# 83 - ASSOCIATION OF LEVEL OF PHYSICAL ACTIVITY, BODY MASS INDEX AND WAIST CIRCUMFERENCE IN THE POPULATION OF VALE DO SINOS, BRAZIL.

GUSTAVO WACLAWOVSKY; CÁSSIA DANIELA S. DE OLIVEIRA; GERALDINE A. DOS SANTOS; ANDRÉIA CRISTINA BULHÕES; JOÃO CARLOS JACCOTTET PICCOLI.
Centro Universitário Feevale - Novo Hamburgo, RS, Brazil.
gustavow@feevale.br

## INTRODUCTION

Recent statistical estimates show that one of every two adults in the United States is overweight or obese. This figure increased the most in the last three decades, and the prevalence of obesity in the United States increased over 50% (LEMURA, 2006).

In Brazil, overweight and low weight populations were estimated by the 2002/2003 Family Budget Program (Programa de Orçamento Familiar) and results were concerning. Analyses conducted with 95.5 million people aged 20 years or older showed that 3.8 million were low weight (4.0%) and 38.8 million were overweight (40.6%); of these, 10.5 million were classified as obese.

Body mass index (BMI), also known as the Quetelet index according to Heyward and Stolarczyk (2000), is the international standard to evaluate obesity. It is calculated by dividing weight in kilograms by the squared height in meters ($kg/m^2$). This method has also been used to assess health risks, but some studies, such as the one conducted by Carneiro (2003), showed that central obesity had a more important role in hypertension than BMI.

Despite the increase in hospitalizations due to high BMI in individuals aged 6 to 60 years (AONSO, 2002), the mortality rate due to cardiovascular diseases in people older than 60 years did not increase significantly (CABRERA et al., 2005).

In the discussion about which pathologies are caused by excessive abdominal fat or higher BMI, the Brazilian Cardiology Society called attention to the cardiovascular risks of metabolic syndrome, usually associated with the accumulation of central fat and insulin resistance (SBC, 2005). However, the cut-off points described by the World Health Organization as risk factors for the development of cardiovascular diseases have not been confirmed in studies that found lower cut-off points for the development of metabolic syndrome in Brazilian populations (BARBOSA, 2006).

All the medical complications from overweight or obesity led Balady (2003) to describe that the relation between body weight and body composition results from the caloric balance of the difference between calorie intake, which is the energy equivalent of food ingested, and caloric use, the energy equivalent of the metabolic rate at rest, of physical activity and of the thermal effect of the food. Findings also support the idea that both a physically active life style and a moderate to high cardiorespiratory capacity independently reduce the risk of several chronic diseases. Foss and Keteyian (2000), for example, found that 250,000 deaths per year in the United States are assigned to the lack of regular physical activity.

Physical activity is defined as the movement produced by the contraction of any skeletal muscle and the substantial caloric consumption, and is several times confused with physical exercise, a subclass of physical activity and different from it because it is a planned, structured and repetitive body movement to improve or maintain one or more components of physical capacity (WILMORE; COSTILL, 2001)..

Regardless of whether movement is performed due to physical activity or physical exercise, it determines energy consumption (FOSS; KETEYIAN, 2000). Wilmore and Costill (2001) define total caloric expenditure as the sum of this rate two others: the metabolic rate at rest (MRR), measured early in the morning after night fasting and 8 h sleep; and the thermal effect of food (TEF), measured as the increase in metabolic rate due to digestion, absorption, transport, metabolism and storage of the food ingested.

Therefore, the pathophysiology of obesity seems to be an imbalance of the body capacity to control weight due to chronically excessive calorie ingestion or to excessively low energy consumption. Its etiology is undoubtedly multifactorial, and results of a complex interaction between genotype and environment (LEMURA, 2006).

The development of physical health programs depends on the investigation of the multidimensional object of this study and on the evaluation of how physical activity affects the factors that determine cardiovascular health or risks.

