

THE CORRELATION BETWEEN THE WAIST CIRCUMFERENCE AND THE LIPID STATUS IN THE GENERAL POPULATION OF THE TIMIS COUNTY

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Abstract

Objectives: In this study we examined the correlation between the waist circumference (WC) and the lipid status in a group of people from the Timis county, apparently healthy, without known history of diabetes mellitus (DM) or other disorders of the carbohydrate metabolism. **Material and method:** The study included 670 subjects, 280 men (41.79 %) and 390 women (58.20 %) with an average age of 47.18 ± 12.83 (20-76) years. Oral glucose tolerance test (OGTT) was performed conform WHO recommendations. The total cholesterol (TC), the triglycerides (TG) and the HDLc were measured. LDLc was calculated after Friedewald's formula. Furthermore, the height,

the weight and the WC of the subjects were measured. **Results and discussions:** From the persons examined, 166 men (59.28%) and 270 women (69.23%) showed a greater WC. Not only in men but in women as well, all the parameters examined were significantly higher in persons with greater WC values ($p < 0.001$). **Conclusions** WC is an essential parameter in the evaluation of the health status of apparently healthy subjects, a direct relationship existing between him and the stated lipid parameters.

Key words: waist circumference, dyslipidaemia, cardiovascular disease.

Introduction

Obesity, especially abdominal obesity, represents a major risk factor for many chronic diseases, as for instance, atherosclerosis, cardiovascular diseases, type 2 DM, dyslipidaemias and arterial hypertension (AHT) ^{6,7}. Generally, obesity is diagnosed by the weight or the body mass index (BMI) of the subject, the local adiposity being measured by other anthropometric indexes, such as WC.

The ideal WC is a relatively new concept, with implications in the medical practice. According to the definition of the metabolic syndrome (MS), (IDF 2005), the actual official recommendation is to keep WC < 94 cm in men and < 80 cm in women ⁴.

The high prevalence of the WC is related with the high frequency of the MS ^{1,2}.

A lot of studies pointed out the strong association between the visceral adiposity und several conditions, such as hyperinsulinaemia, dyslipidaemia or AHT ^{3,13,14}. Furthermore, clinical studies emphasized the high

prevalence of the MS and of the atherosclerotic cardiovascular pathology in the diagnosis of the type 2 DM and, for this reason, DM was regarded as a "coronary risk equivalent"^{15,16}.

Abdominal obesity, the disorder of the carbohydrate metabolism, the atherogen dyslipidaemia (increased level of TG, VLDL and IDL, the presence of small and dense LDL particles, lower HDLc), AHT, the prothrombotic status, the chronic subclinical inflammation and the endothelial dysfunction make up the complex MS picture, all having as common base the insulin resistance (IR) and hyperinsulinemia, considered the pathogenic elements of such. MS was promoted as a practical method for the identification of the persons with high risk to develop type 2 DM and cardiovascular pathology^{8,9}.

WC is the compulsory diagnosis criteria for defining MS. It seems that men as well as women with greater WC, show significantly higher values of the lipid fractions as compared with persons with a normal WC^{11,12}. According to The National Institute of Health, a larger WC is strongly associated with an increased risk of type 2DM, dyslipidaemia, AHT and cardiovascular disease^{5,10}.

The changes suffered by the WC in the course of time, reflect best the level of the abdominal adiposity, strongly associated with the cardiovascular risk.

Material and method

The study included 670 subjects, 280 men (41.8 %) and 390 women (58.2 %) with an average age of 47.18 ± 12.83 (20-76) years.

523 persons (78%) were from urban environment and 147 persons (22%) from rural environment.

OGTT was performed and interpreted conform WHO recommendations. Furthermore, the height, the weight and the WC of the subjects were measured as well as TC, TG and the HDLc. LDLc was calculated after Friedewald's formula.

To compare the data, the mean values of the above-mentioned parameters were calculated. The statistical estimate of the results was performed by using the decision criteria of the statistical tests.

