Changes in serum lipid profile of obese or overweight children and adolescents following a lifestyle modification course

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Abstract

BACKGROUND: Considering rapid global increase in children obesity and high prevalence of dyslipidemia in obese and overweight children, this study aimed to evaluate the effect of an educational course on changes of lipid profile in children.

METHODS: This non-pharmacological clinical trial study was performed on 4-18 year-old children attending outpatient clinics of Isfahan Endocrine and Metabolism Research Center (Iran). Anthropometric measurements were conducted for all children. Fasting blood samples were taken from right hand of the participants at the first laboratory visit. Biochemical tests including measurement of total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were also carried out. Children took part in one educational session in which they were taught about ways and benefits of having regular physical activity once a day and having healthy foods. All children were followed up for about four months and anthropometrics and biochemical tests were repeated. Data was analyzed using $SPSS_{16}$.

RESULTS: A total number of 412 children (245 girls and 167 boys) were divided into four age groups of under 6, 6-9, 10-13, and 14-18 years old. Baseline anthropometric measures were significantly higher in boys. However, there was no difference between boys and girls in baseline lipid profile. Children's body mass index (BMI) z-score increased in all age groups except for 14-18 year-old boys. In boys older than 10 years, there were significant reductions in LDL-C and TC. In girls over 10 years of age, there was a significant increase in HDL-C. Although anthropometric measurements did not change in children (except for 14-18 year-old-boys), there was a significant reduction in children's lipid profile after the study.

CONCLUSION: Our study showed that although one session of interventional education had no significant effects on children's anthropometric measurements, it could change their lipid profile. Moreover, the intervention was more effective on improving lipid profile in children over 10 years of age. Therefore, effective interventional strategies must be invented and implemented on children based on their age group.

Keywords: Children Obesity, Education, Anthropometry, Lipid Profile, Lifestyle

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Introduction

Nowadays, obesity and overweight are among major problems for children worldwide. During the past three decades, there has been a considerable increase in prevalence of obesity in both developed and developing countries. Therefore, obesity is currently identified as a major health problem.[1]

Although obesity in childhood and adolescence is more common among countries with high economic standards, its prevalence is growing rapidly in developing countries and even third world countries including Iran.[2,3] With the increasing trend of prevalence of obesity and its risk factors in children and since obesity is related with cardiovascular diseases (CVD) which in turn account for the highest rates of disability-adjusted life year (DALY), much attention has been given to childhood obesity in Iran.[4]

On the other hand, there is a correlation between plasma cholesterol level and mortality resulted from CVD. The Framingham study showed that increase in

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plasma cholesterol level would lead to increased incidence of myocardial infarction in adults.[5] Moreover, children with high cholesterol level were found to suffer from increased cholesterol in adulthood.[6] Fortunately, compared to adults, children can be better educated to reduce the risks of cardiac diseases.[7,8]

Reinehr et al. observed cardiac risk factors including higher triglyceride (TG) and low density lipoprotei (LDL) and lower high density lipoprotein (HDL) in obese children compared to children with normal weight.[9] Roger et al. evaluated families who referred to family-oriented clinics to control cardiac risk factors. They showed that after 6 months of referring, mean total cholesterol (TC) level of children reduced from 264 to 246 mg/dl. Therefore, the clinics were found to be effective in primary prevention of cardiovascular diseases.[10] King et al. performed a study on obese children to review the effects of weight loss on sub-fractions of LDL. After a one-month period of exercise, dieting, and lifestyle modification and weight loss of 6-8 kg, there was an absolute reduction in LDL-cholesterol (LDL-C), particularly LDL-C III. The authors suggested that these changes could reduce CVD risk factors.[11]

Hence, it is important to prevent and control hyperlipidemia in obese children. Considering the high prevalence of this disease among obese children and its association with cardiovascular complications, we assessed the effects of an educational lifestyle course on lipid profile and weight of obese children who referred to Sedigheh Tahereh Cardiovascular Research Centers (Isfahan, Iran).