The purpose of this study was to compare the level of physical activity with changes in patterns of abdominal obesity and BMI of people living in the area of Vale do Sinos, Brazil.

## METHODS

This study selected 978 people 18 to 80 years old in the region of Vale do Sinos, Brazil, using convenience sampling. The cities included in the study were Novo Hamburgo, Estância Velha, Dois Irmãos, Ivoty, Campo Bom and Sapiranga. Participants were contacted personally or by phone to schedule evaluations. Free transportation was provided to those who were not able to travel to the data collection place. All participants signed an informed consent term and were aware that they were free to discontinue evaluations at any time.

To evaluate BMI, participants' heights were measured to the nearest 0.1 cm using a stadiometer, and weight was measured to the nearest 100 g using a mechanical beam scale (Wellmy). The cut-off points established by the World Health Organization (WHO) were used to classify BMI: low weight = BMI < 18.5 $kg/m^2$; normal weight = BMI = 18.5 and = 24.9 $kg/m^2$; overweight = BMI = 25 and = 29.9 $kg/m^2$; grade 1 obesity = BMI = 30 and = 34.9 $kg/m^2$; grade 2 obesity = BMI = 35 and = 39.9 $kg/m^2$; and grade 3 obesity = BMI = 40 $kg/m^2$.

An anthropometric tape (Sanny) was used to measure waist circumference (WC) at the middle point between the iliac crest and the lowest rib. Waist circumference was measured at three consecutive time points, and the lowest measurement was recorded. Cut-off points were divided into two classes: class I, according to the International Diabetes Federation (IDF) = men = 94,0 cm, and women = 80 cm; and class II, according to the WHO = men = 120,0 cm, and women = 88,0 cm.

The level of physical activity (LPA) was calculated using the short version of the International Physical Activity Questionnaire (IPAQ), which classifies activity into three classes: low physical activity (LPA), moderate physical activity (MPA), and high physical activity (HPA).

A chi-square test, linear regression and the SPSS 12.0 software were used for statistical analyses, and the level of significance was set at $p<0.05$.

**RESULTS AND DISCUSSION**

Table 1 shows sample characteristics according to age, weight, height, percentage of fat, BMI and WC.

| Variable | Men | Min | Max | Women | Min | Max |
|---|---|---|---|---|---|---|
| Age | 38.3 ± 14.8 | 18 | 80 | 42.0 ± 15.3 | 18 | 81 |
| Weight | 78.0 ± 14.0 | 47.4 | 139.2 | 67.9 ± 14.0 | 42.7 | 130.2 |
| Height | 174.0 ± 7.4 | 153.2 | 196.0 | 160.7 ± 6.9 | 140.0 | 185.4 |
| % fat | 20.6 ± 7.7 | 4.0 | 40.8 | 34.1 ± 7.3 | 7.9 | 50.4 |
| BMI | 25.7 ± 4.3 | 17.0 | 45.9 | 26.4 ± 5.7 | 16.5 | 52.2 |
| WC | 88.3 ± 11.3 | 64.5 | 130.6 | 81.3 ± 12.6 | 39.5 | 132.0 |

Significant associations were found for men with HPA and WC class I ($p<0.05$); no similar correlation was found between the other classes. The same analysis did not reveal any correlation in the group of women (Table 2). This result suggests that the level of physical activity may not be a determinant factor for the loss of visceral fat in women. However, Marinho and Martins (2003) evaluated 1,047 adults aged 20 years or older and found a significant correlation between sedentary life and greater waist circumferences for both genders. They also reported that isolated hypercholesterolemia developed in women with greater abdominal circumferences, and described a 7 times or greater increase of abdominal obesity for women than for men.

Waist circumference in young and old people may be associated with aging, which may be another factor for the increase of visceral fat. Studies also describe a significant increase of abdominal circumference in young or old women when compared with men in the same age groups (SAMPAIO; FIGUEIRA, 2005).

