Brief Communication

# Birth Weight as a Cardio Metabolic Risk Factor in Iranian Adolescents

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## Abstract

**Background:** A large number of epidemiological studies from different geographical regions showed a considerable relationship between low birth weight (LBW) and adverse health effects later in life. This study aims to assess the birth weight (BW) as a cardio metabolic risk factor in Iranian adolescents. **Methods:** This cross-sectional study was conducted on 12-year-old students from different areas of Rasht, North Iran. Data were collected by a questionnaire including variables as birth height, BW, gestational age, blood pressure, and laboratory tests including triglycerides (TGs), total cholesterol, low-density lipoprotein-cholesterol (LDL-C), high-density lipoprotein-cholesterol (HDL-C), and insulin level. Data were analyzed using *t*-test, Chi-square, and Pearson correlation coefficient. **Results:** Overall, 858 adolescents participated in this study. Results showed significant correlation between BW and abdominal circumference, hip circumference, total cholesterol, TG, HDL-C and LDL-C ($P$ = 0.064, 0.194, 0.224, 0.017, and 0.017, respectively). **Conclusions:** The study findings on the correlation between BW and cardio metabolic factors might serve as confirmatory evidence on the association of LBW with future cardio metabolic disorders.

**Keywords:** *Birth weight, cardiometabolic, children, Iran, risk factor*

## Introduction

The fetal origins of adult disease hypothesis belonged to the risk factors of intrauterine exposures. It affected the fetus development during sensitive periods and increased the risk of specific diseases in adulthood.[1] A large number of epidemiological studies from different geographical regions showed a considerable relationship between small size at birth and later health defects. Increased risk of developing a disease such as diabetes type 2 and coronary heart disease (CHD) are the common complications of small for gestational age.[2-4]

Furthermore, Barker showed increased rates of hypertension and CHDs in thin or short at birth males and females with lower birth weights or with small placental sizes.[5] The low birth weight (LBW) hypothesis has received considerable support from the growing evidence that blood pressure in adult life inversely related to birth weight (BW).[6]

Barker *et al*. also reported an association between X metabolic syndrome and LBW[7] which was inconsistent with the results mentioned by the previous study.[8]

As considering the role of the family in changing nutritional habits is mandatory, it seems that parental education and changing their perceptions can also prevent diverse consequences.[9] The aim of the current study was to assess BW as a cardio metabolic risk factor in Iranian children.

## Methods

### Study design and participants

This cross-sectional study was conducted on 12-year-old students from different areas of Rasht, Northern Part of Iran. The expert physician examined junior level students. They were selected randomly by stratified proportionate to size sampling from 15 urban health centers. The study was approved by the university Ethical committee. Students were enrolled to the study after obtaining informed written consent from their parents.

### Assessment of variables

Data were collected by a questionnaire which included birth height, BW, gestational age, and clinical examinations (height, weight, blood pressure, body mass index, and physical examination of organs). Similar scales were used in all centers and were



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calibrated daily. Furthermore, all patients referred to the same laboratory in Rasht and fasting blood sugar (FBS), cholesterol. Triglycerides (TGs), low-density lipoprotein (LDL), high-density lipoprotein (HDL), and insulin level (if FBS was higher than 100 mg/dl) were assessed. Children with abnormal laboratory findings were referred to physicians for further assessment.

### Statistical analysis

Quantitative data were assessed by ANOVA and qualitative data were assessed by chi-square. Pearson correlation coefficient was used for quantitative data. Data analysis was conducted by SPSS software (Chicago, IL, version 19.0). The value of $P < 0.05$ was considered to be significant.

## Results

Overall, 858 adolescents including 550 (64%) boys and 309 (34%) girls participated in this study. Table 1 shows mean values of anthropometric measures and laboratory findings according to their BW. In total, 2.8% of the students had systolic blood pressure (SBP) >95$^{th}$ and 12.6% of students had hyperglycemia.

The prevalence of cardio metabolic criteria based on BW showed that macrosomic children encountered with higher prevalence of cardio metabolic abnormalities except for HDL, cholesterol and TG in comparison with other groups [Table 2].

Results showed no significant correlation between FBS and total cholesterol, TG, and LDL [Table 3].

