Original Article

Comparison of Anthropometric and Biochemical Indices of Adolescents Born During and After the Iran-Iraq War; Tehran Lipid and Glucose Study

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Abstract

Background: A country's developmental progress and overall changes in socio-economic structure are reflected in the outcome of secular trend studies on physical growth of children. The aim of this study was to compare anthropometric and biochemical indices of adolescent boys and girls born during and after the Iran-Iraq war.

Methods: Adolescents, aged 11 – 18 years, were selected from the TLGS cohort and divided into two groups. In the first group, adolescents born during the war and in the second group adolescents born after the war were included. Height, weight, serum lipids, FBS, systolic and diastolic blood pressure, and BMI were compared amongst adolescents of the same ages between the two groups.

Results: Mean weight and height increased at the ages of 12, 13, 14, and 17 years in boys of the post-war group. The mean weight of girls in the post-war group increased at the ages of 11, 13, and 14 years. Between 11 – 14 years, the means for total and LDL cholesterol, and between the ages of 15 – 18 years FBS, total cholesterol and LDL cholesterol decreased in boys of the post-war group. For girls between the ages of 11 – 14, FBS, total cholesterol, TG and LDL cholesterol, and between the ages of 15 – 18 years, FBS, total cholesterol and LDL cholesterol decreased in the post-war group. Systolic and diastolic blood pressure decreased at all ages in both groups.

Conclusion: This study showed that some anthropometric indices such as height and weight increased in boys who were born after the war; but in girls, the mean weight in the age groups increased. Systolic and diastolic blood pressure, and some lipid profiles decreased in boys and girls of the post-war group.

Keywords: anthropometric indices, biochemical indices, war

Introduction

Studies on the physical attributes in child and adult populations clearly point to long-term (e.g., secular) changes.[1] Secular changes are due to the interaction of genetic and environmental factors. This interaction is manifested at a specific time as a function of different living conditions in various social groups, as well as on a long-term basis under the influence of gradual changes in living conditions.[1,2] A country's developmental progress and overall changes in socio-economic structure are reflected in the outcome of secular trend studies on physical growth, development, and

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rate of maturation in children.[3] Wars are man-made disasters with a recognized direct impact on enhancing the spread of disease, which have been shown to be related to several somatic disorders, as well as to a wide range of psychiatric disorders such as depression and anxiety.[4] Research on the status of children during war shows that in comparison to the whole population, children are the most jeopardized group. Children's war experiences include the following: death of a parent or close family members, separation from parents, bombardment and shelling, physical injuries, and handicaps as well as extreme poverty and deprivation. War events can have both short and long-term effects. The short-term stress/traumatic effects of war events on children are intrapersonal repetitions of the experience, fears and insecurities, emotional changes, confusion, and disorientation. The long-term stress/traumatic effects of war events on children may exist even for several years after the war has ended. Long-term war effects can be characterized by deviations in child development, changes in personality and identity, school failure, poor physical health, a pessimistic view of the future, etc.[5] Despite some studies about the Iran-Iraq

war, there is no research regarding the physical growth of adolescents born during the war years, which is the purpose for conducting this study, e.g., to compare anthropometric and biochemical indices of adolescent boys and girls born during and after this war.

