BODY FAT DISTRIBUTION AND LIPID PROFILE CHANGES AFTER WEIGHT LOSS – A CASE REPORT

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Abstract: The aim of this study was to discover the relationship between body fat distribution and lipid profile changes after weight loss. In this case report following subject's parameters were determined before and after weight loss of 12 kg: body mass index (BMI), body weight (BW), total, trunk and legs fat mass (FM) with dual energy x-ray absorptiometry (DXA) and their ratios legs/trunk and legs/total FM indexes of abdominal fat distribution. Lipid profile was also determined before and after weight loss: total cholesterol (TC), triglycerides (TG), HDL-C, LDL-C, LDL/HDL-C, TC/HDL-C. BW of 63 kg and BMI value of 28.74 kg/m^2 before the weight loss lowered to 51kg and 22.55 kg/m^2. The percentage difference between the change in BMI and BW was statistically not significant ($p=0.782$). Legs/total FM index value increase from 0.36 to 0.39 was significant ($p<0.025$). Legs/trunk FM index value increase from 0.67 to 0.76 was also significant ($p<0.043$). Legs, total and trunk FM had not significant reduction ($p>0.05$), but the percentage difference between their changes, during weight reduction was statistically significant ($p=0.0001$). TC, HDL-C, LDL-C, LDL/HDL-C, TC/HDL-C changes were also significant. The percentage difference between the change in BMI and BW to normal levels was statistically not significant, but the percentage difference between the changes in DXA indexes of visceral, abdominal obesity was significant and it was associated with significant reduction of atherogenic lipid profile indicating reduced atherogenic risk. These results confirmed that DXA measurements of abdominal fat distribution are very useful in studies related to obesity-associated disease risk.
Keywords: dual-energy x-ray absorptiometry, obesity, weight loss, lipids.

INTRODUCTION

The core abnormality of Metabolic Syndrome is the increased body weight, and particularly central, abdominal obesity as well as dyslipidemia. The TC/HDL-C ratio, known as the atherogenic or Castelli index and the LDL/HDL cholesterol ratio are two important components and indicators of cardiovascular risk, the predictive value of which is greater than the isolated parameters. Obesity and central body fat distribution are known risk factors for cardiovascular and metabolic diseases. Android obesity, which is predominantly visceral, intra-abdominal, is more predictive of adipose-related comorbidities than gynecoid obesity, which has a relatively peripheral (gluteal) distribution. Excess abdominal fat is an important, independent risk factor for disease.

Dual-energy x-ray absorptiometry enabled precise, accurate body composition and body fat distribution assessment and showed that BMI increase was associated with more pronounced abdominal obesity, indicating substantially higher risk for development of metabolic and cardiovascular complications of the hyperinsulinemic-dyslipidemic syndrome [1]. The assessment of abdominal fat accumulation especially in postmenopausal (postM) women is an important screening tool for the prevention of these health complications [2]. DXA measurements of fat distribution are very useful in studies related to obesity-associated disease risk. DXA is an excellent method to measure and monitor body composition changes in obese patients undergoing weight loss. DXA can precisely monitor how much fat was lost during weight loss. Some relationship ratios between central (android, abdominal) regional tissue and FM to peripheral gynoid regional parts of the body in patients with Cushing's syndrome (CS) were discovered as diagnostic criteria of visceral, abdominal obesity in patients with CS and non CS, and they are needed as diagnostic DXA indexes of central obesity [3,4]. DXA indexes of central, abdominal obesity legs/trunk FM and legs/total FM ratios discovered extreme central body fat distribution in CS, differentiated them significantly from healthy control women and obese with the same BMI, and are discovered DXA indexes of abdominal, central obesity that should be used as DXA indexes of extreme central (visceral, abdominal) obesity in CS and non CS obese women. They are indicators of abdominal obesity [4,5].

The aim of this case report was to investigate body composition and body fat distribution changes with DXA indexes of central, abdominal obesity, legs/trunk FM (L/Tr FM) and legs/total FM (L/To FM) as well as lipid values and atherogenic indexes and their changes after weight loss with consequent normal BMI. It was important do discover weight loss influence on body fat distribution, lipid metabolism and atehrogenic risk.

