The effect of loss of body weight on lipid profile in overweight individuals

Faisal A. Alnasir, FRCGP, PhD, Emad M. Masuadi, BS, MSc.

ABSTRACT

Objective: To determine the effect of reducing body weight and body mass index on serum lipid.

Methods: This is a prospective longitudinal study, which was implemented in Naim Primary Health Care Center in the Kingdom of Bahrain during May and June of 2004. The study included 55 individuals who were willing to participate. The criteria for the sample selection included being overweight, having high serum lipid and patients' willingness to reduce their weight. The patients were followed up for a 26 weeks period consisting of continuous health education program, maintenance on low caloric diet and exercise to help them reduce their body weight. This period included a lifestyle enhancement awareness program that included 4 health education sessions on weight loss, 4 sessions on weight loss maintenance and frequent and regular visits to the clinic to make sure that those patients were compliant with the given instructions.

Results: The study showed that patients who completed the designed program had a reduction in body weight, body mass index, and lipid level and an increase in physical activity and dietary readiness to control over-eating. Although in both genders there was a significant drop in all the parameters, only body mass index (p<0.002) and cholesterol (p=0.007) showed a statistically significant difference between men and women. In men, cholesterol level at the initial stage of the study was strongly related to the body weight (r=0.65, p<0.002) and body mass index (r=0.83, p<0.0005). Despite that the cholesterol level reduced more in women than men; women decreased less in weight (p<0.0005) and body mass index (p<0.0005) than men.

Conclusion: Overweight individuals would benefit from a life enhancement program that increases their awareness on the danger of obesity and helps them in reducing body weight and serum lipid level.

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The prevalence of obesity and overweight is increasing worldwide[1] and both have reached epidemic proportions in the developed countries[2] to the extent that in a few countries, such as the Lublin region of Poland, it was reported that only 30% of people have normal body weight (BW) [body mass index (BMI) <25)].[2] In the United States, the age-adjusted prevalence of BMI >30 kg/m^2 increased between 1960 and 1994 from 13-23% for people over 20 years of age.[1]

It has been reported that excess BW is usually associated with deleterious changes in the lipoprotein profile.[3] Higher levels of cholesterol (CHOL) are found in overweight compared with control subjects and significantly higher triglyceride (TRIG) levels were also reported in overweight compared with

From the Department of Family and Community Medicine, Arabian Gulf University, Manama, *Kingdom of Bahrain*.

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Address correspondence and reprint request to: Prof. Faisal A. Alnasir, Department of Family and Community Medicine, Arabian Gulf University, PO Box 22979, Manama, *Kingdom of Bahrain*. Tel. +973 (17) 239701. Fax. +973 (17) 272555. E-mail: faisal@agu.edu.bh

control subjects.[4] As a consequence of increased fat intake and decreased physical activity, the prevalence of obesity has increased.[1] In both genders, the systolic and diastolic blood pressure and serum CHOL increase with weight gain and decrease with weight loss independent of the intentionality to lose.[5]

Obesity is considered as an established predictor of cardiovascular disease. In several populations, increase in BW is associated with an increased risk of morbidity and mortality from coronary heart disease.[6,7] The socio-economic impact of obesity is mainly due to its association with a higher risk of coronary heart disease. It is likely that atherosclerosis develops against a background of obesity.[8] Reports indicate that the relationships between obesity and atherosclerotic risk factors decreases with age in healthy subjects.[9] However, obesity may increase the atherosclerotic risk even at higher ages in diabetic patients.[9] Therefore, patients' education to help in weight reduction by means of life-style changes, supported by medical interventions or appetite suppressants is essential in order to decrease the risk of atherosclerosis.[8] Weight management significantly improves the lipid and non-lipid abnormalities of the metabolic syndrome, which is associated with reduced blood pressure.[10] In children early identification of obesity remain the crucial initial step in the management of obesity later on in life.[11]

Jooste et al[6] in their study in 1988 indicated that the mean values of serum CHOL, uric acid and systolic and diastolic blood pressure increased progressively from the underweight, through the normal and overweight to the obese category in both gender, while the high-density lipoprotein/total CHOL ratio showed an inverse trend.

