PHOENIX TN ON EUROPEAN HEALTH AND SOCIAL WELFARE POLICIES

BODY COMPOSITION AND CARDIOVASCULAR HEALTH RISKS ON PORTUGUESE POSTMENOPAUSAL SEDENTARY WOMEN

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Vila Real, 2003

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1. MENOPAUSE, BODY COMPOSITION AND CARDIOVASCULAR RISK FACTORS

After the end of the reproductive function, the woman begins a new stage that will fill in the last third of her life. The hormonal changes will reflect upon important changes of the body composition and tend to generate a set of symptoms and disorders (obesity, cardiovascular diseases, among others), and to worsen others, resulting from the ageing process and the adoption of an usually sedentary lifestyle.

All over the world there are almost 470 million women above 50 and we expect 30% of them might live until they're 80 years old (NAMS, 2001). In Portugal the life expectance at birth increased, since 1980, at a rhythm equivalent to the European mean, positioning in 78,5 years old in women (Ferreira, 1999) and we calculate it will increase to 84 years old until 2050 (Dang et al., 2001). The increase in life expectation, together with the hormonal changes, turn this biological event into a public health problem, reason why it is important to develop effective strategies of improvement of the body mass components, namely the reduction of intra-abdominal fat and the morbidity related to this condition in a way that life expectance increase in women might be assured with more quality.

Physical exercise can have a very important role in the reduction of menopause symptoms and the decrease at long term of the obesity and cardiovascular disease risk, making this transition in women's life easier. The body composition assessment might constitute an important support to increase that adherence, proportioning the measure of the health risks related with fat excessive quantity and adverse distribution, a safer and more effective physical practice and a better elucidation of this population, of the health benefits that might be reached by the regular practice of it.

The research related to hemodynamical and metabolic profile change according to body composition alteration is still very limited in female sex, comprehending restrict samples, without contingency in forming the control and experimental groups and having in its majority transversal nature. (Figure 1). Parallelly, it's very important to clarify the contribution of the several abdominal deposits and analyse its independence of elements such as age and menopause characteristics.

This work intends to discuss some questions related to this problematic, being analysed the independent effects of age, menopause, obesity and fat mass distribution in the factors of cardiovascular risk in a group of Portuguese sedentary postmenopausal women. Some predictive equations of internal and total abdominal fat mass, developed and rectified in this population group are also presented, being the variation of some metabolic and hemodynamic components examined according to the values predicted by the mentioned equations and the anthropometrics variable selected as predictors.

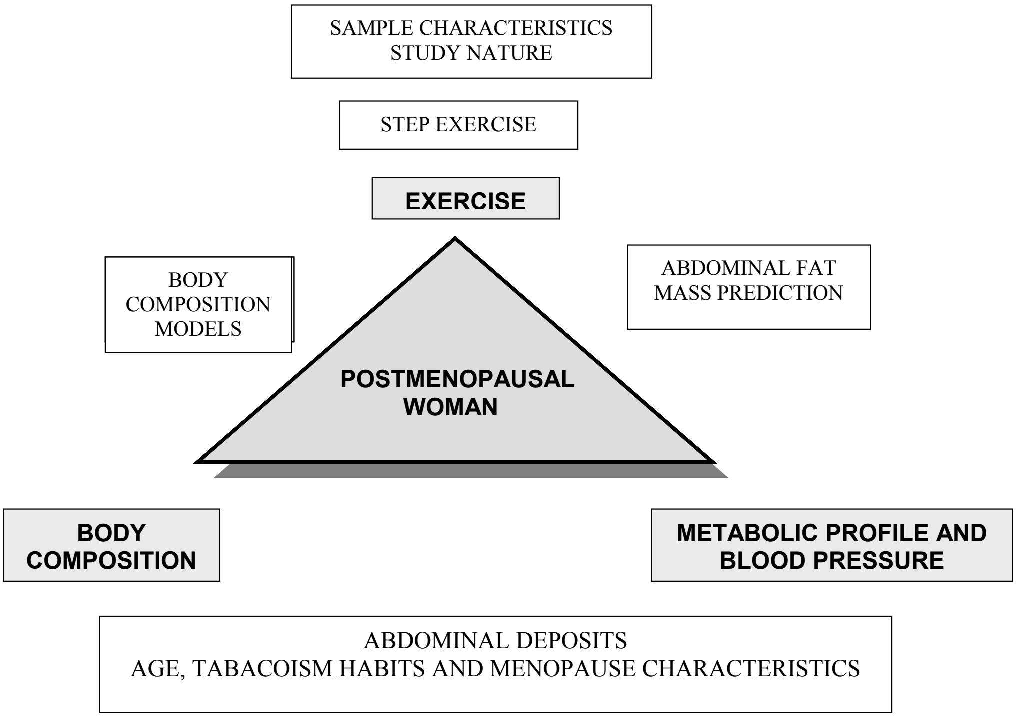


Figure 1 The research problematic in postmenopausal women. The body composition, exercise and metabolic and hemodynamic profile triad.

The exposed contents make part of a doctorate thesis submitted in the University of Trás-os--Montes e Alto Douro that had the valuable collaboration of the Health and Exercise Nucleus of the Faculty of Human Motivity, of the Technical University of Lisbon.

1.1 MENOPAUSE CONCEPT

Menopause usually occurs in European women between 50 and 51 years old (Pasquali et al. 1994) and is defined by the permanent interruption of menstruation, because of the limited endemetrial stimulation by estrogens and the end of the ovarian follicles. The estrogen reduction happens especially during the first year of amenorrhoea (Rannevvik et al., 1986) estradiol levels being reduced to near 75% of those registered in postmenopausal period (Barret-Connor& Stuenkel,1999).