Materials and Methods

This non-pharmacological clinical trial study was performed in 2008. It included 4-18 year-old children and adolescents (245 girls and 167 boys) who had been referred from schools to the Pediatric Clinic of Sedigheh Tahereh Cardiovascular Research Centers. Children with diabetes, thyroid diseases, any disease related to hepatic problems, or any pharmacological treatment that could lead to changes in blood lipids were excluded from the study.

After explaining the objectives of the study to the participants, written consents were obtained. The subjects then underwent anthropometric and blood lipid tests. The examinations were conducted by a professional team including a physician, a trained nurse, and a pediatrician. Anthropometric evaluations included measuring height and weight to calculate body mass index (BMI). Height was recorded by a stadiometer with accuracy of 0.1 cm. Weight was measured with a Seca scale with accuracy of 0.1 kg while the subjects were wearing light clothing and no shoes. Waist (WC) and hip circumference (HC) were also measured using measuring bands with accuracy of 0.1 cm. Measurements were done twice and their mean values were recorded in a form.

Afterward, the participants, who were asked to fast for 12 hours, and one of their parents were referred to the laboratory. Blood sampling was performed by a certain individual and through antecubital veins. HDL-cholesterol (HDL-C), LDL-C, TG, and TC were measured using a enzymatic-photometric analyzer (Pars Company, Iran).

Children and adolescents were trained to modify their lifestyle through correcting their food consumption patterns, avoid advertising and fast foods, having breakfast, and increasing physical activity at home and school.

All data was recorded in special forms and reported as mean ± standard deviation (SD). All statistical analyses were performed with SPSS for Windows 16.0 (SPSS Inc., Chicago, IL, USA). The values of WC, HC, BMI, and lipid profiles before and after the intervention were compared by independent t-test. Regression analysis was used to adjust the models for age and sex and assess the relations between anthropometric indices and lipid profile. P values less than 0.05 were considered significant.

Results

A total number of 245 girls and 167 boys were enrolled for an average duration of four months. The study subjects were divided into four age groups of under 6, 6-9, 10-13, and 14-18 years old. The number of individuals in each group and baseline values of mean BMI, WC, HC, waist to hip ratio (WHR), TG, TC, HDL, and LDL stratified by age and sex are shown in table 1. As it is seen, increasing age was associated with increased BMI. Moreover, baseline BMI, WC, HC, and WHR of boys was significantly more than girls. However, the two sexes were not significantly different in terms of lipid profile.

After the intervention, WC increased in all girls and all boys except the groups of 14-18 years. HC increased in all girls and 6-10 year-old boys. BMI increased in boys and girls except 14-18 year-olds (Table 2).

Table 3 shows lipid profiles of the participants at baseline and after the intervention stratified by age and sex. LDL and TG reduced and HDH increased in 10-18 year-old girls. However, TC reduced only in 14-18 year-old girls. In boys, LDL reduced in all age groups but HDL increased in those under 6 and

14-18 years old. TC reduced in 10-18 year-old boys.

Table 4 shows the relationship between mean changes of anthropometric indices and lipid profile. Regression analysis showed a significant relationship between mean BMI and HDL, TG, and TC.

Since the number of participants was not sufficient for implementation of t-test, the subjects were divided into two age groups of under 10 and 10-18 years old. Independent t-test was then performed to assess significant changes of anthropometric indices and lipids before and after the intervention (Table 5). WC, HC, and BMI in boys and girls under 10 years old had significant increases over the time. In boys over 10 years old, there was a significant reduction in LDL and TC while HDL and TG had no significant reductions. In girls under 10, TG increased significantly after the intervention. On the other hand, TG and HDL significantly reduced in 10-18 year-old girls.

Table 1. Baseline anthropometric characteristics and lipid profile of children and adolescents stratified by age and sex