In middle-aged women, obesity is associated with a significant decrease in serum high-density lipoprotein CHOL and apoA-I levels, a significant increase in apoB and apoB/A-I ratio, even if serum total CHOL and TRIG concentrations are unaltered. Changes of the lipid profile in obese women are indicative of a higher risk of coronary heart disease.[12] Apolipoprotein (apo) A-IV is an antiatherogenic apolipoprotein, which may be involved in the regulation of food intake. Plasma apoA-IV is elevated in human obesity and apoA-IV polymorphisms have been associated with the extent of obesity.[13] It is also reported that women who were health educated and were maintained on a lifestyle enhancement awareness program, maintained a significant loss in BMI, and increased their high-density lipoproteins and dietary readiness to monitor hunger and eating cues. Such women will reduce their risks for developing chronic diseases.[14]

With this background of information, this study was designed to be implemented aiming at assessing the effect of reduction of BW (and BMI) through a structured health education of a 26-week of a lifestyle enhancement awareness program on the level of serum CHOL and TRIG.

Methods. This is a prospective longitudinal study, which was implemented in Naim Primary Health Care Center in the Kingdom of Bahrain during May and June of 2004 on a group of 63 male and female adults. The criteria for sample selection were: a) that they should be overweight, b) that they should be willing to reduce their BW and c) that they have high serum lipid [however few patients who had normal CHOL were also included, since it has been reported that fasting plasma lipids may be normal in obese subjects, but they may be affected by postprandial hyperlipidemia].[9] Their written consent indicating their interest in participating in the study was taken. They were oriented to the study aims and methods and were informed that they would be followed up for a 26 week period while they were on a structured health education program that included a low caloric diet and exercise. Only 55 patients remained to the end of the study period while all efforts to keep the other 8 failed. This 26-week period of lifestyle enhancement awareness program (LEAP) consisted of intensive health education sessions that included 4 sessions on weight loss and another 4 on weight loss maintenance with frequent and regular visits to the clinic to make sure that they were compliant with the given instructions.

A pre-designed educational handout containing general health information, instructions about types of foods and their nutritional values, style of eating and dieting and exercise was handed out to the sample before the study was started and their understanding for all the information was tested.

For the sake of ease of the study, 2 stages were defined, an initial stage at the beginning of the study and the last stage, at the end of the study. Assessments at the initial and at the last stages of the study were made for the entire sample. These included general examination, measurement of height, BW and BMI and laboratory investigation after 8 hours fasting of CHOL and TRIG.

The differences between variables at the initial and last stage were as follows: Body weight value at initial stage minus BW at last stage: BW1-BW2. Body mass index value at initial stage minus Body mass index at last stage: BMI1-BMI2. Cholesterol level at initial stage minus CHOL level at last stage: CHOL1-CHOL2. Triglyceride level at initial stage minus TRIG level at last stage: TRIG1-TRIG2.

The statistical analysis was carried out using SPSS (Statistical product and service solutions)

version 12. The analysis included the mean and its standard error for the parameters. Both paired and independent sample t-tests were used in comparisons. Also, Pearson correlation and stepwise regression was used to identify the relationships between the parameters of the study. *P* value at the level of <0.05 was considered significant.

Results. Out of the 63 males and females who were initially willing to participate in the study, only 55 (87.3%) continued till the last stage of the study. All patients were Bahraini nationals, of whom 20 were males and 35 were females. Their ages ranged between 25 and 49 years.

The males were found to be older than the females (mean age 43.5 versus (vs) 36.5 years) and were taller (mean height 170 vs 164.5 cm). They were also heavier at the initial stage (mean BW 90.55 vs 88.76 kg). However, according to the BMI; the females were more overweight than the males (mean BMI 32.63 vs 31.31). The mean CHOL level in males was lower than the females at the initial stage (6.16 vs 6.31) but higher at the last stage (4.99 vs 4.55). On the other hand, the mean TRIG level in males was higher than in females at the initial stage (1.80 vs 1.42) and in the last stage (1.26 vs 0.93).

The paired T test showed a significant difference between the various parameters at the initial and last stages (**Table 1**).