MATERIALS AND METHODS

Author's personal BMI and BW reduction were determined before and after weight loss of 12 kg as well as the changes of the DXA indexes of abdominal obesity L/To FM and legs/trunk L/Tr FM and lipid profile. Examined subject was postmenopausal (postMP).

Table1. BMI and BW values before and after weight loss, and percentage of their change

	Before weight lost	After weight lost	% of change	P
BMI (kg/m2)	28.74	22.55	21.54	0.077
Body weight (kg)	63	51	19.05	0.067

The percentage difference between the change in BMI and BW, was statistically not significant
Difference test: Difference 2,49% [(-13,41-21,90) CI 95%]; Chi-square=0,077; df=1 p=0,782.

Body height was measured by a wall stadiometer in barefoot subjects with head in a horizontal Frankfurt plane to the nearest 0.1 cm. BW was measured by a digital scale while wearing light clothing and it was estimated in kilograms (kg). BMI was calculated with the following formula: weight (kg)/height (m^2). DXA assessment was performed with DXA System Lunar DPX-NT, which uses encore 10.x Windows-XP Professional OS computers. The entire body of the subject was scanned. During DXA scan, the subject was in a supine position while the x-ray scanner performed a series of transverse scans, measured at 1-cm intervals from the top of the head to the bottom of the toes. The DXA machine was calibrated daily in accordance with the manufacturer's guidelines to ensure adequate quality control. The system enabled simultaneous assessment of total and regional body composition and body fat distribution. Total (To), trunk (Tr) as well as legs (L) fat mass were determined and their ratios L/Tr, L/To [4]. Total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), LDL/HDL-C, TC/HDL-C were also determined.
Statistical analyses were performed using the statistical software program SPSS for Windows, version 19. Differences between the examined values before and after weight loss were tested by One-Sample T Test. P values <0.05 were considered to be statistically significant. Difference test, the percentage difference between the change of the examined values was determined with MedCalc statistical software.

RESULTS

Table 2. L/To, L and To FM before and after weight loss and percentage of their change

	Before weight lost	After weight lost	% of change	P
Legs/Total index	0.36	0.39	7.69	0.025
Legs FM (kg)	9.89	5.78	41.6	0.164
Total FM (kg)	27.89	14.96	46.33	0.186

The percentage difference between the change in L FM and To FM, was statistically significant.
(Difference test: Difference 4,73% [(3,47-5,98) CI 95%]; Chi-square=53,981; df=1 p=0,0001) in favor of To FM.

Table 3. L/Tr index, L and Tr FM before and after weight loss and percentage of their change

	Before weight lost	After weight lost	% of change	P
Legs/Trunk index	0.67	0.76	11.84	0.043
Legs FM (kg)	9.89	5.78	41.6	0.164
Trunk FM (kg)	14.88	7.59	48.94	0.199

The percentage difference between the change in L FM and Tr FM, was statistically significant.
(Difference test: Difference 7,34% [(6,08-8,59) CI 95%]; Chi-square=128,921; df=1 p=0,0001) in favor of Tr FM.

Table 4. Lipid levels before and after weight loss and percentage of their change

Fat mass	Before weight lost	After weight lost	% of change	P
Triglycerides	1.2	0.83	30.83	0.12
Total Cholesterol	6.5	5.65	13.08	0.044
HDL cholesterol	1.65	1.63	1.21	0.04
LDL cholesterol	4.3	3.61	16.05	0.05
LDL-C/HDL-C	2.61	2.21	15.32	0.05
TC/HDL-C	3.94	3.47	11.93	0.04