In the first four years, the woman shows an hormonal profile predominantly androgenic, given that the dehydroepiandrosterona sulfate production (DHEA-S) by the suprarenal glands isn't too much affected (Sonnichsen & Schwandt, 1991; Tchernof et al., 2000) being the endogenous estrogen concentrations determined by the conversion of the androgens in stroma, in the muscular and adipose tissue (Bjorntorp & Edén, 1996; Sonnichsen & Schwandt, 1991). The relative androgens excess in this period, combined with an usually sedentary lifestyle and the food pattern changes, cause an increase of the total and central adiposity (Panatopoulos et al., 1996; Wang et al., 1994) and will expose the woman to an enlarged risk of cardiovascular diseases (Liu et al., 2001; NAMS, 2001). During the course of menopause, the adrenocorticotropin (ACTH) produced in the pituitary anterior lobe and stimulator of the adrenal androgens, decreases its activity.

For Tchernof et al. (2000) menopause is accepted as being natural when the absence of the regular menstrual cycle occurs between 6 to 12 months. Although some recent orientations of the *Council of Affiliated Menopause Societies* (CAMS) report that menopause can only reflect a natural decrease of the ovaries' hormonal secretion after 12 consecutive months of amenorrhoea (NAMS, 2001), the precocious or premature menopause defined by CAMS as the one that occurs 2SD (SD, standard deviation) below the mean calculated for the reference population or, when in the absence of those indicators, in an age inferior to 40 years old (Utian, 1999), increases the woman's exposition to factors of risk for diseases related to estrogens levels and enlarges the risk of precocious mortality (Bromberger et al., 1997).

1.2 BODY COMPOSITION IN POSTMENOPAUSAL WOMEN AND METABOLIC SYNDROME

With the increase of the androgens expression in menopause, especially in the firsts years, the fat cells in the abdominal, mammary and gluteal-femoral regions will undergo a change in its metabolic activity, bringing the woman fat distribution model close to the one registered in male sex. The fat mass (FM) tends to increase and the fat-free mass (FFM) decreases, negatively conditioning postmenopausal women's functional independence, especially in those that clearly show a sedentary lifestyle and/or whose food is rich in fats and poor in proteins and calcium. The trunk FM proportion comparing to inferior limbs is amplified (Ijuin et al., 1999; Wang et al., 1994) one registering a preferential accumulation of fat in mesenteric and omental adipocytes. Given its evident lipolitic activity (higher irrigation and innervation, high β lipolitic receptors sensitivity, great density of receptors for the glucocorticoids hormones, low volume of its cells, etc.) and its connection with the hepatic portal vein, its started a high flow of free fatty acids to the liver, causing insulin resistance (Wajchenberg, 2000) and leading to a metabolic syndrome components manifestation (Figure 2) according to the individual genetic susceptibility and independently of the obesity degree (Abate, 2000; Lamarche, 1998).

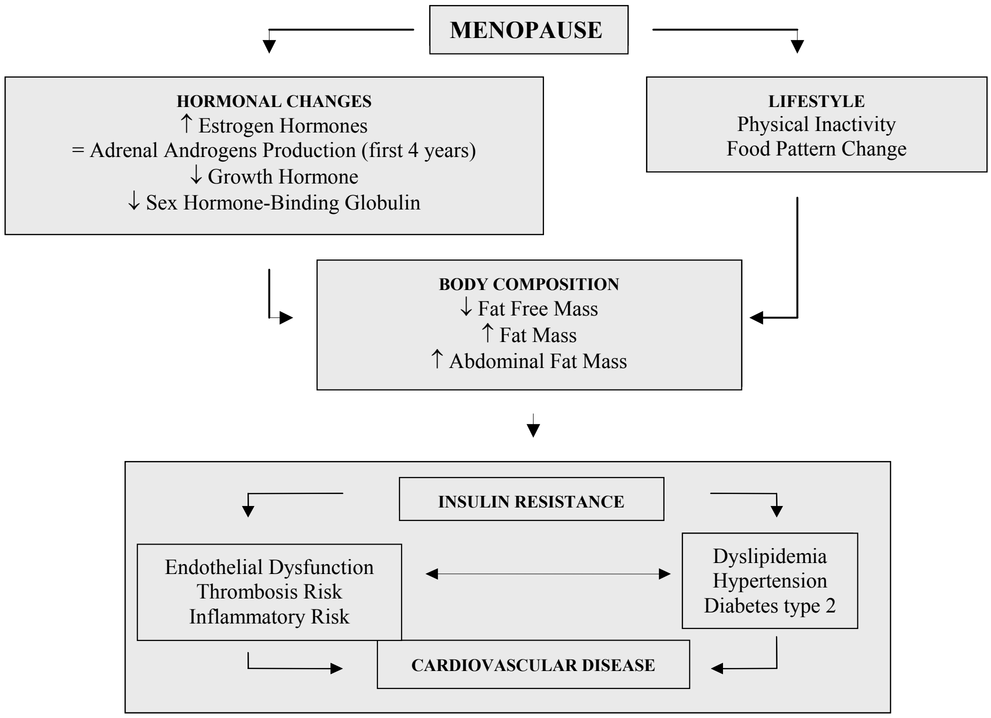


Figure 2 Menopause relationships to the manifestation of the metabolic syndrome.

The metabolic syndrome is defined in the *Third Report of the National Cholesterol Education Program Expert Panel on Detection Evaluation and Treatment of High Blood Cholesterol in Adults* (NHLBI, 2001) by the presence of three or more of the following conditions: (1) waist circumference superior to 88 cm in women, (2) triglycerides ≥ 150 mg/dl (1,69 mmol/l), (3) HDL-cholesterol < 50 mg/dl in women (1,29 mmol/l), (4) Glucose ≥ 110 mg/dl (6,1 mmol/l) and (5) blood pressure ≥ 130/85 mmHg.