Materials and Methods

The current study was conducted within the framework of the Tehran Lipid and Glucose Study (TLGS). We selected 3816 persons aged between 11 and 18 years, and divided them into two groups. The first group included 2540 boys and girls born during the war years (from September 22, 1980 until August 20, 1988). The second group included 1276 boys and girls born after the war (after August 20, 1988). The first group (war group), were investigated between 1998 – 2002 while the second group of adolescents (after war group) were studied between 2005 – 2008. Subjects were interviewed privately, face to face, by trained interviewers using questionnaires. Blood pressure was measured by a qualified physician using a standard mercury sphygmomanometer. Additional information regarding age, sex, education, marital status, and employment history was obtained with questionnaires. Weight and height were measured according to standard protocol and body mass index (BMI) was calculated.[6,7] Blood samples were drawn from all subjects between 7:00 and 9:00 a.m. after 12 – 14 hr of overnight fasting and all blood lipid analyses were done at the TLGS research laboratory on the day of blood collection, using the Selectra 2 Auto-analyzer (Vital Scientific, Spankeren, Netherlands). Fasting blood sugar (FBS) was measured on the day of blood collection by the enzymatic colorimetric method using glucose oxidase. Serum total cholesterol and triglyceride concentration were measured by commercially available enzymatic reagents (Pars Azmoon, Iran) adapted to the Selectra Auto-analyzer. HDL cholesterol was measured after precipitation of the apolipoprotein B-containing lipoproteins with phosphotungstic acid. LDL cholesterol was calculated according to the method of Friedewald et al.[8] and it was not calculated when the serum concentration of triacylglycerol was >400 mg/dL. All samples were analyzed only when internal quality control met the acceptable criteria. Inter- and intra-assay CVs were 2% and 0.5% for total cholesterol, 16%, and 0.6% for triacylglycerol, and 2.2% and 2.2% for glucose, respectively. In the TLGS cohort study, for reducing the time effect of the cohort in data gathering and to avoid changing methods and instruments during the years of study, a data quality program was performed to ensure the accuracy of the interview, instruments such as weight scales, the measurement method, laboratory facilities and data entry,

etc. This program, as a protocol, has been described elsewhere .[9,10]

Statistical methods

Means of anthropometric indices were calculated in each age group and differences were compared between the two groups. Bonferroni correction was used for multiple comparisons. Because of the large amount of data, we have presented the data in three age groups: 13, 15, and 17 years (Table 1) and data related to ages 11, 12, 14, 16, 18 have been presented in the text. Mean of serum lipids (total cholesterol, triglycerides, LDL cholesterol, HDL cholesterol, fasting blood sugar, as well as systolic and diastolic blood pressure) were compared between the two groups for ages 11 – 14 and 15 – 18 years, and separately for boys and girls. We used SPSS software (version 16; SPSS Inc., Chicago IL) for all statistical analyses. P values less than 0.01 were considered statistically significant.

Results

The war group included 2540 individuals, (1340 girls, 1200 boys) and the post-war group consisted of 1276 persons (662 girls, 614 boys). Anthropometric indices of each age group in girls and boys are as follows:

Anthropometric indices

Age group 11 years: In girls of the post-war group, the average weight increased 5.74 kg ($P<0.001$), and BMI increased 2.2 kg/m^2 compared to girls of the war group who were of the same age ($P<0.001$). In boys of the post-war group, waist circumference increased 5.7 cm ($P<0.001$) compared to same age boys of the war group.

Age group 12 years: At the age of 12 years, the differences in anthropometric indices were not statistically significant between girls of both groups while all anthropometric indices increased in boys of the post-war group. The most important of these indices were height (4.51 cm), weight (7.81 kg), waist circumference (10.36 cm), BMI (2.23 kg/m^2) and hip circumference (6.29 cm), $P<0.001$.

Age group 14 years: In girls of the post-war group, weight increased 6.6 kg ($P<0.001$), waist circumference increased 3.5 cm ($P<0.01$), BMI increased 2.2 kg/m^2 ($P<0.001$) and hip circumference increased 3.4 cm ($P<0.01$) compared to girls of the war group. In boys of the post-war group, height increased 4.5 cm, weight increased 11.2 kg, waist circumference increased 12.8 cm, BMI increased 2.92 kg/m^2 and hip circumference increased 7.7 cm compared to boys of the war group ($P<0.001$).

