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Original Research Article

Association of birth weight with body mass index of school children of central India: a cross sectional study

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ABSTRACT

Background: Overweight and obesity has become an important public health problem in both developed and developing nations. This is even more alarming as obese children are likely to become obese adults.
Methods: A cross sectional study was conducted in a government aided school in urban area of Nagpur, Maharashtra during January 2016 to April 2016. This study was conducted in students of age group of 9 to 15 years to assess the association of birth weight and body mass index of school children. Height and weight of the children were measured according to standard guidelines. BMI was calculated and classified using the percentile charts according to age and gender. Data was collected using EPI Info version 7.2. Descriptive statistics using frequencies and percentages were used. Chi square test was used to indicate the differences between two proportions. Odds ratio was used to define the strength of the association.
Results: The mean age of children was 11.92±1.27 and 11.31±1.27 in males and females respectively**.** In our study, there was a significant positive association between the birth weight and body mass index of the children.
Conclusions: We found that the children whose birth weight was lower than 2500 grams were having decreased risk of being overweight/ obese in their later life with an odds ratio of 0.55 (0.34 to 0.90). But, the correlation between the birth weight and body mass index is weakly positive (r=0.063).

Keywords: Birth weight, Childhood obesity, School health

INTRODUCTION

The worldwide prevalence of obesity has more than doubled between 1980 and 2014. Most of the world's population lives in countries where overweight and obesity kills more people than underweight. 41 million children under the age of 5 were overweight or obese in 2014 and nearly half of the children under- 5 who were overweight or obese in 2014 lived in Asia.[1] This scenario is particularly alarming because obese children are likely to become obese adults. Further, this problem is no more limited to the developed countries, but is also increasing rapidly in developing countries.

Several studies have shown tracking of obesity from childhood to adulthood, suggesting that early life factors are important in promoting adult obesity. Birth weight is supposed to be a crude indicator of prenatal growth. But, there are two sides to a coin and so, both high and low birth weights are linked to development of several diseases in later life. A Swedish study documented the association between birth weight and later risks of cardiovascular disease, obesity and type 2 diabetes mellitus for both sexes.[2]

According to Barker's hypothesis, under-nutrition at different stages of pregnancy leads to phenotypes characterized by low birth-weight, or low birth- weight relative to placental weight, or thinness at birth, or shortness at birth with subsequent failure of infant growth. Each of these phenotypes is associated with a particular pattern of metabolic abnormalities in adult life.[3]

A study in UK found a positive correlation between birth weight and later obesity. Furthermore, there was a tendency towards a J-shaped relationship.[4] A Danish study of school children showed that birth weight was positively related to the risk of overweight at all ages and the risk of overweight increased consistently with each increase in birth weight category.[5]

In a study of school children at Madurai, it was found that prevalence of obesity increased as the birth weight increased (p value of 0.021) which is significant.[6]

In a study done in 6-12 year old school children of Vadodara city, it was found that the prevalence of overweight and obesity in subjects with birth weight >2.5 kg was 19.1% as against 16% in those having birth weight <2.5 kg.[7]

Very few studies have been conducted in India to show association of birth weight with body mass index of children. Hence, this study was conducted to assess the association of birth weight and body mass index of school children.

METHODS

The present cross-sectional study was carried out during January 2016 to April 2016 among school going children of 9-15 years of age. One of the schools from central place of city was purposively selected by convenient sampling technique. After taking permission from the school authorities, the class teachers of the respective standards were explained the purpose of the study. A rapport was built up with the students and their assents were obtained. Written and informed consent was obtained from the parents. The purpose of the study and the nature of the information which had to be furnished by the study subjects were explained to them. A pre-designed and pre-tested self-administered questionnaire was used for data collection. It included socio-demographic factors like age, gender, socio-economic status, educational status of parents etc. and information about date of birth of child, birth weight of child, gender of child, age up to which child was breast fed etc. Anthropometric parameters of the children like height and weight were measured according to standard guidelines[8]. We used the formula Body mass index = weight (kg)/{height (m)}^{2} to calculate BMI of the children. Obesity in children was defined according to the CDC classification for body mass index percentile for age and sex.[9,10]

The research protocol was approved by the Institutional Ethics Committee, Indira Gandhi Government Medical College, Nagpur.

Considering proportion of study participants born with low birth weight being overweight or obese i.e. 9.2% as was reported in the pilot study, an alpha error of 5 per cent, an absolute allowable error 1 per cent and a non-response rate 10 per cent, the sample size was calculated as 958. Considering 10% drop outs due to other reasons, we recruited 1200 children in our study. However; 136 students did not report the birth weight and other relevant information in their questionnaire. So, the final sample size 1064 was considered for final analysis.