The increase of plasma triglyceride (TG) concentration is closely related to the decrease of the insulin inhibitory activity upon the hormone-sensitive lipase (stressing the triglyceride hydrolysis in the adipose tissue) and with the captation in excess of plasma glucose by the hepatic organ, being this one used in the TG synthesis (Yamashita & Matsuzawa, 1999).

The insulin resistance and the increase of androgens levels also emphasise the hepatic lipase enzyme activity negatively conditioning plasma presence of lipoproteins of high density (HDL-C), effective in free cholesterol capture and in its transportation to the hepatic organ (Abate, 2000), raising the plasma lipoprotein concentrations of low density (LDL-C) small and dense (Bruckdorfer, 1999).

Hyperinsulinemia generates a blood pressure raise, either by the abnormality in plasma lipids (increase of the fatty acids flux to the plasma and the development of atheromatous plates or by its vasoconstrictor effect, related to some factors as: (1) the decrease of the endothelial production of nitric oxide, with negative implications in muscle blood irrigation and in the velocity of dilatation of the blood vessel (Montagnani & Quon, 2000), (2) the elastin reduction in the arterial wall (Bosello & Zamboni, 2000) and (3) the increase of the angiotensin II levels, with repercussions in the increase of vasoconstriction and of the aldosterone synthesis (Bjorntorp & Rosmond, 1999).

While the trunk FM constitutes an important predictor of insulin resistance and dyslipidemia in postmenopausal women, the inferior limbs fat mass has a cardioprotective effect (Terry et al., 1991; Williams et al., 1997) given that its adipocytes are more resistant to the epinephrine lipolitic activity and because the subcutaneous adipose tissue, unlike the subfascial is rather associated to the insulin resistance (Goodpaster et al., 2000a).

1.3 EXERCISE IN POSTMENOPAUSAL WOMEN

The exercise program in this population should be implemented in a motivating context, proportionate social support and appropriate technical supervision, avoiding chronical fatigue and the appearance of lesions. A modest weight reduction of 10% reflects on the central and total adiposity decrease (Jansen & Ross, 1999), in higher levels of the non-adipose components (Houmard et al., 1994; Pietrobelli et al., 1999) and in the improvement of the tissues sensitivity to insulin (Jones et al., 2000) being recommended a weekly weight loss of 0,4 to 0,6 kg (Goldstein, 1992). The implementation of a regular exercise practice in this population is essential given that the body mass increase after a restrained weight loss (± 12 kg) results in the restitution of the visceral fat initial values and in additional gains of abdominal subcutaneous fat, especially if those changes were reached through caloric restraint (Kooy et al., 1993).

Postmenopausal women benefit from the combination of aerobic exercise and hypocaloric diet, given that it stressed the fat loss by the visceral and subcutaneous abdominal deposits level. According to Ross & Rissanen (1994), visceral adipocytes localized in the abdomen superior area, are the most beneficed by this combination, what doesn't happen when the weight reduced was reached through diet (Weinsier et at., 1992; Wood et al., 1991).

Because women are more resistant than men to weight reduction through exercise action, loosing less total, visceral and subcutaneous fat mass (Wilmore et al., 1999), the duration and frequency of the exercise sessions constitutes important predictors of the energetic consumption (Ballor & Keesey, 1991). Sessions with 45 to 60 minutes duration enable to accentuate fats mobilization and its oxidation through the muscle fibers, avoiding the glycogen stores finishing (Pérez-Martin et al., 2001).

2. SUBCUTANEOUS AND INTERNAL ABDOMINAL FAT MASS IN PORTUGUESE POSTMENOPAUSAL SEDENTARY WOMEN AND CARDIOVASCULAR HEALTH RISKS

The hormonal changes related to menopause cause an increase of the global adiposity and a centralised distribution of the fat mass, producing the appearance of a metabolic and hemodynamic profile with aterogenetic characteristics. These changes are especially obvious when the ovarian changes happen suddenly (Kirchengast et al., 2000) or the woman doesn't use the hormonal compensation therapy (Di Carlo et al., 2000; Rebuffe-Scrive et al.1986)

The estimation of fat distribution in post menopausal women namely through easily implemented techniques and a good understanding of the metabolic impact of the several abdominal deposits are essential for this population's morbidity risk appreciation and for the development of effective strategies to reduce intra-abdominal adiposity and the morbidity related to this condition, helping in a way that the increase of this population's expectation of life can be assured with better quality.

2.1 ESTIMATION OF THE ABDOMINAL FAT MASS THROUGH DUAL ENERGY X-RAY ABSORPTIOMETRY

The dual energy X-ray absorptiometry (DXA) is now-a-days one of the most used techniques in the estimation of regional and global fatness (inferior and superior limbs and trunk) proportioning a rigorous estimation of these components including fat inside adipose tissue and soft tissue, namely the skeletal muscle (Svendsen et al., 1993a)

From a complete body exam and based in a software standardised option, DXA enables us to quantify the FM of the abdominal region comprehended between the second lumbar vertebra and the pubic symphysis, distinguishing two important regions: the $FM_{TA(L2\text{-}L4)}$, placed between the second superior side and the fourth inferior side of the lumbar vertebrae and the $FM_{TA(L4\text{-}P)}$ as high as the first, that goes from the fourth lumbar vertebra inferior limit to the pelvic region (Figure 3). It is possible to distinguish for each of them a mass placed more internally (FM_{IA}) whose side limits are levelled by the exterior side of the coastal grid (Bertin et al., 2000) and a total mass, involving the subcutaneous fat, resulting of its subtraction, the subcutaneous abdominal fat mass (FM_{SA}).