## Discussion

The results of this study showed a positive relationship between different children's BW indicators and obesity at school aged children. In which, children with higher BW were more likely to be obese than other children ($P = 0.007$) these results were consistent with the findings reported by Loaiza *et al*.[10] Mardones *et al*.,[11] and with other studies.[12,13] They found higher relation between macrosomia in children and obesity at school.

Therefore, it seems that identifying macrosomic children and applying preventive interventions could be recommended to decrease later obesity.

By correct measuring of blood pressure which is mandatory in childhood,[14] there was a significant association between high BW and SBP and diastolic blood pressure (DBP). These results were opposite with the findings reported recently by Mori *et al*.[15] They found a significant association between LBW with risk factors of metabolic syndrome such as SBP and DBP in healthy Japanese high school girls. However, Hemachandra *et al*. mentioned that each 1-kg increase in BW could induce 2.19 and 1.82 folds increase in high SBP and DBP, respectively.[16] According to previous investigations, increased trend of weight and body mass index were associated with higher blood pressure and its consequences.[17,18]

In this study, we did not document a considerable association between lipid profile (except HDL) and BW. This result was inconsistent with Mori *et al*.[15] They found a significant association between LBW with hypertriglyceridemia in healthy Japanese high school girls. However, it was consistent with the part of findings reported recently by Byberg *et al*. They found that BW did not relate ($P > 0.10$) with waist circumference, serum TGs, or HDL-cholesterol (HDL-C). This relation regarding HDL was against our results.

Our results showed a significant relation between low HDL and macrosomia. However, Evagelidou *et al*. reported higher HDL-C levels ($P < 0.01$), in large for gestational

**Table 1: Demographic data and mean of glucose and lipid profile measurements**

| | LBW (BW ≤2500) | Normal BW (2500< BW <4000) | Macrosemia (4000≤ BW) | Total | *P* |
|---|---|---|---|---|---|
| Sex distribution | | | | | |
| Male, *n* (%) | 29 (52.7) | 288 (66.7) | 40 (58) | 357 (64.2) | NS* |
| Female, *n* (%) | 26 (47.3) | 144 (33.3) | 29 (42) | 199 (35.8) | |
| Total, *n* (%) | 55 (100) | 432 (100) | 69 (100) | 556 (100) | |
| Abdominal circumference (mean±SD) | 67.3±11.8 | 70.7±11.7 | 75.1±13.8 | 71±12.2 | 0.002** |
| Hip circumference (mean±SD) | 82±9 | 84±10 | 89±12 | 85±10 | <0.001** |
| BMI (mean±SD) | 18.2±4.5 | 20±6.4 | 21.7±5.8 | 20±6.2 | 0.007** |
| Weight (mean±SD) | 40.5±12.5 | 44.1±12.8 | 51.3±16.6 | 44.6±13.6 | <0.001** |
| Height (mean±SD) | 147.4±6.1 | 148.2±8.8 | 152.6±7.2 | 148.7±8.5 | <0.001** |
| FBS (mean±SD) | 92±6 | 93±7 | 95±6 | 93±7 | 0.037** |
| Total cholesterol (mean±SD) | 159±33 | 158±29 | 159±25 | 158±29 | NS** |
| Triglyceride (mean±SD) | 108±79 | 107±60 | 109±73 | 107±64 | NS** |
| HDL (mean±SD) | 45±9 | 43±9 | 41±9 | 43±9 | 0.032** |
| LDL (mean±SD) | 91±25 | 93±25 | 97±21 | 94±24 | NS** |

*Chi-square, **ANOVA. SD=Standard deviation, NS=Not significant, BMI=Body mass index, HDL=High-density lipoprotein, LDL=Low-density lipoprotein, FBS=Fasting blood sugar, LBW=Low birth weight, BW=Birth weight, ANOVA=Analysis of variance