Results and discussions

From the subjects under study, 166 men (59.3%) and 270 women (69.2%) showed a larger WC. In subjects with a normal WC as well as in those with a greater WC, following parameters were examined and compared: average TC, average TG, average HDLc, average LDLc, average fasting glycemia and glycemia at 2 hrs. during OGTT (Table 1).

Not only in men but in women as well, all the parameters examined were significantly higher in persons with a larger WC ($p < 0.001$).

In the table above, one can notice a very strong relationship between the WC and the lipid fractions, as well as between the WC and the two glycemia measurements, fact demonstrated by other studies, too.

In both genders, the percentage of dyslipidaemias was significantly higher in persons with a larger WC, ($p < 0.001$) (Table 2).

Table 1: Comparison between the main characteristics of the subjects, depending on the WC and gender

Characteristics	Men		Women	
	< 94	≥ 94	< 80	≥ 80
WC (cm)	< 94	≥ 94	< 80	≥ 80
Number (%)	114 (40.7%)	166 (59.3%)	120 (30.8%)	270 (69.2%)
TC (mg%)	190.2 ± 50.1 (113-296)	205.7 ± 49.7 (89-318)	187.2 ± 41.1 (89-284)	208.2 ± 50.6 (105-352)
TG (mg%)	156.3 ± 58.3 (48-352)	174.87 ± 73.5 (48-430)	106.01 ± 52.8 (34-290)	161.5 ± 66.5 (41-410)
HDLc (mg%)	44 ± 7.3 (25-62)	40.87 ± 7.1 (27-62)	48.6 ± 6.6 (32-62)	42.9 ± 6.7 (30-70)
LDLc (mg%)	108.1 ± 32.1 (49-224)	126.1 ± 29.1 (58-289)	112.2 ± 33.1 (57-193)	132.4 ± 38.7 (76-293)
Fasting glycemia (mg%)	90.5 ± 13.2 (58-119)	98.8 ± 23 (40-196)	79.9 ± 11.1 (59-115)	96.6 ± 23.5 (52-199)
Glycemia at 2 hrs (mg%)	112.4 ± 20.5 (63-174)	127.9 ± 37.6 (65-259)	88.8 ± 25.4 (45-190)	122.1 ± 45.4 (40-318)

Table 2: Frequency of the lipid metabolism disorders depending on WC and gender

Characteristics	Men		Women	
	< 94	≥ 94	< 80	≥ 80
CA (cm)	< 94	≥ 94	< 80	≥ 80
Number (%)	114 (40.7%)	166 (59.3%)	120 (30.8%)	270 (69.2%)
Hypercholesterolemia	42 (36.8%)	90 (54.2%)	41 (34.1%)	137 (50.7%)
Hypertriglyceridemia	48 (42.1%)	97 (58.4%)	19 (15.8%)	122 (45.1%)
Mixt dyslipidemia	29 (25.4%)	69 (41.5%)	9 (7.5%)	86 (31.8%)

Correlating the average WC with the values of the lipid fractions, we ascertained statistically significant differences.

In both men and women, we found an increase of the average TC values associated with a greater WC. The leap from normal and pathologic takes place with a WC >95 cm in men and >80 cm in women. The highest value of the average TC was found in men having a WC between 95-104 cm and in women with WC ≥100 cm: 232.7 ± 41.3 (129-397) mg%,

respectively 229.3 ± 44.9 (126-368) mg% (Table 3, Table 4).

As concerning TG, the situation is similar but here the leap from normal to pathologic took place with more reduced values of WC than those defining the MS: 76-84 cm in men and 70-79 cm in women. The maximum value of the average TG was recorded in men with a WC ≥105 cm and in women with a WC between 90-99 cm: 266.7 ± 48.6 (132-427) mg%, respectively 246.5 ± 51.8 (119-397) mg% (Table 3, Table 4).