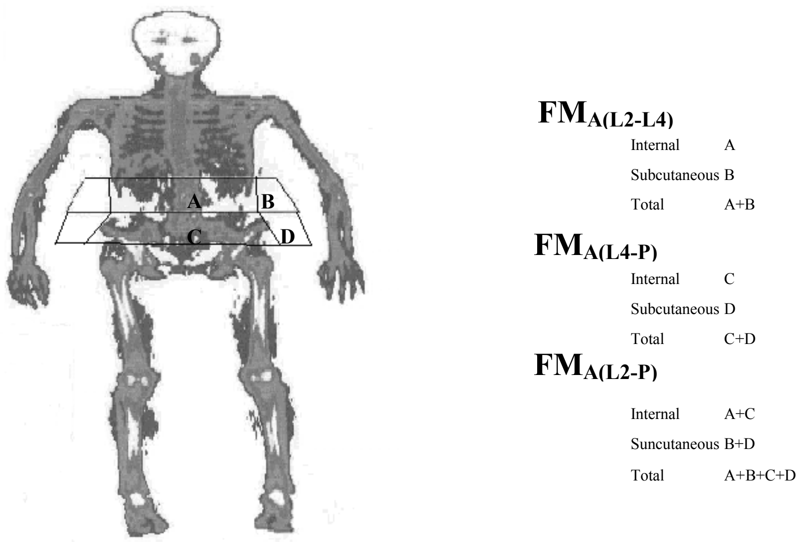


Figure 3 Representation of the abdominal fat mass deposits (internal, subcutaneous and total) obtained through dual energy X-ray absorptiometry.

The distribution model focused in postmenopausal women fat may cause some difficulties in estimating the abdominal adiposity for anteroposterior diameter values superior to 25 cm, as these change the extenuating constants established (Prior et al., 1997) for body mass different compartments (fat mass, water, protein, glycogen, cellular mineral and bony mineral), resulting in the overestimation in more than 3% of FM (Kohrt, 1995)

Although DXA considers a constant hydration value (73%) of fat free mass (FFM) and this value varies between 68% and 78% among old people (Baumgartner et al., 1991) the DXA precision doesn't seem to be jeopardised by this, given that the software is sensitive to changes in MIG's hydration between 1% and 5% (Pietrobelli et al., 1998). In the other hand, despite the bodily water volume decrease with ageing, MIG's hydration levels tend to maintain constant (Shoeller, 1998)

The fat mass evaluation by the trunk is affected by the ectopic calcification effects and by the distinguished interaction of soft tissues and bony tissues especially by the ribs, making it difficult to read the fat values placed under and around the bones (Roubenoff et al., 1993), as many research works note (Milliken et al., 1996; Salamon et al., 2000; Snead et al., 1993). Fat mass underestimation (Jebb et al., 1995; Jebb et al., 1995; Roubenoff et al., 1993; Salamon et al., 2000) tend to be particularly evident in women with pathologic ponderal overload and especially in those that present an android body topography.

2.2 ABDOMINAL FAT MASS DEPOSITS IN POSTMENOPAUSAL WOMEN

In adulthood, women, comparing to men, tend to present a higher quantity of subcutaneous fat (Enzi et al.,1986) and about 50% less visceral fat (Cooillard et al., 1999). The hormonal changes induced by menopause and ageing (reduction of the growth hormone and the globulin of connection to the sexual hormones, etc.) cause the enlargement of the subcutaneous and visceral deposits, especially the second (De Nino et al., 2001), creating in the female sex a fat distribution pattern similar to the one registered in male population.

Because the subcutaneous deposits in the abdominal region are more emphasised comparing to those internally localised they're responsible for a high transference of fat acids to the systemic circulation (Martin & Jansen 1991), which combined with fat free mass decrease (adoption of an inactive lifestyle and food pattern changes), will contribute to the increase of insulin secretion and to the decrease of its extraction from plasma (Ferranninni et al.,1997, Frayn, 2000).

In a study which involved 121 Portuguese postmenopausal (amenorrhoea for at least 6 months) and sedentary (less than 1 hour of physical exercise per week during the last 6 months) women aged between 48 and 79 years old (Moreira, 2002) we verified that abdominal fat mass in the L2-P region was formed by 78% of internally localised fat (Figure 4) the most part of the sample elements standed out high levels of body fat, that is, values of body mass index equivalent or superior to 25,5 kg/m^2 (Sardinha & Teixeira, 2000) and the supremacy of a fat distribution model of the android type, to which shouldn't be strange the use of hormonal therapy of substitution in less than 30% of the analysed women. The high storage capacity of the abdominal deposits more internally localised can be explained by several factors of which: a) the stressed irrigation and innervation of the adipocytes (Bjorntorp, 1996) and its reduced volume, (Rebuffe-Scrive et al., 1990) and b) the pronounced action of the lipase lipoprotein (Bjontorp, 1996), essentially in obese postmenopausal women (Enzi et al., 1996; Hellstrom & Reynisdottir, 2000; Rebuffe-Scrive et al., 1989), due to its stimulation by insulin (Wajchenberg, 2000).