	Girls					**Boys**					
Age (years)	**Under 6**	**6-9**	**10-13**	**14-18**	**Total**	**Under 6**	**6-9**	**10-13**	**14-18**	**Total**	**P***
LDL (mg/dl)	114 ± 38	111 ± 24	109 ± 28	104 ± 21	111 ± 27	111 ± 28	108 ± 28	112 ± 28	110 ± 30	109 ± 28	0.485
HDL (mg/dl)	45 ± 14	47 ± 12	45 ± 11	37 ± 7	46 ± 12	44 ± 9	46 ± 12	42 ± 8	39 ± 7	44 ± 10	0.096
TG (mg/dl)	99 ± 51	127 ± 71	158 ± 105	176 ± 100	151 ± 84	95 ± 33	109 ± 54	153 ± 72	185 ± 139	131 ± 73	0.586
TC (mg/dl)	178 ± 35	187 ± 27	194 ± 37	190 ± 28	188 ± 31	182 ± 32	182 ± 29	186 ± 34	189 ± 39	184 ± 32	0.281
WC (cm)	81 ± 11	78 ± 11	87 ± 11	100 ± 13	83 ± 12	68 ± 8	73 ± 8	82 ± 10	90 ± 12	77 ± 11	0.001
HC (cm)	86 ± 11	86 ± 10	96 ± 11	109 ± 15	90 ± 12	75 ± 8	82 ± 7	92 ± 10	104 ± 10	86 ± 11	0.016
WHR	0.94 ± 0.04	0.91 ± 0.05	0.91 ± 0.05	0.91 ± 0.02	0.91 ± 0.054	0.91 ± 0.04	0.89 ± 0.05	0.89 ± 0.05	0.86 ± 0.07	0.89 ± 0.05	0.002
BMI	22.5 ± 3.7	22.8 ± 3.7	25.7 ± 3.1	29.6 ± 4.6	24.0 ± 4.2	21.0 ± 13.7	21.1 ± 3.1	24.4 ± 3.9	27.8 ± 4.1	22.9 ± 4.1	0.012
Total Number	20	85	53	9	167	30	107	91	17	245	

LDL: Low density lipoprotein, HDL: High density lipoprotein, TG: Triglyceride, TC: Total cholesterol, WC: Waist circumference, HC: Hip circumference, WHR: Waist to hip ratio, BMI: Body mass index

* P between girls and boys

Table 2. Anthropometric characteristics of the participants before and after the intervention stratified by age and sex

Girls										
	Before the intervention					**After the intervention**				
Age (years)	**Under 6**	**6-9**	**10-13**	**14-18**	**Total**	**Under 6**	**6-9**	**10-13**	**14-18**	**Total**
WC (cm)	68 ± 8	73 ± 8	82 ± 10	90 ± 12	77 ± 11	74 ± 10	81 ± 6	88 ± 11	90 ± 17	83 ± 11
HC (cm)	75 ± 8	82 ± 7	92 ± 10	104 ± 10	86 ± 11	81 ± 10	90 ± 7	96 ± 13	104 ± 11	92 ± 12
WHR	0.91 ± 0.04	0.89 ± 0.05	0.89 ± 0.05	0.86 ± 0.07	0.89 ± 0.05	0.91 ± 0.04	0.89 ± 0.03	0.92 ± 0.12	0.86 ± 0.09	0.90 ± 0.08
BMI	21.0 ± 13.7	21.1 ± 3.1	24.4 ± 3.9	27.8 ± 4.1	22.9 ± 4.1	21.5 ± 4.3	22.6 ± 3.2	25.1 ± 4.5	26.2 ± 4.4	23.7 ± 4.3
BMI z-score	+2	+1	+2	+1		+2	+2	+2	+1	
Boys										
	Before the intervention					**After the intervention**				
Age (years)	**Under 6**	**6-9**	**10-13**	**14-18**	**Total**	**Under 6**	**6-9**	**10-13**	**14-18**	**Total**
WC (cm)	81 ± 11	78 ± 11	87 ± 11	100 ± 13	83 ±12	86 ± 12	86 ± 12	93 ± 14	99 ± 19	89 ± 13
HC (cm)	86 ± 11	86 ± 10	96 ± 11	109 ± 15	90 ± 12	90 ± 11	92 ± 10	93 ± 14	107 ± 18	95 ± 12
WHR	0.94 ± 0.04	0.91 ± 0.05	0.91 ± 0.05	0.91 ± 0.02	0.91 ± 0.05	0.95 ± 0.02	0.92 ± 0.05	0.95 ± 0.15	0.91 ± 0.03	0.93 ± 0.09
BMI	22.5 ± 3.7	22.8 ± 3.7	25.7 ± 3.1	29.6 ± 4.6	24.0 ± 4.2	23.7 ± 3.9	23.6 ± 4.1	25.7 ± 5.4	28.8 ± 5.4	24.6 ± 4.8
BMI z-score	+3	+2	+1	+2		+3	+2	+1	+1	