Table 3: Mean value of average TC and TG in men, depending on WC

WC - men (cm)	Average TC (mg%)	Average TG (mg%)
< 75	146.5 ± 23.4 (86-246)	133.8 ± 41.9 (69-288)
76-84	163.9 ± 33.6 (95-219)	174.5 ± 44.5 (104-368)
85-94	184.33 ± 36.5 (89-314)	219.3 ± 39.8 (79-359)
95-104	232.7 ± 41.3 (129-397)	242.9 ± 36.9 (127-378)
≥105	226.9 ± 39.2 (144-346)	266.7 ± 48.6 (132-427)

Table 4: Mean value of average TC and TG in women, depending on WC

WC - women (cm)	Average TC (mg%)	Average TG (mg%)
< 70	143,9 ± 29,6 (88-198)	142,9 ± 39,6 (78-297)
70-79	169,4 ± 28,4(92-232)	159,8 ± 40,1 (108-329)
80-89	201,3 ± 34,2 (126-321)	184,9 ± 44,7 (99-345)
90-99	209,4 ± 38,4 (97-346)	246,5 ± 51,8 (119-397)
≥100	229,3 ± 44,9 (126-368)	239,7 ± 50,6 (113-443)

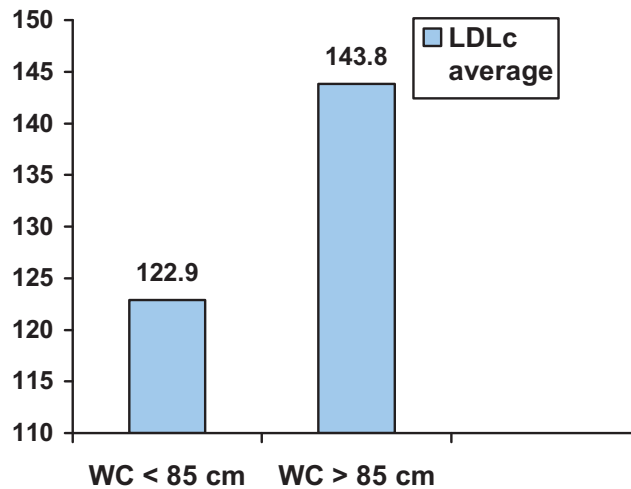


Fig. 1. Average LDLc in men, depending on WC

As concerning LDLc, we ascertained a statistically significant increase of the average LDLc, with a WC ≥85 cm in men and ≥80 cm in women (p<0.001) (Figure 1, Figure 2).

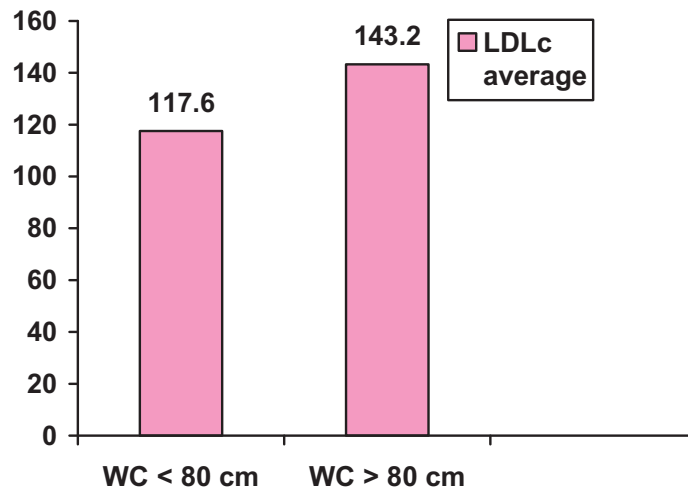


Fig. 2. Average LDLc in women, depending on WC

We noticed no significant differences of the average HDLc depending on WC.

We also ascertained an increase of the fasting glycemia as well as of the glycemia at 2 hrs. during OGTT, at the same time with a greater WC.

The maximum value of the fasting glycemia was recorded in men with a WC ranging between 95-104 cm and in women

with a WC between 90-99 cm: 99.6 ± 21.2 (75-132) mg%, respectively 98.8 ± 18.4 (69-139) mg%.

Calculating the average value of the glycemia at 2 hrs., depending on the WC, we noticed that it rises statistically significant with a WC ≥ 85 cm in men and ≥ 80 cm in women (Figure 3, Figure 4).