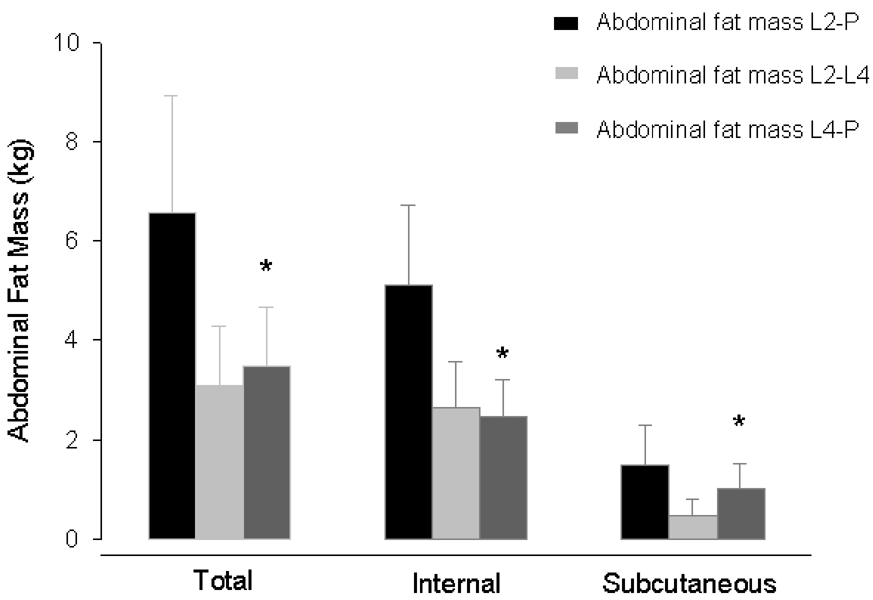


Figure 4 Subcutaneous, internal and total fat mass for the several considered regions (L2-P, L2-L4 and L2–P). Significant differences (*p<0,01) between regions (Moreira, 2002).

In the same study (Moreira, 2002) we registered in region L4-P the largest concentration of abdominal adiposity, which, according to Baumgartner et al. (1988), is related to the reproductive process in the female sex. The L2-L4 region presented, comparing to L4-P, higher values of (p<0,01) of FM_{IA} (2,63 and 2,46 Kg, respectively), being this results similar to those registered by Kamel et al. (2000) in obese women, whose estimation of intra-abdominal fat by magnetic resonance, allowed to identify a bigger volume of it, 5 to 10 cm above the articulation of the 4th and the 5th lumbar vertebra.

3. ANTHROPOMETRIC EQUATIONS OF ABDOMINAL ADIPOSITY PREDICTIONS IN PORTUGUESE SEDENTARY POSTMENOPAUSAL WOMEN AND ITS RELATION WITH SOME METABOLIC VARIABLES

The interaction of centralised fat distribution with the aetiology of the cardiovascular risks factors, particularly evident in women after the menopause installation has been legitimating and increasing interest of the investigators in the estimation of abdominal fat mass and in the construction and validation of more accessible diagnosis methods in terms of costs and operationalisation. Some anthropometrical variables as the waist circumference (WC), the saggital diameter (SD), the waist-to-hip ratio circumference ratio (WHR) and the waist-stature index (WSI) are largely used in abdominal fat diagnosis and monitoring.

With ageing and no matter which physical activity levels, the woman tends to display, comparing to the male sex, a more enhanced waist circumference, being this of 1% per decade (Poehlman et al., 1995). Although the woman body mass isn't that much influenced by menopause (fat mass increase and fat free mass decrease), she might have the perception of being fatter, because of this anthropometric measure increase (± 2,55cm) that forces her to dress some large sizes of clothes (Davies et al., 2001).

According to Seidell et al., (2001) in adult and elder women, the presence of a high WC reflects the presence of a large amount of visceral fat and less of subcutaneous fat, apart from the body mass index (BMI). This anthropometrical measure easily used in clinical, scholarly and epidemiological contexts might proportionate evidence about the health risk related to a certain fat mass distribution model in postmenopausal women, enabling the settlement of cohorts from which increases the extent of occurrence of metabolic and cardiovascular complications.

Although in literature there are several studies that used the waist circumference, there is no such thing as a globally accepted method to measure it, which usually renders the confrontation between the results of the different research works difficult. Thus, the WC can be measured (1) half a way between the last ribs and the iliac crests (Who, 1995), (2) in the area of less perimeter between the coastal grid and the iliac crests that in this work we designate by WC_I (Lemieux et al.,1996; Pouliot et al., 1994) (3) right above the iliac crests (NHLBI, 1998), here named by WC_{II}, or (4) by the last rib (Jansen et al., 2002). According to some authors (Dobbelsteynet al., 2001; Jakicic et al., 1993) the WC_I is the one that presents a bigger predictive ability of the metabolic profile and the one that proportionate a bigger consistency in localising the anthropometric spots, since the need to identify bony prominence might be difficult in some obese women, jeopardising its interpretation in a public health context.

In Kamel et al. (2000) study, the WHR and the FM_A measured by DXA presented equivalent values of correlation with the fat localised in the peritoneum interior, measured by magnetic resonance in obese women (r> 0,70), being both anthropometrical measures assumed as good visceral fat predictors. In several research works (Bertin et al., 2000; Clasey et al. 1999; Lemieux et al., 1996; Treuth et al., 1995), the WC and the SD are indicated as being the best visceral adipose tissue predictors measured by computed tomography (CT), comparing to WHR. For Kooy & Seidell (1993), the SD measured in dorsal decubit presents a better association with the intra-abdominal fat, when comparing to WC, WHR or WSI, given that the estimation technique that was used allows to maintain the thickness of the subcutaneous adipose tissue, being an excellent predictor of the SD measured by CT on the L4-L5 level (Clasey et al., 1999; Svendsen et al., 1993b).