WC: Waist circumference, HC: Hip circumference, WHR: Waist to hip ratio, BMI: Body mass index

Table 3. Lipid profile of the participants before and after the intervention stratified based on age and sex

Girls										
	Before the intervention					After the intervention				
Age (years)	Under 6	6-9	10-13	14-18	Total	Under 6	6-9	10-13	14-18	Total
LDL	111 ± 28	108 ± 28	112 ± 28	110 ± 30	109 ± 28	108 ± 21	10 ±926	105 ± 26	96 ± 18	107 ± 25
Percentile	----	50	75	50		----	50	50	50	
HDL	44 ± 9	46 ± 12	42 ± 8	39 ± 7	44 ± 10	4 ±59	45 ± 13	47 ± 28	41 ± 8	45 ± 19
Percentile	----	10	10	10		----	10	25	10	
TG	95 ± 33	109 ± 54	153 ± 72	185 ± 139	131 ± 73	103 ± 44	125 ± 62	151 ± 73	158 ± 87	134 ± 68
Percentile	90	90	95	95		90	90	95	95	
TC	182 ± 32	182 ± 29	186 ± 34	189 ± 39	184 ± 32	182 ± 31	184 ± 30	186 ± 33	179 ± 32	185 ± 31
Percentile	75	75	75	90		75	90	75	75	
Boys										
	Before the intervention					After the intervention				
	Under 6	6-9	10-13	14-18	Total	Under 6	6-9	10-13	14-18	Total
LDL	114 ± 38	111 ± 24	109 ± 28	104 ± 21	111 ± 27	105 ± 28	108 ± 24	102 ± 31	98 ± 22	105 ± 27
Percentile	----	75	75	50		----	75	50	50	
HDL	45 ± 14	47 ± 12	45 ± 11	37 ± 7	46 ± 12	47 ± 10	46 ± 12	45 ± 11	40 ± 6	45 ± 11
Percentile	---	10	10	10		----	10	10	25	
TG	99 ± 51	127 ± 71	158 ± 105	176 ± 100	151 ± 84	122 ± 50	124 ± 62	159 ± 83	185 ± 98	138 ± 72
Percentile	95	95	95	95		95	95	95	95	
TC	178 ± 35	187 ± 27	194 ± 37	190 ± 28	188 ± 31	182 ± 37	186 ± 30	184 ± 36	178 ± 31	184 ± 33

LDL: Low density lipoprotein, HDL: High density lipoprotein, TG: Triglyceride, TC: Total cholesterol

Table 4. The relationship between mean changes of anthropometric indices and mean changes of lipid profile

	LDL	HDL	TG	TC
WC	ß = -0.005 P = 0.949	ß = 0.950 P = 0.233	ß = 0.076 P = 0.324	ß = 0.045 P = 0.546
BMI	ß = 0.097 P = 0.092	ß = 0.213 P < 0.001	ß = 0.125 P = 0.026	ß = 0.166 P = 0.002
WHR	ß = 0.068 P = 0.394	ß = 0.030 P = 0.706	ß = -0.012 P = 0.991	ß = 0.046 P = 0.535

WC: Waist circumference, WHR: Waist to hip ratio, BMI: Body mass index, LDL: Low density lipoprotein, HDL: High density lipoprotein, TG: Triglyceride, TC: Total cholesterol

Table 5. Relationships between mean changes of anthropometric indices and average changes of lipid profile in children and adolescents