Table 1 shows that in both genders, there was a significant drop in all the parameters after the 26 weeks of the LEAP program, and there were no significant differences between males and females in all parameters at the initial stage. However, only BMI and CHOL showed a statistically significant difference between males and females at the last stage. It is also noticed that although in females the mean reduction in BW (the difference between mean BW1 and BW2) was less than males (3.27 vs 7.79 kg); the mean reduction in CHOL was more than males (1.77 vs 1.17 mmol/dl). **Table 2** highlights the difference between both genders, and shows that the degree of decrease in all parameters was highly significant except in TRIG.

The degrees of losses in BW, BMI, CHOL and TRIG in both gender between the initial and last stages of the study are shown in **Table 2**. Although the mean BW loss in males was more in females, the amount of CHOL loss in females was more in males.

Males. Pearson correlation showed that there is a strong correlation, at the initial stage, between BW1 and BMI1 (r=0.79, $p<0.0005$), and CHOL1 level with both BW1 (r=0.65, $p<0.002$), and BMI1 (r=0.83, $p<0.0005$). The results also showed that the decrease in CHOL level has a significant and strong positive relation with the decrease in weight (r=0.59, $p=0.006$) and in BMI (r=0.49, $p=0.029$), while age has a strong negative significant relation with the decrease in weight (r=-0.58, $p=0.007$) and in BMI (r=-0.65, $p=0.029$), which indicate that the loss in weight in young males was higher than in older males. Also, it was found that there is a relationship

Table 1 - Mean and its standard of parameters at both the initial and last stages for males and females (N=55).

Parameters	Stages	Mean ± SE			*P*-value†
		Male	Female	Total	
Body weight (kg)	Initial	90.55 ± 1.74	88.64 ± 2.63	89.34 ± 1.78	0.547
	Last	82.76 ± 1.29	85.37 ± 2.74	84.42 ± 1.80	0.393
	p-value	<0.0005*	<0.0005*	<0.0005*	
Body mass index	Initial	31.31 ± 0.48	32.60 ± 0.71	32.13 ± 0.49	0.137
	Last	28.63 ± 0.37	31.35 ± 0.73	30.36 ± 0.51	0.002
	p-value	<0.0005[a]	<0.0005*	<0.0005*	
Cholesterol (mmol/dL)	Initial	6.15 ± 0.07	6.31 ± 0.14	6.26 ± 0.10	0.329
	Last	4.99 ± 0.11	4.55 ± 0.10	4.71 ± 0.08	0.007
	p-value	<0.0005[a]	<0.0005*	<0.0005[a]	
Triglyceride (mmol/dL)					
	Initial	1.80 ± 0.21	1.43 ± 0.09	1.57 ± 0.10	0.121
	Last	1.26 ± 0.19	0.93 ± 0.06	1.05 ± 0.08	0.104
	p-value	<0.0005[a]	<0.0005*	<0.0005*	

*p-values computed using paired samples t-test
†p-values computed using independent samples t-test

Table 2 - Mean age, height and changes in the parameters for males and females (N=55).

Parameters	Mean ± SE			*P*-value*
	Male	Female	Total	
Age (years)	43.5 ± 1.27	36.5 ± 1.14	39.5 ± 0.97	<0.0005
Height (cm)	170 ± 1	164.5 ± 1.10	166.5 ± 0.86	0.002
BW1-BW2 (kg)	7.80 ± 0.52	3.52 ± 0.19	5.07 ± 0.36	<0.0005
BMI1-BMI2	2.68 ± 0.16	1.32 ± 0.08	1.82 ± 0.12	<0.0005
CHOL1-CHOL2 (mmol/dL)	1.17 ± 0.11	1.77 ± 0.16	1.55 ± 0.12	0.003
TRIG1-TRIG2 (mmol/dL)	0.54 ± 0.10	0.51 ± 0.07	0.52 ± 0.06	0.779

*p-value computed using independent samples t-test
BW - body weight, BMI - body mass index, CHOL - cholesterol, TRIG - triglyceride,

Table 3 - Pearson Correlation between age, height and other parameters at the initial stage and the differences between the initial and last stages.