In a group of 119 Portuguese sedentary postmenopausal women (48-79 years old) we proposed ourselves to develop and validate predictive equations of the abdominal FM from anthropometrical parameters (Moreira, 2002), aiming the acquisition of precise estimates of the regression rates that would better translate the abdominal adiposity variation, measured by DXA in regions L2-L4 and L4-P. We were also seeking to examine some metabolic variables components variation (total cholesterol, low and high-density lipoproteins cholesterol, insulin and glucose) according to FM_A (total and internal) predicted through developed formulas.

The considered anthropometrical variables were the following: body mass index (BMI= weight/stature^2), SD (Figure 5), waist circumferences (WC_I and WC_{II}), abdominal circumference (AC, measured in the most prominent abdominal area), hip circumference (appreciated in the area of larger gluteal volume), WHR and WSI. In the multiple regression analysis, the control variables considered were the smoking habits, the age and menopause associated characteristics (time, nature and substitution hormonal therapy).

The sample selection was made by medical history and based on criterion as (Moreira, 2002): (1) Caucasian and sedentary, (2) absence of vertebral column surgery or metabolic diseases clinically not controlled, (3) non-use of medication susceptible of influencing the lipidic and lipoproteic metabolism and (4) inexistence of alcoholic habits.

Figure 5 Measure technique of the anteroposterior saggital diameter (SD). The subject lays in dorsal decubitus with stretched legs, being the anthropometer rods placed on the umbilicus and under the spinal apophysis of the correspondent lumbar vertebra.

The sample elements were causally divided in: group A (age, 62.19±7.06 years; FM, 44.21± 6.18 %) and group B (age, 60.50±5.58 years; FM, 43.20±5.81 %), both contemplating women with surgical menopause (15 and 16, respectively), synthesis estrogens users (18 and 17, respectively) and smokers (4 in each group). The menopause time was calculated based on the knowledge of when the last menstrual period took place.

In the group A (n=60) we developed predictive equations of the FM_{IA} and FM_{TA} for the considered regions L2-L4 and L4-P) and in group B (n= 59) we proceeded to the validation of the mencioned equation, being the means equality of the predicted abdominal fat mass and of inferred reference through *t*-test, for match samples. In the validation process we analysed the total error ($TE=[\Sigma(\text{predicted scores-reference scores})^2/N]^{1/2}$) and the constant error (difference between the observed and predicted values mean), having been tested the chance of the regressions declivity and interception being different from 1 and 0, respectively, through the method of Passing & Bablok (1983).

No differences were registered (p≤ 0,05) in the several components analysed (Table 1), having both groups show the presence of more than 28% of pathologic ponderal overload women, with a BMI≥ 25,5 kg/m^2 (Sardinha & Teixeira, 2000).

Table 1 Descriptive analysis of the anthropometrical body composition and biochemical variables in groups A (validation group) and B (cross-validation group). Differences in the quantitative variable means (Adapted from Moreira, 2002).

Variables	Group A (n=60)		Group B (n=59)		Teste *t*
					p
	Mean±SD	Limits	Mean±SD	Limits	
Menopause Time (years)	13.34± 7.83	1.45 – 34.87	11.43± 7.81	0.74– 42.22	1.33
Body Mass Index (kg/m^2)	28.11± 4.32	19.68 – 39.48	27.76± 4.30	20.79 – 41.84	0.44
Saggital Diameter (cm)	20.03± 2.99	13.10 – 30.85	19.84± 2.83	14.80 – 29.10	0.36
Waist Circumference I (cm)	85.43± 9.28	68.00–108.95	84.91± 9.44	66.95–115.75	0.29
Waist Circumference II (cm)	91.94±10.21	69.15–123.50	91.74± 10.04	74.05–121.60	0.10
Abdominal Circumf. (cm)	102.79±11.32	86.50–138.00	99.47± 10.64	64.00–121.80	1.65
Hip Circumference (cm)	104.96±10.71	91.85–140.75	104.14± 8.87	88.00–129.10	0.46
Waist-to-hip ratio	0.82± 0.06	0.65 – 0.94	0.81± 0.05	0.70 – 0.94	0.06
Waist-stature index	0.55± 0.06	0.44 – 0.68	0.55± 0.07	0.41 – 0.79	-0.20
Fat Mass (%)	44.21± 6.18	28.90 – 58.90	43.20± 5.81	31.50 – 56.00	0.92
$FM_{IA(L2-L4)}$ (kg)	2.68± 0.95	0.93 – 5.17	2.61± 0.97	0.73 – 4.97	0.38
$FM_{TA(L2-L4)}$ (kg)	3.16± 1.27	1.13 – 7.16	3.05± 1.17	0.83 – 6.03	0.51
$FM_{IA(L4-P)}$ (kg)	2.50± 0.81	1.28 – 4.87	2.45± 0.74	1.03 – 4.43	0.30
$FM_{TA(L4-P)}$ (kg)	3.55± 1.35	1.72 – 7.89	3.41± 1.15	1.30 – 7.14	0.60
Total-cholesterol (mg/dl)	224.65±31.42	160.00–306.00	233.98±40.54	156.00–355.00	-1.40
LDL-cholesterol (mg/dl)	147.82±28.04	97.00–221.00	154.63±34.31	87.00–255.00	-1.19
HDL-cholesterol (mg/dl)	55.28±12.16	33.00 – 85.00	55.27±10.39	33.00 – 79.00	0.01
Glucose (mg/dl)	95.90± 14.86	63.00– 159.00	100.75± 19.53	80.00– 189.00	-1.53
Insulin (mcUI/ml)	11.34± 6.21	1.90 – 32.70	10.74± 5.78	2.90– 26.40	0.54

The predictive formulas developed for the abdominal areas L2-L4 are presented in Figure 6 and 7. being indicated in each of them the R^2 adjusted to the predictors number (Adjusted R^2) the predictive standard error of estimate (SEE) and the total error obtained in the cross-validation process. For every predictive equations, the method of Passing and Bablock (1983) allowed to observe that interception and the declivity weren't different from 0 and 1. respectively.