Age group 16 years: Waist circumference increased

Table 1. Mean±SD for anthropometric indices in the two groups

Variables	Age 13			Age 15			Age 17		
	War group	After war group	P	War group	After war group	P	War group	After war group	P
Boys (n)	**161**	**101**		**161**	**94**		**152**	**65**	
Height (cm)	156.3±8.7	159.1±7.9	0.01	168.5±7.8	170.7±6.8	0.023	173.3±6.3	175.4±5.6	0.022
Weight (kg)	48.3±12.2	54.1±12.4	0.001	59.9±14.8	64.5±16.1	0.022	67.1±14.2	72.6±14.4	0.009
Waist circumference (cm)	67.6±10.4	76.4±11.5	0.001	72.5±12.3	80.2±14.1	0.001	76.05±11.2	82.8±11.3	0.001
BMI (kg/m^2)	19.6±4.1	21.3±4.1	0.002	21.1±4.8	22.2±5.4	0.068	22.3±4.4	23.6±4.4	0.046
Hip circumference (cm)	81.7±8.9	86.2±8.5	0.001	88.8±10	92.8±9.8	0.002	92.4±8.5	96.5±8.5	0.001
Wrist circumference (cm)	15.8±1.2	16.15±1.19	0.014	16.6±1.1	16.9±1.1	0.028	17.1±0.9	17.2±0.9	0.237
Girls (n)	**187**	**80**		**184**	**102**		**180**	**64**	
Height (cm)	156.4±6.1	156.1±5.9	0.718	159.4±6.1	158.0±5.5	0.058	159.49±5.8	160.7±5.8	0.155
Weight (kg)	49.3±10	53.2±10.8	0.005	55.2±9.6	56±9.9	0.482	56.2±11.1	56.8±9.4	0.678
Waist circumference (cm)	70.2±8.7	71.6±9.2	0.214	71.9±7.8	70.4±8.6	0.139	73.1±8.78	69.88±8.8	0.016
BMI (kg/m^2)	20.1±3.7	21.8±4.2	0.001	21.7±3.6	22.5±4	0.102	22.1±4.2	22.1±3.8	0.967
Hip circumference (cm)	89.8±8.2	92.2±8.4	0.029	94.9±7.6	94.7±7.3	0.772	96.5±8.1	95.7±7	0.465
Wrist circumference (cm)	15.1±0.8	14.9±0.9	0.282	15.2±0.8	14.9±0.8	0.004	15.2±0.9	14.7±0.8	0.001
BMI= body mass index									

Table 2. Mean±SD for blood pressure, blood sugar and serum lipids in the two groups.

Variables	Ages 11– 14			Ages 15 – 18		
	War group	After war group	P	War group	After war group	P
Boys (n)	**601**	**328**		**569**	**269**	
Fasting blood sugar (mg/dL)	90.4±14.9	89.6±7.1	0.340	88.9±7.5	86.9±6.8	0.001
Total cholesterol (mg/dL)	166±31.7	155.3±29.2	0.001	160.6±32.3	145.9±29.4	0.001
Triglyceride (mg/dL)	103.9±59.5	103.5±57.9	0.924	114.9±69.3	103.5±59.4	0.021
HDL cholesterol (mg/dL)	44.4±10.5	44.5±10.3	0.918	40.2±9.2	40±7.7	0.663
LDL cholesterol (mg/dL)	100.4±27.9	89.4±24.6	0.001	97.6±26.8	85.3±25.1	0.001
Systolic blood pressure (mm Hg)	103.9±11.6	100.9±12	0.001	110.7±12.1	107±10.9	0.001
Diastolic blood pressure (mm Hg)	69.5±9.1	64.2±9.7	0.001	72.7±8.6	69.6±9.4	0.001
Girls (n)	**624**	**335**		**694**	**322**	
Fasting blood sugar (mg/dL)	89.1±7.9	87.7±6.5	0.004	85.9±7.5	84±7.2	0.001
Total cholesterol (mg/dL)	169.4±29.7	157.7±30.7	0.001	169.3±30.9	153.2±29.5	0.001
Triglyceride (mg/dL)	121.4±61.9	107.8±55.3	0.001	101.5±47.7	93.5±46.2	0.012
HDL cholesterol(mg/dL)	42±9.8	43.2±10.1	0.069	43.9±10.2	44.9±9.9	0.156
LDL cholesterol (mg/dL)	103±26.5	92.3±24.7	0.001	104.8±27.1	89.9±25.9	0.001
Systolic blood pressure (mm Hg)	102.4±10.9	97.3±11.3	0.001	106.5±10.6	98.6±11.4	0.001
Diastolic blood pressure (mm Hg)	70±9.5	63.9±9.4	0.001	72.9±8.4	65.4±9.3	0.001

5.54 cm in boys of the post-war group (*P*<0.001).

Age group 18 years: There were no significant indices in this age group.