Cut-off points to describe health risks resulting from abdominal obesity are currently under study to estimate reliable values for each population and ethnic group. The values calculated by the WHO are for the American population, and its use in the study of the Brazilian population may not be reliable. Cut-off points for waist circumference associated with metabolic disorders and cardiovascular health risks were investigated in a Brazilian study that found that 84.0 cm for women and 88.0 cm for men were the most sensitive cut-off points to detect metabolic syndrome and type II diabetes (BARBOSA et al., 2006). The establishment of an accurate cut-off point for abdominal obesity for the Brazilian population is extremely important because cardiovascular and metabolic problems resulting from metabolic syndrome are a consequence of abdominal obesity (SBC, 2005).

The analysis of the association between BMI and LPA did not reveal any correlation for men or women. This finding contradicts the suggestions of the Pan-American Health Organization (2003), which reported that low activity levels are one of the determinant factors of obesity. Moreover, no association was found between age, BMI and LPA for men or women.

Therefore, gender seems to have an important role in the development of central obesity in women, but not on BMI. Gigante, Barros and Post (1997) studied 1035 people aged 20 to 69 years to investigate the prevalence of obesity and its risk factors. Their controversial findings show that the increase in BMI is associated with age and low physical activity in women, but not in men.

Therefore, further studies should be conducted to investigate the lack of an effect of physical activity on anthropometric parameters associated with cardiovascular disease in women. One of the possible explanations for this association may be found in a study conducted with menopausal women, which reported a significant association between visceral obesity and this variable (RASKIN et al., 2000). However, the mean age of the sample studied by Raskin et al. (2000) was greater (51,7 ± 5,1) than in our study (42.02 ± 15.0). Therefore, such results may reflect the age of participants in our study, which was not controlled and whose purpose was not to investigate differences for menopausal women.

**Table 2** - Data about the correlation between level of physical activity and waist circumference.

| Gender | WC (cm) | LPA | MPA | HPA | TOTAL |
|---|---|---|---|---|---|
| M | < 94,0 | 62.30% (n=81) | 67.00% (n=75) | 84.90% (n=62)* | 69.20% (n=218) |
| | > 94,0 | 20.80% (n=27) | 21.40% (n=24) | 11.00% (n=8) | 18.70% (n=59) |
| | > 102,0 | 16.90% (n=22) | 11.60% (n=13) | 4.10% (n=3) | 12.10% (n=38) |
| F | < 80,0 | 52.20% (n=132) | 46.10% (n=125) | 43.90% (n=61) | 48.00% (n=318) |
| | > 80,0 | 19.00% (n=48) | 22.90% (n=62) | 26.60% (n=37) | 22.20% (n=147) |
| | > 88,0 | 28.90% (n=73) | 31.00% (n=84) | 29.50% (n=41) | 29.90% (n=198) |

**CONCLUSIONS**

For men, only the level of physical activity that results in the greatest energy consumption, that is, high physical activity, was associated with the decrease of abdominal fat; the same was not found for women. The LPA did not differ for different age groups and did not alone determined BMI, which may suggest that other factors, such as poor nutrition, may be responsible for the degree of abdominal obesity.

Regardless of the fact that visceral obesity is more frequently found in women, other factors, such as eating habits and low physical activity, are important factors. A healthy life style resulting from regular physical activity is, nonetheless, a powerful tool to improve physical and psychological capacities.