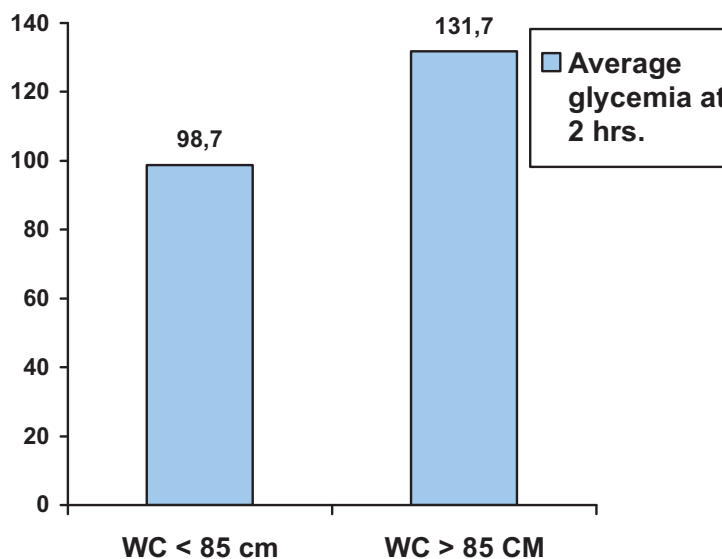


Fig. 3. Average value of the glycemia at 2 hrs., depending on the WC in men

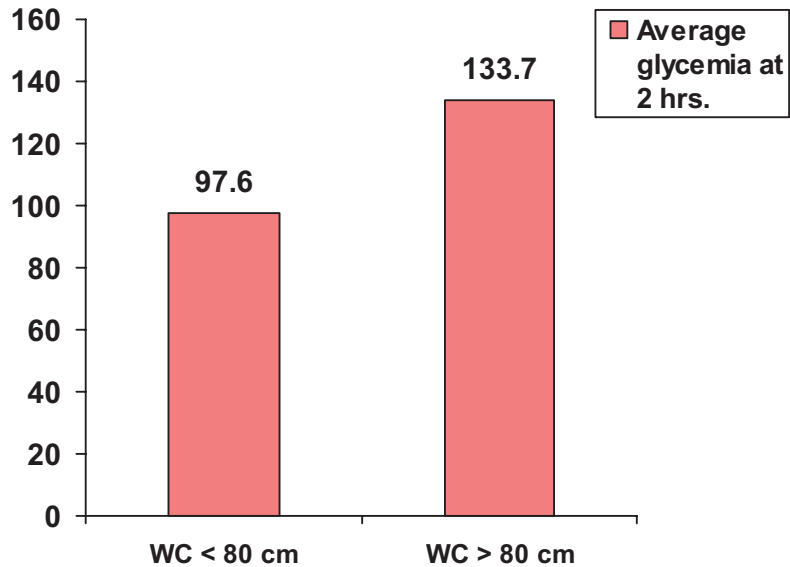


Fig. 4. Average value of the glycemia at 2 hrs., depending on the WC in women

The maximum value of the glycemia at 2 hrs. was shown by men with WC ≥ 105 cm and by women with WC ≥ 100 cm: 139.8 ± 23.5 (45-323) mg%, respectively 132.2 ± 18.6 (40-297) mg%.

Calculating the Pearson (r) correlation coefficient between the various parameters studied, after the interpretation suggested by Colton, we ascertained a strong correlation not only between the fasting glycemia and the WC but between the glycemia at 2 hrs. and the WC as well ($r=0.50$, $p<0.001$). A reasonable degree of correlation was noticed between WC and TG ($r=0.042$, $p<0.001$) as well as between the glycemia at 2 hrs. and TG ($r=0.41$, $p<0.001$).

Conclusions

WC is an essential indicator for the assessment of the health status of apparently healthy subjects.

In the subjects with a greater WC (≥ 94 cm in men and ≥ 80 cm in women), the indicators of the lipid and carbohydrate metabolism are much more frequently altered as compared with the subjects with smaller WC values.