The maximum height and weight increments were observed in boys of the post-war group at the ages of 12 and 14 years (4.5 cm for height and 7.8 – 11.2 kg for weight). Anthropometric indices at the age of 13, 15 and 17 are shown in Table 1.

Biochemical indices: The results of blood pressure and biochemical indices in the two age groups (11 – 14) and (15 – 18) are shown in Table 2.

Discussion

This study showed that anthropometric indices of boys in the post-war group increased in all age groups, although the number of significant indices in all age groups was not equal. Anthropometric indices only increased in girls of the post-war group for ages 11, 13, and 14 years. Blood pressure and most biochemical indices decreased significantly in both girls and boys in the post-war group compared to the war group.

There are several studies showing that during the last century children of the same age have experienced a progressive rise in mean body height and weight. The phenomenon is termed secular trend or growth acceleration.[11,12] Variations in adolescent growth are ascribed to the improvement of environmental conditions, socioeconomic conditions of the family, nutritional status, standards of health care and care provided by parents, both strongly associated with the parents' educational level.[11,13] In an overview based on a literature review and new data from three cohorts, it has been determined that genetic predisposition is a major determinant of height, in addition to early life environment, which also has an important impact. Plausible non-genetic determinants of height include nutrition, illness, socioeconomic status, and psychosocial stress.[14]

In this study, we cannot determine with certainty the cause of the differences between the two groups. There are many confounding factors in this regard, which were not studied, for example: lifestyle, level of access to food, economic status of families, parental education level, and age of menarche in girls. In addition, data pertaining to subjects before the war was not available.

There are some possible factors that appear to cause these differences. The subjects in both groups were assessed at different times and in the six year interval between the two assessments, many national health programs have been initiated,[15] many factors may have changed, which possibly influence anthropometric and biochemical indices. Another factor may be related to the natural secular trend in physical growth. In a study it has been shown that in 2001, 18-year-old males attained a mean height of 180.1 cm, which is 12 cm greater than the mean height of 18-year-old men in 1895. The mean height of 18-year-old women in 2001 was 167.2 cm, an increase of 10 cm over the mean height in 1895.[13] In our study there were no significant height differences between girls in the two groups. In an overview it has been shown that growth in males is more sensitive to changes in living conditions than females.[14] Another study has shown a diminishing secular increase in female stature whereas height in men has continued to rise in a stepwise fashion.[16] In the present study, the duration between both groups studied was 3 to 10 years; therefore, it seems that the observed height rise in this study is greater than the normal trend of physical growth during these years. Another possible factor that can be noted is the circumstances of war. The Iran-Iraq imposed war, a war between the Republic of Iraq and the Islamic Republic of Iran, lasted from September 22, 1980 until August 20, 1988. This war, one of the disasters of the twentieth century, was the longest war in the world after the Vietnam War.[17] Some studies have shown the effects of war on physical growth in children born during the war that was ascribed to war-induced degradation in economic conditions.[11,18,19] Also, in a study it has been shown that blood pressure was higher in males born during the war[20]; other studies have shown that psychosocial stress caused by war is an important risk factor for the increase in blood sugar during the years following a war in addition to the incidence of diabetes.[21–24]

Future longitudinal studies that control for confounding factors and assessment of more variables can more accurately determine the causes of these differences.

In conclusion, this study has shown that most anthropometric indices such as height and weight increased in boys who were born after the war; whereas in girls, the mean weight in the three age groups increased. Systolic and diastolic blood pressure, as well as some lipid profiles decreased in both boys and girls who were born after the war years.

Acknowledgments

References

1. Vignerova J, Brabec M, Blaha P. Two centuries of growth

among Czech children and youth. *Econ Hum Biol.* 2006; **4:** 237 – 252.

2. Vignerova J , Humenıˊkova L, Brabec M, Riedlova J, Blaˊha P. Long-term changes in body weight, BMI, and adiposity rebound among children and adolescents in the Czech republic. *Econ Hum Biol.* 2007; **5:** 409 – 425.

3. Dasgupta P, Saha R, Nubé M. Changes in body size, shape, and nutritional status of middle-class Bengali boys of Kolkata, India, 1982 – 2002. *Econ Hum Biol.* 2008; **6:** 75 – 94.