			LDL	HDL	TC	TG	WC	HC	BMI
Boys	Under 10 years old	Before	112 ± 27	47 ± 13	185 ± 28	122 ± 69	80 ± 11	87 ± 10	22.7 ± 3.4
		After	106 ± 25	46 ± 11	185 ± 32	124 ± 60	86 ± 12	92 ± 11	23.6 ± 4.1
		P	0.124	0.322	0.923	0.749	< 0.001	< 0.001	< 0.001
	Over 10 years old	Before	110 ± 27	44 ± 11	193 ± 35	162 ± 64	91 ± 12	99 ± 11	26.5 ± 5.1
		After	101 ± 30	44 ± 11	183 ± 35	165 ± 87	94 ± 15	100 ± 13	26.2 ± 5.4
		P	0.011	0.822	0.014	0.813	0.179	0.689	0.390
Girls	Under 10 years old	Before	109 ± 28	46 ± 12	182 ± 30	106 ± 51	72 ± 8	81 ± 8	21.1 ± 3.3
		After	109 ± 26	45 ± 13	184 ± 30	119 ± 60	79 ± 8	88 ± 8	22.4 ± 3.5
		P	0.960	0.912	0.387	< 0.001	< 0.001	< 0.001	< 0.001
	Over 10 years old	Before	107 ± 25	41 ± 8	187 ± 35	159 ± 85	84 ± 12	94 ± 11	24.9 ± 4.2
		After	105 ± 26	47 ± 27	185 ± 33	152 ± 77	89 ± 12	97 ± 13	25.3 ± 4.7
		P	0.437	0.045	0.501	0.271	< 0.001	0.006	0.078

LDL: Low density lipoprotein, HDL: High density lipoprotein, TC: Total cholesterol, TG: Triglyceride, WC: Waist circumference, HC: Hip circumference, BMI: Body mass index

Discussion

The present study indicated that one educational intervention session had more impact on reducing lipids of the children over 10 years old. On the other hand, despite lack of a significant change in anthropometric indices, the educational intervention improved serum lipid indices. However, it did not affect BMI, WC, and HC in children under 10.

Reductions in LDL and TC despite the reduction in HDL in children over 10 years old in this study could be due to changes in their diet. Similar to the present study, the study of Ben et al. on 24 obese boys showed reductions in TG and LDL after two months of lifestyle educational intervention.[12] Shalitin et al. instructed children on nutrition and physical activity and found considerable reductions in LDL and WC.[13] Although many studies have suggested lipid profile modification to require long-term interventions, we observed improvements in lipid profile of the children even after one-session of educational intervention.[14,15]

Reductions in LDL and TC in boys over 10 years of age in the present study indicated the effects of reduced fat intake and increased physical activity on lipid profile. However, there was no significant change in boys over 10 years of age which might have been caused by the fact that HDL would not be increased immediately after dieting. In fact, as a cardiovascular preventive factor, HDL increases a few months after dieting when body weight is reduced and stabilized.[16]

We observed more reductions in lipids of participants over 10 years old. The reason could have been the impacts of parents and peer groups. An Australian study pointed out the impact of parents and peer groups on weight loss of individuals in early and middle adolescence. The researchers trained fathers of boys and mothers of girls on weight reduction. Finally, mothers and friends were found to have the greatest effects on weight loss. However, peer groups had no important influence on boys and mass media had very little effect on both sexes.[17]

Significant increases in anthropometric indices of children under 10 years of age and lack of significant reductions in lipids in this study could be justified by adiposity rebound. The effects of parents as role models and the impact of peer groups could also be responsible.[18-21] In Australia, parents reported children's resistance, inaccessibility of appropriate food, busy life, and the impact of advertising as effective factors on improper diet of their children.[17] Although these factors were not effective on children of the present study, the role of parents as role models, particularly for school-aged children, is accepted. Moreover, food combination of children is associated with the combination of their parents', especially mothers', food.[22]

One of the limitations of the present study was the involvement of other environmental factors such as school and peer groups. Another limitation was lack of full cooperation of fathers of the family which could have a very great impact on the development of cardiovascular risk factors in their children.

Conclusion

Modern lifestyle and new nutritional patterns put children and adolescents at risk of CVD in many countries including Iran. Since our results varied in different age groups of children, appropriate treatment methods should be planned specifically for each age group. In addition, regular educational sessions are necessary to make changes in behavior and attitude of children and families toward obesity. Therefore, physicians and health experts can play a very important role in improving lipid disorders of overweight children and adolescents, and thus preventing CVD, through training them about proper nutrition and regular physical activity.

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Conflict of Interests

Authors have no conflict of interests.

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