body mass index above the 95th percentile of the Centers for Disease Control and Prevention reference data. In 19,397 participants with complete data (69.6%), the prevalence of overweight status at age 7 years was 5.4%. The rate of weight gain during the first 4 months of life (as 100 g/month) was associated with being overweight at age 7 years after adjustment for several confounding factors- odds ratio- 1.38; 95% confidence interval- 1.32-1.44. This association was present in each birth weight quintile and remained significant after adjustment for the weight attained at age 1 year (odds ratio- 1.17; 95%, confidence interval- 1.11-1.24). A pattern of rapid weight gain during the first 4 months of life was associated with an increased risk of overweight status at age 7 years, independent of birth weight and weight attained at age 1 year. These findings may lead to new hypotheses regarding the cause of childhood obesity, which may contribute to our understanding of this increasing public health problem in the United States.

CONCLUSION

Those low birth weight neonates who had exclusive breast-feeding had lesser fasting insulin levels when compared to those who were fed with fortified breast milk.

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