4. Farhood L, Zurayk H, Chaya M, Saadeh F, Meshefedjian G, Sidani T. The impact of war on the physical and mental health of the family: the Lebanese experience. *Soc Sci Med.* 1993; **36:** 1555 – 1567.

5. Brajsa-Zganec A. The long-term effects of war experiences on children's depression in the Republic of Croatia. *Child Abuse Negl.* 2005; **29:** 31 – 43.

6. Azizi F, Rahmani M, Mohammad M, Emami H, Mirmiran P, Hajipour R. Introducing the objectives, implementation methods and structure of Tehran Lipid and Glucose [In Farsi]. *Iran J Endocrinol Metabol.* 2000; **2:** 77 – 86.

7. Azizi F, Rahmani M, Emami H, Madjid M. Tehran Lipid and Glucose Study: Rationale and design. *CVD Prevention.* 2000; **3:** 242 – 247.

8. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem.* 1972; **18:** 499 – 502.

9. Azizi F, Ghanbarian A, Momenan AA, Hadaegh F, Mirmiran P, Hedayati M, et al. The Tehran Lipid and Glucose Study Group. Prevention of non-communicable disease in a population in nutrition transition: Tehran Lipid and Glucose Study phase II. *Trials.* 2009; **10:** 5.

10. Azizi F, Rahmani M, Emami H, Mirmiran P, Hajipour R, Madjid M, et al. Cardiovascular risk factors in an Iranian urban population: Tehran Lipid and Glucose Study. *Soz Praventiv Med.* 2002; **47:** 408 – 426.

11. Jakić M, Jakić M. Secular growth trend in urban children enrolling primary school in the war time. *Acta Med Croatica.* 2006; **60:** 195 – 199.

12. Cole TJ. The secular trend in human physical growth: a biological view. *Am J Epidemiol.* 2003; **1:** 161 – 168.

13. Vignerova J, Brabec M, Blaha P. Two centuries of growth among Czech children and youth. *Econ Hum Biol.* 2006; **4:** 237 – 252.

14. Batty GD, Shipley MJ, Gunnell D, Huxley R, Kivimaki M, Woodward M, et al. Height, wealth, and health: an overview with new data from three longitudinal studies. *Econ Hum Biol.* 2009; **7:** 137 – 152.

15. Rafati M, Ghotbi M, Ahmad Nia H. Principle of disease prevention and surveillance. In: *Surveillance Systems of Non-Communicable Diseases* [In Farsi]. 1st ed. Tehran: Sepid Barg Bagh Ketab; 2008.

16. Cavelaars AE, Kunst AE, Geurts JJ, Crialesi R, Grotvedt L, Helmert U, et al. Persistent variations in average height between countries and between socio-economic groups: an overview of 10 European countries. *Ann Hum Biol.* 2000; **27:** 407 – 421.

17. Abrahamian E. *A History of Modern Iran.* New York: Cambridge University Press; 2008.

18. Jakić M, Jakić M. Influence of the war events on body weight and height in children enrolling the first grade of elementary school. *Lijec Vjesn.* 2005; **127:** 211 – 214.

19. Rickets in Germany: a study of the effects of war on children. *Lancet.* 1920; **195:** 88 – 190.

20. Yoo JH. Deletion polymorphism in the gene for angiotensin-converting enzyme is associated with essential hypertension in men born during the Pacific War. *Mech Ageing Dev.* 2005; **126:** 899 – 905.

21. Nonogaki K. New insights into sympathetic regulation of glucose and fat metabolism. *Diabetologia.* 2000; **43:** 533 – 549.

22. Diabetes Epidemiology Research International. Preventing insulin dependent diabetes mellitus: the environmental challenge. *BMJ.* 1987; **295:** 479 – 481.

23. Kumar D, Gemayel NS, Deapen D. North-American twins with IDDM. Genetic, etiological, and clinical significance of disease concordance according to age, zygosity, and the interval after diagnosis in first twin. *Diabetes.* 1993; **42:** 1351 – 1363.

24. Dahlquist G. The aetiology of type 1 diabetes: an epidemiological perspective. *Acta Paediatr Suppl.* 1998; **425:** 5 – 10.