Statistical analysis

The data was collected and compiled using EPI info 7.2 and the analysis was done using social package for statistical software (SPSS) version 20.00 for windows. The level of significance was set at <0.05. Chi square test was used to indicate the differences between two proportions. Odds ratio was used to define the strength of the association.

RESULTS

Table 1 describes the mean and standard deviation of various demographic characteristics like age, height, weight, BMI, birth weight, type of delivery according to gender.

Table 1: Demographic characteristics of the children.

	Male (n=607)	Female (n=457)
	Mean±SD	**Mean±SD**
Demographic characteristics		
Age	11.92±1.27	11.31±1.27
Height	149.18±10.23	144.87±8.97
Weight	36.99±10.05	35.70±9.26
Body mass index	16.43±3.30	16.81±3.14
Birth weight	2.65±0.63	2.66±0.60
Type of delivery	**Number (%)**	**Number (%)**
Caesarean section	168 (27.67)	144 (31.5)
Normal delivery	439 (72.33)	313 (68.5)

Table 2 shows association of birth weight and overweight or obesity status of the children.

The children who had low birth weight (<2.5 kg) had decreased risk of being overweight/obese with an odds ratio of 0.55 (0.34 to 0.90) and the association was found to be statistically significant.

In our study, we found a positive correlation between birth weight and body mass index of the children (Figure 1).

Table 2: Association of birth weight and body mass index of the children.

Birth weight	Body mass index of the children				P value	Odds ratio (95% CI)
	Overweight/obesity		Normal			
	Number	%	Number	%		
≤2500 gms	23	7.21	296	92.79	0.015	0.55 (0.34 to 0.90)
>2500 gms	91	12.21	654	87.79		

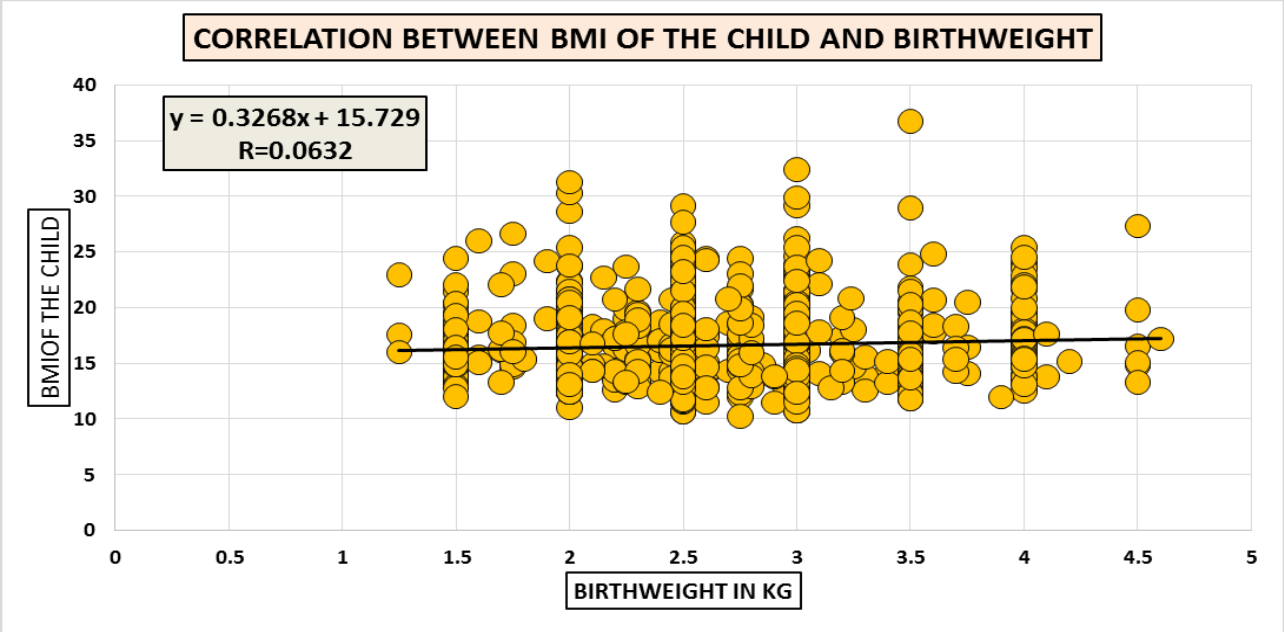

Figure 1: Scatter diagram showing correlation between birth weight and body mass index of the children.

DISCUSSION

An interesting concept of plasticity and life course framework has been implicated in the causation of the chronic diseases in later life of a child. Plasticity occurs more in some critical window periods, which generate long lasting effects in the phenotype.[11,12] Relation between birth weight and subsequent development of obesity/overweight has been assessed in several other studies.