A greater WC requires the investigation of the carbohydrate and lipid metabolism which must include the performance of OGTT, the measurement of TC, TG, HDLc, as well as the dosing or the measurement of LDLc.

The measurement of the WC is of real help for the clinicians in their selection of the subjects who must be evaluated to determine the cardiovascular risk factors, such as dyslipidaemia and hyperglycemia.

REFERENCES

1. **Bjorntorp P.** Body fat distribution, insulin resistance, and metabolic diseases. *Nutrition* 1997; 13: 795–803.
2. **Carr DB, Utzschneider KM, Hull RL, et al.** Intra-abdominal fat is a major determinant of the National Cholesterol Education Program Adult Treatment Panel III criteria for the metabolic syndrome. *Diabetes* 2004; 53: 2087–2094.
3. **Despres JP, Moorjani S, Lupine PJ, et al.** Regional distribution of body fat, plasma lipoproteins, and cardiovascular disease. *Arteriosclerosis* 1990; 4: 497–511.
4. **Grundy SM, Cleeman JI, Daniels ST, et al.** Diagnosis and management of the metabolic syndrome. An American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Executive Summary. *Circulation* 2005; 112: 2735–2752.
5. **Janssen I, Katzmarzyk PT, Ross R.** Body mass index, waist circumference, and health risk: evidence in support of current National Institutes of Health guidelines. *Arch Intern Med* 2002; 162: 2074–2079.
6. **Kaplan NM.** The deadly quartet. Upper-body obesity, glucose intolerance, hypertriglyceridemia, and hypertension. *Arch Intern Med* 1989; 149: 1514–1520.
7. **Kissebah AH, Videlingum N, Murray R, et al.** Relation of body fat distribution to metabolic complications of obesity. *J Clin Endocrinol Metab* 1982; 54: 254–260.
8. **Ko GT, Chan JC, Cockram CS, Woo J.** Prediction of hypertension, diabetes, dyslipidaemia or albuminuria using simple anthropometric indexes in Hong Kong Chinese. *Int J Obes Relat Metab Disord* 1999; 23: 1136–1142.
9. **Meisinger C, Doring A, Thorand B, et al.** Body fat distribution and risk of type 2 diabetes in the general population: Are there differences between men and women? The MONICA/KORA Augsburg Cohort Study. *Am J Clin Nutr* 2006; 84: 483–489.
10. **Meisinger C, Doring A, Thorand B, Heier M, Lowel H.** Body fat distribution and risk of type 2 diabetes in the general population: are there differences between men and women? The MONICA/KORA Augsburg cohort study. *Am J Clin Nutr* 2006; 84(3): 483–489.
11. **National Institutes of Health, National Heart, Lung, and Blood Institute.** Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—The Evidence Report. *Obes Res* 1998;6(suppl):51S–209S.
12. **Pan WH, Flegal KM, Chang HY, Yeh WT, Yeh CJ, Lee WC.** Body mass index and obesity-related metabolic disorders in Taiwanese and US whites and blacks: implications for definitions of overweight and obesity for Asians. *Am J Clin Nutr* 2004; 79: 31–39.
13. **Pouliot MC, Despres JP, Nadeau A.** Visceral obesity in men: association with glucose tolerance, plasma insulin, and lipoprotein levels. *Diabetes* 1992; 41: 826–834.
14. **Visscher TL, Seidell JC, Molarius A, van der Kuip D, Hofman A, Witteman JC.** A comparison of body mass index, waist-hip ratio and waist circumference as predictors of all-cause mortality among the elderly: the Rotterdam study. *Int J Obes Relat Metab Disord* 2001; 25: 1730–1735.
15. **Wilson PW, D'Agostino RB, Sullivan L, Parise H, Kannel WB.** Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. *Arch Intern Med* 2002; 162: 1867–1872.
16. **Yusuf S, Hawken S, Ounpuu S, et al.** Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: A case-control study. *Lancet* 2005; 366: 1640–1649.
17. **Zhu S, Heshka S, Wang ZM, et al.** Combination of BMI and waist circumference for identifying cardiovascular risk factors in whites. *Obes Res* 2004;12: 633–645.