**Table 2: Prevalence of cardio metabolic criteria based on birth weight**

| | BW category | | | | | | | | *P* |
|---|---|---|---|---|---|---|---|---|---|
| | LBW | | Normal | | LGA | | Total | | |
| | Count | Percentage | Count | Percentage | Count | Percentage | Count | Percentage | |
| SBP >95th percentile | | | | | | | | | |
| No | 51 | 98.1 | 409 | 97.6 | 64 | 94.1 | 524 | 97.2 | >0.05 |
| Yes | 1 | 1.9 | 10 | 2.4 | 4 | 5.9 | 15 | 2.8 | |
| SBP >90th percentile | | | | | | | | | |
| No | 48 | 92.3 | 388 | 92.6 | 61 | 89.7 | 497 | 92.2 | >0.05 |
| Yes | 4 | 7.7 | 31 | 7.4 | 7 | 10.3 | 42 | 7.8 | |
| DBP >95th percentile | | | | | | | | | |
| No | 46 | 90.2 | 367 | 90.2 | 50 | 74.6 | 463 | 88.2 | 0.001 |
| Yes | 5 | 9.8 | 40 | 9.8 | 17 | 25.4 | 62 | 11.8 | |
| DBP >90th percentile | | | | | | | | | |
| No | 46 | 90.2 | 367 | 90.2 | 50 | 74.6 | 463 | 88.2 | 0.001 |
| Yes | 5 | 9.8 | 40 | 9.8 | 17 | 25.4 | 62 | 11.8 | |
| HDL >40 | | | | | | | | | |
| No | 10 | 18.2 | 126 | 29.2 | 27 | 39.1 | 163 | 29.4 | 0.039 |
| Yes | 45 | 81.8 | 305 | 70.8 | 42 | 60.9 | 392 | 70.6 | |
| FBS categorized | | | | | | | | | |
| <100 | 49 | 89.1 | 377 | 87.5 | 59 | 85.5 | 485 | 87.4 | >0.05 |
| >100 | 6 | 10.9 | 54 | 12.5 | 10 | 14.5 | 70 | 12.6 | |
| LDL >95th percentile | | | | | | | | | |
| No | 52 | 94.5 | 406 | 94.2 | 65 | 94.2 | 523 | 94.2 | >0.05 |
| Yes | 3 | 5.5 | 25 | 5.8 | 4 | 5.8 | 32 | 5.8 | |
| Cholesterol >95th percentile | | | | | | | | | |
| No | 49 | 89.1 | 405 | 94.0 | 65 | 94.2 | 519 | 93.5 | >0.05 |
| Yes | 6 | 10.9 | 26 | 6.0 | 4 | 5.8 | 36 | 6.5 | |
| Triglyceride >95th percentile | | | | | | | | | |
| No | 37 | 67.3 | 278 | 64.5 | 48 | 69.6 | 363 | 65.4 | >0.05 |
| Yes | 18 | 32.7 | 153 | 35.5 | 21 | 30.4 | 192 | 34.6 | |

HDL=High-density lipoprotein, LDL=Low-density lipoprotein, FBS=Fasting blood sugar, LBW=Low birth weight, BW=Birth weight, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, LGA=Large for gestational age

**Table 3: Correlation between birth weights and cardio metabolic risk factors**

| BW | Weight | Height | SBP | DBP | FBS | Abdominal circumference | Hip circumference | Total cholesterol | Triglyceride | HDL | LDL | Insulin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pearson correlation | 0.224 | 0.199 | 0.146 | 0.123 | 0.064 | 0.194 | 0.224 | 0.017 | 0.017 | −0.098 | 0.060 | 0.245 |
| *P* | <0.001 | <0.001 | 0.001 | 0.005 | NS | <0.001 | <0.001 | NS | NS | 0.021 | NS | 0.040 |

NS=Not significant, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, BW=Birth weight, HDL=High-density lipoprotein, LDL=Low-density lipoprotein, FBS=Fasting blood sugar

age compared with the appropriate for gestational age individuals.[19]

Previous studies showed that LBW is associated with increased risk for type 2 diabetes[2-4] but no population-based study has reported an association until now. It has been hypothesized that inadequate nutrition during gestation results in later-life resistance to insulin-stimulated glucose uptake but does not affect insulin secretion. Norris *et al*. found lower BW and accelerated weight gain after 48 months as risk factors for adult glucose intolerance. Accelerated weight gain between 0 and 24 months did not predict glucose intolerance but can predict higher insulin resistance.[20] Although in our study impaired fasting glucose in macrosomia was higher than LBW, our finding regarding weight gain and insulin level was incomplete.

According to results, it seems that further screening of cardiometabolic risk factors in patients with LBW can be recommended.

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## Conflicts of interest

There are no conflicts of interest.