	Gender	Age	Height	BW1	BMI1	CHOL1	TRIG1	BW1-BW2	BMI1-BMI2	CHOL1-CHOL2
Height	Male	-0.014								
	Female	-0.447**								
BW1	Male	-0.251	0.636**							
	Female	-0.291	0.719**							
BMI1	Male	-0.301	0.026	0.788**						
	Female	-0.098	0.309	0.882**						
CHOL1	Male	-0.39	0.018	0.651**	0.829**					
	Female	0.09	0.022	-0.053	-0.068					
TRIG1	Male	0.435	-0.200	-0.271	-0.184	-0.112				
	Female	0.473**	-0.236	-0.027	0.124	-0.092				
BW1-BW2	Male	-0.583**	0.619**	0.898**	0.665**	0.637**	-0.389			
	Female	0.031	-0.487**	-0.188	0.047	-0.133	0.075			
BMI1-BMI2	Male	-0.65**	0.480*	0.871**	0.740**	0.709**	-0.395	0.986**		
	Female	0.114	-0.646**	-0.309	-0.008	-0.152	0.12	0.98**		
CHOL1-CHOL2	Male	-0.206	0.844**	0.563**	0.054	0.249	-0.278	0.592**	0.487*	
	Female	-0.052	0.467**	0.165	-0.069	0.800**	-0.165	-0.449**	-0.517**	
TRIG1-TRIG2	Male	-0.01	-0.355	-0.726**	-0.659**	-0.431	0.463*	-0.588**	-0.582**	-0.248
	Female	0.323	-0.112	-0.028	0.035	-0.089	0.751**	0.074	0.091	-0.087

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed),
BW - body weight, BMI - body mass index, CHOL - cholesterol, TRIG - triglyceride
height in centimeters; body weight in kilograms, cholesterol and triglyceride in mmol/dL

Table 4 - A stepwise regression analysis for factors that affect the change in the cholesterol level (CHOL1–CHOL2).

Gender	Parameters	Unstandardized coefficients	Standardized coefficients	t	*P*-value	R square	Adjusted R square
Males	(Constant)	-14.252		-6.161	<0.0005		
	Height (cm)	0.091	0.844	6.669	<0.0005	0.712	0.696
Females	(Constant)	-17.192		-8.968	<0.0005		
	CHOL1 (mmol/dL)	0.852	0.773	11.897	<0.0005	0.640*	0.629
	Height (cm)	0.09	0.625	6.685	<0.0005	0.842†	0.832
	BW1 (kg)	-0.015	-0.243	-2.601	<0.014	0.870‡	0.858

*Predictors: (Constant), CHOL1; †Predictors: (Constant), CHOL1, Height; ‡Predictors: (Constant), CHOL1, Height, BW1

between the CHOL and BW at the initial stage of the study and the amount of BW and BMI lost at the end of the study. This means that males who had higher CHOL level and were heavier at the initial stage of the study lost more CHOL, weight and BMI after the LEAP program (**Table 3**).

A stepwise regression analysis was carried out to find the factors that affect the change in the CHOL level in males. Age, height, CHOL1, BW1, BMI1, TRIG1, BW1-BW2, BMI1-BMI2, TRIG1-TRIG2 were used as independent variables and CHOL1-CHOL2 was used as the dependent variable. The variable in the final step was the height (R-square=71%). For each 1 cm of increase in height the loss in CHOL (CHOL1-CHOL2) will increase around 0.09 units **Table 4**.

Females. In females, **Table 3** shows the following findings: At the initial stage, a strong correlation was found between BW1 and BMI1 (r=0.88, $p<0.0005$). Also, a strong correlation was found between CHOL1 and loss of CHOL (r=0.80, $p<0.0005$). The decrease in CHOL level has a significant and strong negative relation with the decrease in BW (r=-0.45, $p=0.007$) and in BMI (r=-0.52, $p=0.001$).