Our study demonstrated that children who had birth weight <2.5 kg had decreased risk of being overweight or obese in their later life. A study conducted in Australia by Oldroyd et al, among 4-5 year old children showed that high birth weight was associated with a higher risk of child overweight/obesity in boys (adjusted OR: 2.42 95% CI 2.06, 2.86) and girls (adjusted OR: 1.76, 95% CI 1.12, 2.78) before and after adjustment for socio-demographic factors.[13] However, LBW was associated with a lower risk of child overweight/obesity (OR 0.50, 95%CI 0.32, 0.77) in girls but not in boys. Another multinational, cross-sectional study of 5141 children aged 9–11 years was conducted in 12 countries by Qiao et al, showed that the multivariable-adjusted odds ratios (ORs) of childhood obesity were significantly higher among children whose birth weights were 3500–3999 g (OR 1.45; 95% confidence interval (CI): 1.10–1.92), and 4400 g (OR 2.08; 95% CI: 1.47–2.93), compared with the reference group (2500–2999 g).[14] The positive association between birth weight and the odds of childhood obesity was seen in girls, whereas a U-shaped association appeared in boys.

In a study conducted in China by Li et al, on children aged 3 years and under, it was found that there was a positive association between birth weight and childhood overweight or obesity from 6 months to 3 years of age.[15] The odds ratios (ORs) of overweight or obesity were significantly higher among children whose birth weights were 3,000–3,499 g (1.35–1.53 folds), 3,500–3,999 g (2.09–2.37 folds), 4,000–4,499 g (2.80–3.32 folds), and more than 4,500 g (3.54–4.90 folds), compared with the reference group (2,500–2,999 g). Studies conducted by Oldroyd et al, Li et al and Qiao et al were in concordance with our study findings.[13-15] Another study conducted by Hirschler et al concluded that low birth weight is not associated with overweight/obesity in children, but high birth weight was associated with overweight/ obesity and metabolic syndrome.[16]

A cohort study by Renn et al inferred that the relative risk of child who was low birth weight, being overweight/ obese was 1.34 (1.09 to 1.64) and 1.72 (1.35 to 2.19) in

their childhood and adolescence respectively.[17] Similar findings were postulated by Morandi et al in their study.[18] A study by Vale et al concluded that the high birth weight was a strong predictor for overweight and obesity in adolescence. Similar findings were postulated by Goldani et al, Gillman et al and Strufaldi et al.[6,19,20] A systemic review and metanalysis done by Yu et al also substantiated the fact that high birth weight is associated with higher risk of overweight/obesity in later life.[21] Similar findings were also postulated by Schellong et al in their study.[22]

Our study was in accordance with majority of the studies conducted across the world. But, a study by Zarrati et al observed that the mean body mass index (kg/m^2) of children of 10 to 13 years of age whose birth weight was less than 2500 gms, 2500 to 4000 gms and more than 4000gms was 21.91±5.26, 18.78±3.44 and 19.48±3.61 respectively.[23]

A study was conducted in Canada by Hill et al where the study cohorts comprised obese subjects aged 10 to 16 years.[24] It was found that body mass index z-score correlated positively with birth weight (r^2=0.05, p=0.03), which is in concordance with the present study. A study conducted in Arkansas by Frame, where the sample consisted of medical records of patients that have documented birth weight, weight at 2 years, weight at 5 years, and weight at 7 years, showed that there were small positive correlations between birth weight and body mass index at ages two and four.[25]

One of the limitations is that, it was a cross sectional study the inferences drawn should be confirmed by analytical studies. The second limitation is that the birth weight is self-reported and also undergoes recall bias. The third limitation is that, some other factors that influence the association like cultural factors, ethnic factors, and physical activity patterns of the children have not been considered. In spite of these limitations, our study was able to a significant association between high birth weight and overweight/obesity in children due to the large sample size we have included.

CONCLUSION

In our study, there was a significant positive association between the birth weight and body mass index of the children. We found that the children whose birth weight was higher than 2500 grams were having increased risk of being overweight/obese in their later life. But, the correlation between the birth weight and body mass index is weakly positive.

We recommend that analytical studies have to be conducted in a larger representative population to infer with more precise results. The prevention of childhood overweight and obesity should start with pregnancy and postpartum care. Understanding of intrauterine growth and paediatric nutrition will help in targeting the interventions.