C- cholesterol; HDL - high density lipoprotein; LDL - low density lipoprotein

DISCUSSION

Obesity is a medical condition in which excess body fat has accumulated to an extent that it may have a negative effect on health [6]. Obese subjects have higher percentage of FM from the total body mass compared to non obese [7]. Central obesity can be an early warning sign of a condition called metabolic syndrome. People with metabolic syndrome have elevated blood pressure, high triglycerides, low levels of HDL cholesterol and insulin resistance. This combination of factors creates an especially high risk for stroke, coronary artery disease, cardiovascular disease-related mortality and type 2 diabetes. DXA measurements of fat distribution may be useful in studies related to obesity-associated disease risk [8]. Excess body fat in the abdominal region is referred to as android obesity, and it is associated with increased risk for cardiovascular disease. There is a growing evidence that intra-abdominal adipose tissue (IAAT), rather than total body fat, is a risk factor for metabolic conditions associated with obesity. For this reason the evaluation of IAAT is clinically important [9]. In a previous study, in 2011 Shubeska S. [1] discovered with DXA that BMI increase in healthy women was associated with a more pronounced abdominal fat distribution [8]. Because of that, effective methods for assessing visceral fat are important to investigate its role for the increased health risks in obesity [7]. There is an increased interest in the evaluation of various methods for assessment of body composition and fat distribution [10]. DXA body composition and fat distribution assessment may be useful in studies related to obesity-associated risks [11, 12].

Menopause is a high-risk time for weight gain. PostMP women have significantly more fat, a more central fat distribution, and less lean tissue mass than premenopausal (preMP) women [13]. Menopause-related central body fat accumulation potentially contributes to the increased incidence of disease observed in postMP, compared with preMP women [14, 15]. The subject of this case report is 60yr old postMP woman [1].

DXA is fast becoming the new "gold" standard" because it provides a higher degree of precision in only one measurement and has the ability to show exactly where fat is distributed throughout the body. It is very reliable and its results extremely repeatable; in addition, the method is safe and presents little burden to the subject. DXA method determines absolute (kg) and relative (%) total, bone, lean and fat body mass and separately their regional values on arms, legs, head and trunk (including ribs, pelvis, thoracic and lumbar spine). Body composition, including fat mass, body fat distribution and muscle mass, gradually change with aging, even if the body weight and BMI remain unchanged. LBM decreases significantly, while fat mass increases and is preferentially stored in abdominal tissues [16,17,18]. Trunk FM increase is a result of dominant android, abdominal FM increase indicating increased risk for metabolic complications [1]. Body fat distribution is simply determined with DXA by the relationship of the regional (segmental) fat compartments. The relationship of the predominantly central, android, abdominal FM and tissue mass (TM) and the gynoid (peripheral FM and TM) is an indicator of the central, abdominal obesity [3].

It was found that low weight, independent of menopausal status, leads to the typical gynoid pattern of fat distribution while excess weight and obesity result in an android pattern of distribution in pre- and postMP women [11]. By measuring body composition, a person's health status can be more accurately assessed and the effects of both dietary and physical activity programs better directed. Total body analysis with DXA is the ideal way for the serious athlete, the person monitoring or beginning a program of exercise or weight loss, or anyone curious or concerned about their health to receive a quick, painless, accurate and confidential assessment of their body's composition. Also, measurements of body composition and body fat distribution with DXA have provided a research tool to study the metabolic effects of aging, obesity, and various wasting conditions. Because a scale measures "body weight," which includes fat, muscles, bones and organs, it can't specifically tell how much fat had been lost, and the only way to measure actual fat loss is to measure "body composition," not body weight in weight loss programs [19,20]. DXA can precisely monitor how much fat is lost during weight loss.

Changes in body composition during weight loss programs might have a significant effect on long-term results and sensitive DXA indexes of visceral central obesity are needed, because of lack of normal reference data, which is an issue that is currently being addressed.