A stepwise regression analysis was carried out to find the factors that affect the change in the CHOL level in females. Age, height, CHOL1, BW1, BMI1, TRIG1, BW1-BW2, BMI1-BMI2, TRIG1-TRIG2 were used as independent variables and CHOL1-CHOL2 was used as the dependent variable. The variables in the final step were CHOL1, height, and BW1 (R-square = 87%). For females with the same initial BW and height, it was found that for each unit of increase in CHOL1 the loss in CHOL will increase by 0.85 units. Also for females with the same initial CHOL1 and height it was found that for each unit of increase in BW the loss in CHOL will decrease by 0.02 unit, and finally for females with the same initial CHOL1 and BW it was found that for each unit of increase in height the loss in CHOL will increase by 0.09 unit **Table 4**.

Discussion. The obesity epidemic is a worldwide problem and its complications have great consequences on the health of the population and the economy of countries. Its prevalence is very high, reaching up to 20% in Australia and 25% in some states in the United States. In the United Kingdom, 22% of men and 24% of women are obese. The direct cost of obesity to the national health services in the United Kingdom is £0.5 billion, while the indirect cost is £2 billion.[7,15] It is well known that the mean total CHOL and TRIG concentrations are higher in obese persons in comparison with normal weight subjects and high-density lipoprotein-CHOL concentration is lower in obese subjects as compared to normal and overweight individuals.[2]

Obesity in women has been shown to be associated with indices predisposing to coronary heart disease. However, this type of obesity has not been associated with significant differences in either serum CHOL or TRIG concentrations.[16] Increase in the BMI is reported to be strongly associated with elevation in TRIG level and diabetes in women. It is also associated with an adverse effect on all major coronary heart disease risk factors.[7]

In our study, we found that the women were more obese than men (BMI 32.63 vs 31.31), a finding that has been reported elsewhere.[17] Although all women included in our study were obese and their CHOL was high and hence, they could be labeled as hyperlipidemic, it has been reported that even if serum total CHOL and TRIG concentration in middle aged obese women are unaltered, the chances that they have decreased high density lipoprotein CHOL and increase in apo B and apo B/A- ratio are very high.[12] Therefore, medical professionals should be aware of this fact when they are dealing with obese females.

In women, we found a significant negative relationship between the amount of CHOL lost and the patients' age. That means older women lost less CHOL than the younger. This finding is consistent with Denke et al[18] who reported that excess BW in older women was associated with smaller differences in total CHOL level.[18]

Our study found that patients' height is positively associated with the amount of CHOL lost after the 26 weeks of LEAP, but there was no relationship between height and the level of CHOL. However, other studies suggested that in pubertal children, total CHOL level was negatively associated with height.[19] This finding may indicate that there are differences in the relationship between the CHOL level and the height of adult and child populations.

In males, the age of the patient was found to be negatively associated with the decrease in BW and BMI. This finding has been supported by other reports, which indicated that advancing age may blunt the BMI-associated differences in total and LDL CHOL levels.[3]

Any intervention program that consists of dieting and exercise could effectively improve the dietary pattern, control BW, and decrease the level of serum CHOL.[20] The outcome of our study indicated that after a 26 weeks of health education a life style enhancement program, the sample population managed to reduce their BW, BMI and their lipid profile. These findings are consistent with other studies. Walcott-McQuigg et. al[14] reported that women completing the weight

loss phase of a special program managed to reduce their BWs, BMI, percentage body fat and waist/hip ratio, increased their high-density lipoproteins and reduced their risks for developing chronic diseases.

In the primary care setting there is a strong need for increased public awareness about early identification and prevention of obesity, which will help in reducing the proportion of people with high lipid level that consequently increases the risk of acquiring cardiovascular diseases. Therefore, patient education is the cornerstone for any disease prevention. Since obesity and overweight are accompanied by unfavorable blood lipid patterns that increases the risk of acquiring coronary heart disease, excess BW is to be considered a major public health issue. There is a strong association between reducing BW and hence, the BMI with the decrease in a patient's lipid profile.