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REFERENCES

1. WHO | Obesity and overweight . WHO. World Health Organization; 2017. Available at: http://www.who.int/mediacentre/factsheets/fs311/en/. Accessed on 19 September 2017.
2. Johnsson IW, Haglund B, Ahlsson F, Gustafsson J. A high birth weight is associated with increased risk of type 2 diabetes and obesity. Pediatr Obes. 2015;10(2):77–83.
3. Barker DJ., Godfrey K., Gluckman P., Harding J., Owens J., Robinson J. Fetal nutrition and cardiovascular disease in adult life. Lancet. 1993;341(8850):938–41.
4. Eriksson J, Forsén T, Tuomilehto J, Osmond C, Barker D. Size at birth, childhood growth and obesity in adult life. Int J Obes Relat Metab Disord. 2001;25(5):735–40.
5. Rugholm S, Baker JL, Olsen LW, Schack-nielsen L, Bua J, Sørensen TIA, et al. Stability of the Association between Birth Weight and Childhood Overweight during the Development of the Obesity Epidemic, 2006.
6. G BR, Sivakumar E, Rajkumar D, Nagendran M. Prevalence Of Obesity Among School Children In Madurai. Int J Cur Res Rev. 2016;8(22):1–7.
7. Iyer U, Elayath N, Akolkar A. Magnitude and Determinants of Overweight and Obesity in 6-12 year old school children of Vadodara City. Curr Pediatr Res. 2011;15(1):105-9.
8. World health organisation. Physical status: the use and interpretation of anthropometry 1995. Available at: http://www.who.int/childgrowth/publications/physical_status/en/. Accessed on 21 October 2017.
9. Who.int. World health organisation, Growth Reference Standards- BMI for Age (5 to 19 years). Available at: http://www.who.int/growthref/who2007_bmi_for_age/en/. Accessed on 12 April 2016.
10. Cdc.gov. Centers for Disease Control and Prevention, Defining Childhood obesity. Available at: https://www.cdc.gov/obesity/childhood/defining.html. Accessed on 12 April 2015.
11. Ribeiro AM, Lima MD, Lira PI, Silva GA. Low birth weight and obesity: causal or casual casual association? Rev Paul Pediatr. 2015;33(3):340–8.

12. Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epidemiol. 2002;31(2):285–93.
13. Oldroyd J, Renzaho A, Skouteris H. Low and high birth weight as risk factors for obesity among 4 to 5-year-old Australian children: does gender matter ? Eur J Pediatr. 2011;170:899–906.
14. Qiao Y, Ma J, Wang Y, Li W, Katzmarzyk PT, Chaput J, et al. Birth weight and childhood obesity : a 12-country study. Int J Obes Suppl. 2015;5:74–9.
15. Li N, Liu E, Sun S, Guo J, Pan L, Wang P, et al. Birth Weight and Overweight or Obesity Risk in Children Under 3 Years in China. Am J Hum Biol. 2014;26:331–6.
16. Hirschler V, Bugna J, Roque M, Gilligan T, Gonzalez C. Does low birth weight predict obesity/overweight and metabolic syndrome in elementary school children? Arch Med Res. 2008;39(8):796–802.
17. Ren J, Wu J, Ji M, Rong F, Li Y, Gao E, et al. The effect of high birth weight on overweight and obesity in childhood and adolescence. Saudi Med J 2013;34(21):623–31.
18. Morandi A, Meyre D, Lobbens S, Kleinman K, Kaakinen M, Shiman S, et al. Estimation of Newborn Risk for Child or Adolescent Obesity: Lessons from Longitudinal Birth Cohorts. PLoS One. 2012;7(11).e49919.
19. Goldani MZ, Haeffner LS, Agranonik M, Barbieri MA, Bettiol H, Silva AA. Do early life factors influence body mass index in adolescents? Braz J Med Biol Res. 2007;40(9):1231–6.
20. Strufaldi MW, Silva EM, Puccini RF. Overweight and obesity in prepubertal schoolchildren: the association with low birth weight and family antecedents of cardiovascular disease. Embu - metropolitan region of Sao Paulo, 2006. Cien Saude Colet. 2011;16(11):4465–72.
21. Yu ZB, Han SP, Zhu GZ, Zhu C, Wang XJ, Cao XG, et al. Birth weight and subsequent risk of obesity: a systematic review and meta-analysis. Obes Rev. 2011;12(7):525–42.
22. Schellong K, Schulz S, Harder T, Plagemann A. Birth Weight and Long-Term Overweight Risk: Systematic Review and a Meta-Analysis Including 643,902 Persons from 66 Studies and 26 Countries Globally. PLoS One. 2012;7(10):e47776.
23. Zarrati M, Shidfar F, Moradof M, Nasiri Nejad F, Keyvani H, Rezaei Hemami M, et al. Relationship between Breast Feeding and Obesity in Children with Low Birth Weight. Iran Red Crescent Med J. 2013;15(8):676–82.
24. Hill DJ, Prapavessis H, Shoemaker JK, Jackman M, Mahmud FH, Clarson C. Relationship between Birth Weight and Metabolic Status in Obese Adolescents. ISRN Obesity. 2013;490023:1-8.
25. Frame M. The Influence of Birth Weight on Body Mass Index in Young Children in Northwest Arkansas. University of Arkansas, Fayetteville; 2016.

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