CS patients are discovered gold standard of extreme central, visceral, abdominal body fat distribution. DXA indexes of central body fat distribution in Cushing's (CS) also could be used as a gold standard for abdominal obesity in non CS. They were discovered as diagnostic criterion of extreme central, visceral obesity in CS and obese controls (CO) with the same BMI as CS (non CS). Shubeska-Stratrova S. (2015), showed that the ratios of insignificantly different central and peripheral regional parts of the body, precisely differentiated the patients with CS and non CS obese, and confirmed central body fat distribution in CS [2,21]. In that study it was found that legs/trunk FM ratios differentiated CS and CO with very high significance ($p<0.001$) and discovered extreme central body fat distribution in CS. DXA indexes legs/trunk FM, legs/total FM ratios discovered extreme central body fat distribution in CS, differentiated them significantly from C and CO, and could be used as DXA indexes of extreme central, abdominal obesity in CS and non CS obese women. DXA indexes of central body fat distribution in CS also could be a gold standard and diagnostic criterion of extreme central, visceral fat distribution in different types of obesity (non CS). Cut-off points of the following indexes confirmed extreme central, abdominal obesity: legs/trunk FM lower than 0.65 and legs/total FM indexes lower than 0.36 [2, 3].

In this case report subject's L/Tr FM ratio value was 0.67, but after the weight loss of 12 kg it increased significantly to normal value of 0.76 ($p<0.048$). L/To FM ratio value of 0.36 before the weight loss, increased significantly to its normal value of 0.39 ($p<0.025$) after the weight loss. The percentage difference between the change in L FM and To FM, was statistically significant in favor of To FM. The percentage difference between the change in L FM and Tr FM, was statistically significant in favor of Tr FM. Significant higher percentage of trunk FM reduction (48.94%) compared to legs FM reduction (41.6%) showed significant higher reduction of intra-abdominal, android FM mass indicating reduced risk for metabolic complications. Significant difference of L/Tr and L/To FM indexes compared to its value after weight reduction confirmed lowering of the android fat mass and significantly reduced risk for metabolic complications. Significant increase in these indexes of central obesity after the weight loss confirmed reduction of abdominal obesity and normalized body fat distribution.

An increase in total cholesterol concentration, and specifically LDL cholesterol (an atherogenic lipid marker), and reduced HDL cholesterol concentration are correlated with numerous risk factors, including the components of the metabolic syndrome, and probably involve independent risk [22, 23, 24]. Low-density lipoprotein (LDL) cholesterol concentration has been the prime index of cardiovascular disease risk and the main target for therapy.

In an attempt to optimize the predictive capacity of the lipid profile, several lipoprotein ratios or "atherogenic indices" have been defined. These ratios can provide information on risk factors difficult to quantify by routine analyses and could be a better mirror of the metabolic and clinical interactions between lipid fractions. Total/high-density lipoprotein (HDL) cholesterol and LDL/HDL cholesterol ratios are risk indicators with greater predictive value than isolated parameters used independently, particularly LDL. Total cholesterol/HDL ratio is considered a more sensitive and specific index of cardiovascular risk than total cholesterol [25, 26, 27, 28].

In this study lipid levels in the examined overweight subject also showed higher risk for development of metabolic complications. Higher LDL-C values reduced for 16.05% and total cholesterol reduced for 13.08% after the weight loss. LDL/HDL-C and TC/HDL-C significantly lowered after weight lost and BMI normalization. Atherogenic indexes reduced significantly, LDL/HDL-C ($p<0.05$) and TC/HDL-C ($p<0.04$). BMI and BW reduction to normal levels was associated with significant increase of indexes of central body fat distribution legs/total and legs/trunk FM to normal values as well as significant reduction of atherogenic lipid indexes indicating reduced atherogenic risk.

CONCLUSION

Legs/total and legs/trunk fat mass values before the weight loss confirmed abdominal obesity with dyslipidemic profile and higher cardiovascular risk in a DXA examined overweight subject. BMI, BW, legs/total and legs/trunk FM change to normal levels after the weight loss, confirmed reduced abdominal body fat distribution and consecutive normalized body composition and body fat distribution. This showed that body weight reduction in overweight subjects is important in order to improve body composition and minimize the cardiometabolic profile and risk. These results confirmed that DXA measurements of body composition and fat distribution are very useful in studies related to obesity-associated disease risk.

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