Similarity to Thomas et al. (1998) study. in which the abdominal fat mass estimation was made by magnetic resonance. the variation in the total and internal abdominal deposits revealed to be independent from the BMI, meaning that women with BMI< 25.5 kg/m^2 might present higher values of FM_{IA} and FM_{TA}. Comparing to those that indicate a pathologic weight. not being obesity a necessary condition to the relationship between the abdominal adiposity and the metabolic risk (DiPietro et al.. 1999). The age and the menopause-associated characteristics (time. nature. and therapy hormonal) also didn't reveal an explanatory capacity in the change of postmenopausal women abdominal deposits, although literature notes its influence in abdominal adiposity.

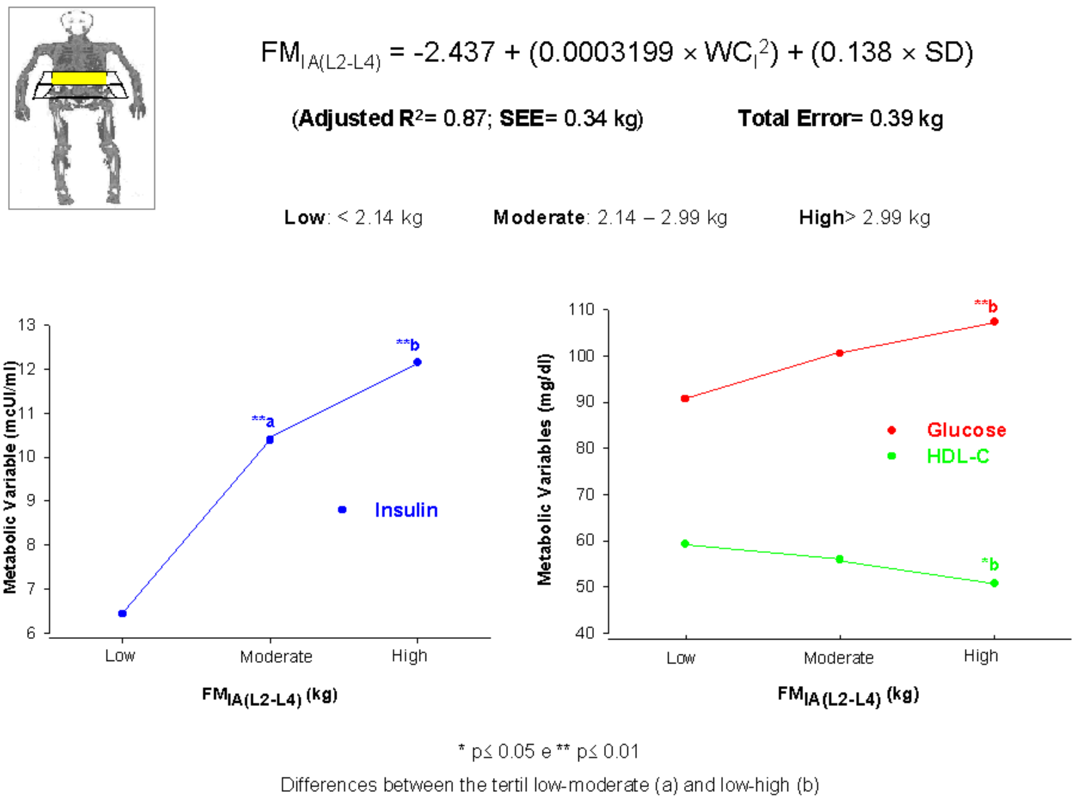


Figure 6 Characteristics of the developed equation for the $FM_{IA(L2-L4)}$ and analysis of the means variation of some metabolic variables in group B, according to the tertils defined for the predicted $FM_{IA(L2-L4)}$ (< 2.14 kg. 2.14 – 2.99 kg and > 2.99 kg).

In the region L2-L4, the WC_I and the SD established the anthropometrical measures that showed higher association degrees with the FM_{IA} and FM_{TA}, being this equal or superior to 0.88 ($p \leq 0.01$). These two anthropometrical variables explained in 87% the FM_{IA} variation, with a SEE of 0.34 kg, being Adjusted R^2 value higher for the FM_{TA} of this area (0.91).

The predictive equation of the $FM_{IA(L2\text{-}L4)}$ revealed a good performance in cross-validation with a total error of 0.30 kg and a mean difference of –0.02 kg, comparing to the reference method. The analysis of the metabolic variable means by the tertils of the predicted $FM_{IA(L2\text{-}L4)}$, presented in Figure 6, make us suggest that from values superior to 2.99 kg postmenopausal sedentary women aged between 48 and 79 years old tend to present high plasma insulin and glucose concentrations and lower levels of cholesterol in high-density lipoproteins (HDL-C), with adverse implications in cholesterol reverse transportation (Moreira, 2002).