References

1. Schrauwen P, Westerterp KR. The role of high-fat diets and physical activity in the regulation of BW. ***Br J Nutr*** 2000; 84: 417-427.
2. Szczygielska A, Widomska S, Jaraszkiewicz M, Knera P, Muc K. Blood lipids profile in obese or overweight patients. Annales Universitatis Mariae Curie-Sklodowska. Section D: ***Medicina*** 2003; 58: 343-349.
3. Denke MA, Sempos CT, Grundy SM. Excess BW. An under recognized contributor to high blood cholesterol levels in white American men. ***Arch Intern Med*** 1993; 153: 1093-1103.
4. Viroonudomphol D, Pongpaew P, Tungtrongchitr R, Changbumrung S, Tungtrongchitr A, Phonrat B, et al. The relationships between anthropometric measurements, serum vitamin A and E concentrations and lipid profiles in overweight and obese subjects. ***Asia Pac J Clin Nutr*** 2003; 12: 73-79.
5. Czernichow S, Mennen L, Bertrais S, Preziosi P, Hercberg S, Oppert JM. Relationships between changes in weight and changes in cardiovascular risk factors in middle-aged French subjects: effect of dieting. ***Int J Obes*** 2002; 26: 1138-1143.
6. Jooste PL, Steenkamp HJ, Benade AJ, Rossouw JE. Prevalence of overweight and obesity and its relation to coronary heart disease in the CORIS study. ***South Africa Medical Journal*** 1988; 74: 101-104.
7. Lamon-Fava S, Wilson PW, Schaefer EJ. Impact of BMI on coronary heart disease risk factors in men and women. The Framingham Offspring Study. ***Arterioscler Thromb Vasc Biol*** 1996; 16: 1509-1515.
8. Castro Cabezas M, Halkes CJ, Erkelens DW. Obesity and free fatty acids: double trouble. ***Nutrition Metabolism and Cardiovascular Disease*** 2001; 11: 134-142.
9. Wakabayashi I, Masuda H. Relationship between obesity and atherosclerotic risk in elderly type 2 diabetic patients. ***Nippon Ronen Igakkai Zasshi*** 2004; 41: 223-227.
10. Christ M, Iannello C, Iannello P, Grimm W. Effects of a weight reduction program with and without aerobic exercise in the metabolic syndrome. ***Int J Cardiol*** 2004; 97: 115-118.
11. O'Brien SH, Holubkov R, Reis EC. Identification, evaluation, and management of obesity in an academic primary care center. ***Pediatrics*** 2004; 114: 154-159.
12. Maksvytis A, Stakisaitis D. Impact of obesity on lipid profiles in middle-aged women. ***Medicina*** 2004; 40: 553-557.
13. Lingenhel A, Eder C, Zwiauer K, Stangl H, Kronenberg F, Patsch W, et al. Decrease of plasma apolipoprotein A-IV during weight reduction in obese adolescents on a low fat diet. ***Int J Obes*** 2004; 28: 1509-1513.
14. Walcott-McQuigg JA, Chen SP, Davis K, Stevenson E, Choi A, Wangsrikhun S. Weight loss and weight loss maintenance in African-American women. ***J Natl Med Assoc*** 2002; 94: 686-694.
15. Ioana Vlad. Obesity costs UK economy £2bn a year. ***Brit Med J*** 2003; 327: 1308.
16. Al-Mannai A, Khalfan HA, Dickerson JW, Morgan JB. Blood lipids and body fat in Bahraini women. ***Saudi Med J*** 2001; 22: 793-796.
17. Hu D, Hannah J, Gray RS, Jablonski KA, Henderson JA, Robbins DC, et al. Effects of obesity and body fat distribution on lipids and lipoproteins in non diabetic American Indians: The Strong Heart Study. ***Obes Res*** 2000; 8: 411-421.
18. Denke MA, Sempos CT, Grundy SM. Excess BW. An under-recognized contributor to dyslipidemia in white American women. ***Arch Intern Med*** 1994; 154: 401-410.
19. Kouda K, Nakamura H, Fan W, Takeuchi H. Negative relationships between growth in height and levels of cholesterol in puberty: a 3-year follow-up study. ***Int J Epidemiol*** 2003; 32: 1105-1110.
20. Zhang Z, Wang J, Zhu W, Bai A. Effects of dietary intervention on hyperlipidemia in eight communities in Beijing. ***Wei Sheng Yan Jiu*** 2002; 31: 275-278.