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## References


1. Skogen JC, Overland S. The fetal origins of adult disease: A narrative review of the epidemiological literature. JRSM Short Rep 2012;3:59.
2. Rich-Edwards JW, Kleinman K, Michels KB, Stampfer MJ, Manson JE, Rexrode KM, *et al.* Longitudinal study of birth weight and adult body mass index in predicting risk of coronary heart disease and stroke in women. BMJ 2005;330:1115.
3. Eriksson JG, Osmond C, Kajantie E, Forsén TJ, Barker DJ. Patterns of growth among children who later develop type 2 diabetes or its risk factors. Diabetologia 2006;49:2853-8.
4. Lawlor DA, Davey Smith G, Clark H, Leon DA. The associations of birthweight, gestational age and childhood BMI with type 2 diabetes: Findings from the Aberdeen Children of the 1950s cohort. Diabetologia 2006;49:2614-7.
5. Barker D. The fetal origins of hypertension. J Hypertens Suppl 1996;14:S117-20.
6. Law CM, Shiell AW. Is blood pressure inversely related to birth weight? The strength of evidence from a systematic review of the literature. J Hypertens 1996;14:935-41.
7. Barker DJ, Hales CN, Fall CH, Osmond C, Phipps K, Clark PM. Type 2 (non-insulin-dependent) diabetes mellitus, hypertension and hyperlipidaemia (syndrome X): Relation to reduced fetal growth. Diabetologia 1993;36:62-7.
8. Higgens M, Keller J, Moore F, Ostrander L, Metzner H, Stock L. Studies of blood pressure in Tecumseh, Michigan. I blood pressure in young people and its relationship to personal and familial characteristics and complications of pregnancy in mothers. Hypertension 1980;111:142-55.
9. Koomanaee S, Tabrizi M, Naderi N, Hassanzadeh Rad A, Boloky Moghaddam K, Dalili S. Parental anthropometric indices and obesity in children. Acta Med Iran 2016;54:270-5.
10. Loaiza S, Coustasse A, Urrutia-Rojas X, Atalah E. Birth weight and obesity risk at first grade in a cohort of Chilean children. Nutr Hosp 2011;26:214-9.
11. Mardones F, Villarroel L, Karzulovic L, Barja S, Arnaiz P, Taibo M, *et al.* Association of perinatal factors and obesity in 6- to 8-year-old Chilean children. Int J Epidemiol 2008;37:902-10.
12. Gaskins RB, LaGasse LL, Liu J, Shankaran S, Lester BM, Bada HS, *et al.* Small for gestational age and higher birth weight predict childhood obesity in preterm infants. Am J Perinatol 2010;27:721-30.
13. Dalili S, Rezvani SM, Dalili H, Mohtasham Amiri Z, Mohammadi H, Medghalchi A, *et al.* Cardio-metabolic risk factors in Iranian children: Where we are and the others? Acta Med Iran 2014;52:831-6.
14. Badeli H, Assadi F. Strategies to reduce pitfalls in measuring blood pressure. Int J Prev Med 2014;5 Suppl 1:S17-20.
15. Mori M, Mori H, Yamori Y, Tsuda K. Low birth weight as cardiometabolic risk in Japanese high school girls. J Am Coll Nutr 2012;31:39-44.
16. Hemachandra AH, Howards PP, Furth SL, Klebanoff MA. Birth weight, postnatal growth, and risk for high blood pressure at 7 years of age: Results from the Collaborative Perinatal Project. Pediatrics 2007;119:e1264-70.
17. Badeli H, Hassankhani A, Naeemi Z, Hosseinzadeh S, Mehrabi S, Pourkarimi M, *et al.* Prevalence of hypertension and obesity-related hypertension in urban school-aged children in Rasht. Iran J Kidney Dis 2016;10:364-8.
18. Dalili S, Mohammadi H, Rezvany SM, Dadashi A, Novin MH, Gholaminejad H, *et al.* The relationship between blood pressure, anthropometric indices and metabolic profile in adolescents: A cross sectional study. Indian J Pediatr 2015;82:445-9.
19. Evagelidou EN, Kiortsis DN, Bairaktari ET, Giapros VI, Cholevas VK, Tzallas CS, *et al.* Lipid profile, glucose homeostasis, blood pressure, and obesity-anthropometric markers in macrosomic offspring of nondiabetic mothers. Diabetes Care 2006;29:1197-201.
20. Norris SA, Osmond C, Gigante D, Kuzawa CW, Ramakrishnan L, Lee NR, *et al.* Size at birth, weight gain in infancy and childhood, and adult diabetes risk in five low- or middle-income country birth cohorts. Diabetes Care 2012;35:72-9.