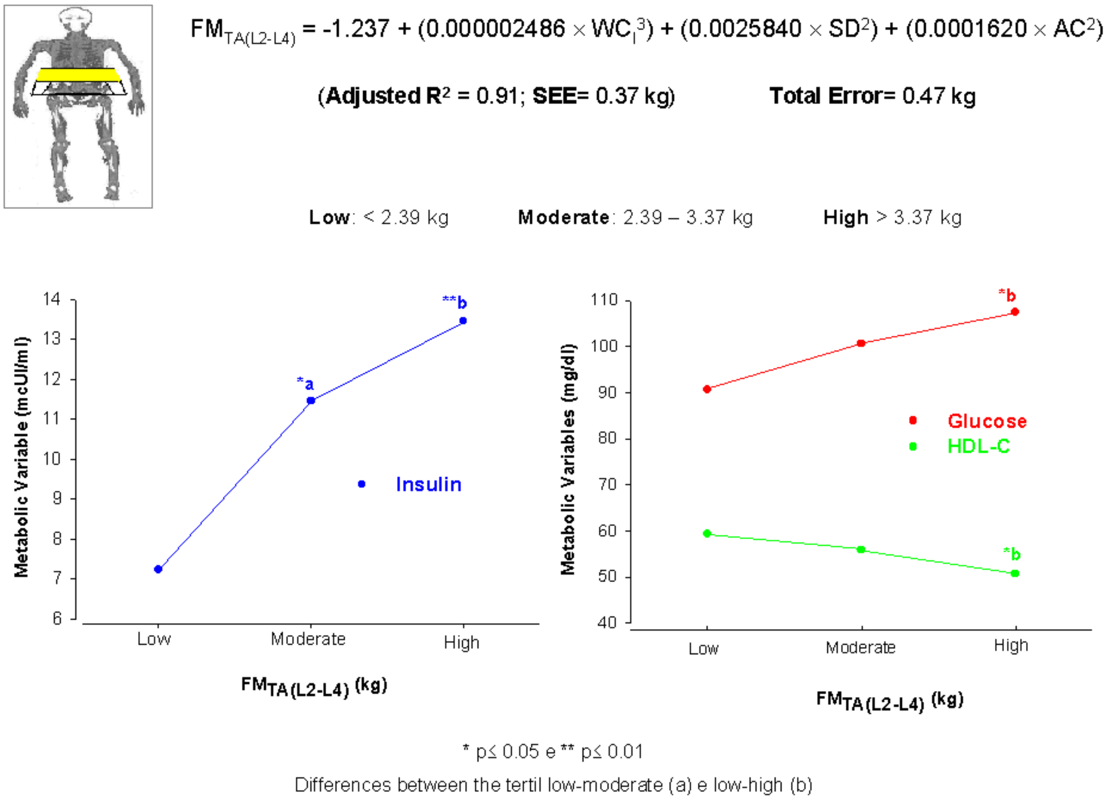
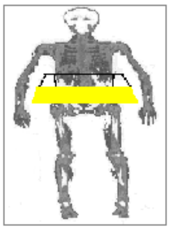


Figure 7 Characteristics of the developed equation for the $FM_{TA(L2\text{-}L4)}$ and analysis of the means variation of some metabolic variables in group B, according to the tertils defined for the predicted $FM_{TA(L2\text{-}L4)}$ (< 2.39 kg. 2.39 – 3.37 kg and > 3.37 kg).

The WC_I, the SD and the AC (abdominal circumference) explained 91% of the FM_{TA} variation with a mean difference between the two methods of 0.04 kg and a total error of 0.47 kg (Figure 7). Predicted values of FM_{TA} superior to 3.37 kg revealed to be associated to a metabolic profile also more atherogenic.

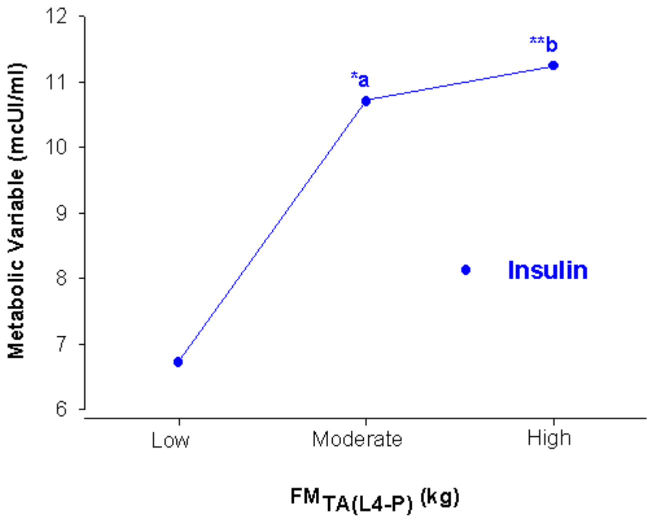
In the abdominal region L4-P, the AC represented the only selected prediction variable but only the $FM_{TA(L4\text{-}P)}$ predictive equation didn't present values different from those obtained by DXA (Figure 8).



$$FM_{TA(L4\text{-}P)} = -8.127 + (0.114 \times PAb)$$

(**Adjusted R^2** = 0.90; **SEE**= 0.43 kg) **Total Error**= 0.86 kg

Low: < 2.65 kg **Moderate**: 2.65 kg – 3.85 kg **High** > 3.85 kg



* p≤ 0,05 e ** p≤ 0,01; Differences between the tertil low-moderate (a) and low-high (b)

Figure 8 Characteristics of the developed equation for the $FM_{TA(L4\text{-}P)}$ and analysis of the means variation of insulin in group B, according to the tertils defined for the predicted $FM_{TA(L4\text{-}P)}$ (< 2.65 kg. 2.65 – 3.85 kg and > 3.85 kg).

The selection of this anthropometrical parameter can be related to the of the abdominal adiposity increase and the usual presence of an abdominal wall rather toned up in postmenopausal women justify its measure being done under the level of the iliac crests, thus justifying its high degree of association with the $FM_{TA(L4\text{-}P)}$. Values of $FM_{TA(L4\text{-}P)} \geq 2.65$ kg appeared associated to high levels of plasma insulin, suggesting the presence of a higher total abdominal adiposity in this area.

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