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**ASSOCIATION OF LEVEL OF PHYSICAL ACTIVITY, BODY MASS INDEX AND WAIST CIRCUMFERENCE IN THE POPULATION OF VALE DOS SINOS, BRAZIL.**

**ABSTRACT**

The purpose of this descriptive cross-sectional study was to correlate the level of physical activity (LPA) and body mass index (BMI) with health risks determined by waist circumference in people living in the area of Vale do Sinos, Brazil. This study enrolled 978 people 18 to 80 years old in Vale do Sinos, Brazil, using convenience sampling. The short version of the International Physical Activity Questionnaire (IPAQ) was used to assess LPA; for the calculation of BMI, weight was measured to the nearest 100 g using a beam scale (Wellmy), and height was measured to the nearest 0.1 cm using a stadiometer (Wellmy). Waist circumference was measured to the nearest 0.1 cm with an anthropometric tape (Sanny). The cut-off points for the association of waist circumference (WC) and health risk were class I, according to the International Diabetes Federation (men = 94.0 cm, and women = 80 cm), and class II, according to the WHO (men = 120.0 cm, and women = 88.0 cm). A chi-square test, linear regression and the SPSS 12.0 software were used for statistical analyses, and the level of significance was set at $p<0.05$. Significant associations were found for men with HPA and class I WC ($p<0.05$); no similar correlation was found between the other classes. The same analysis did not reveal any correlation in the group of women. The analysis of the BMI and LPA did not reveal any correlation for either gender. The same was found in the analysis of BMI and LAP with age. For men, only the level of physical activity that results in the greatest energy consumption, that is, high physical activity, had a significant association with the decrease of abdominal fat; the same was not found for women. LPA did not differ for different age groups and did not alone determine BMI, which may suggest that other factors, such as poor nutrition, may be responsible for abdominal obesity.

KEY WORDS: Body mass index. Physical activity. Abdominal fat.

**LE RAPPORT ENTRE LE NIVEAU D'ACTIVITÉ PHYSIQUE, L'INDICE DE MASSE CORPORELLE ET LA CIRCONFÉRENCE DE LA TAILLE DES HABITANTS À LA RÉGION DU VALE DOS SINOS/RS, BRÉSIL**

**RESUME**

Le but de cette étude descriptive et des données transversales est de vérifier le rapport entre le Niveau d'activité physique (NAP) et l'Indice de masse corporelle (IMC) avec les facteurs des risques de maladies montrés par la Circonférence de la taille (CT) dans les individus qui habitent à la région du Vale do Sinos/RS. L'échantillon a été composé par 978 individus, hommes et femmes, d'un groupe d'âge de 18 à 80 ans, habitants à la région du Vale do Sinos/RS. Ils ont été sélectionnés par convenance. Le Questionnaire International d'Activité Physique (QIAP) a été utilisé pour le variable de NAP, avec une version petite ; une balance et un stadiomètre, tous les deux de la marque Wellmy, de la précision de 100g et 0,1cm respectivement, ont été utilisé pour mésurer le IMC, dans la variable anthropométrique de masse corporelle globale (MCG). En ce qui concèrne à la variable anthropométrique de CT, un ruban anthropométrique de la marque Sanny, de la précision de 0,1cm a été utilisé. On a pris pour réaliser le rapport entre la circonférence de la taille et les facteurs des risques de maladies des points de césure prescrits par la Fédération Internationale du Diabète (FID) qui fixe comme Catégorie I, les hommes = 94cm et les femmes = 80cm, tandis que la OMS fixe comme Catégorie II, les hommes = 120cm et les femmes = 88cm. L'analyse statistique a été effectuée par les tests du Chi2 et de la Régression linéaire avec le programme informatique en SPSS, version 12.0, et $p < 0,05$. On a vérifié chez les hommes des rapports significatifs entre le groupe d'individus évalué comme très actif (TA) et la CT Catégorie I ($p < 0,05$), sans présenter la même corrélation entre les autres catégories. Cette analyse n'a pas présenté de la corrélation chez les femmes. On n'a pas visualisé une correlation entre tous les deux sexes lors du rapport entre le IMC et le NAP. On a conclu que seulement le NAP, chez les hommes, dans la catégorie de plus grande dépense énergétique, a un rapport significatif avec la diminuition de l'adiposité abdominale, ce que toutefois ne se produit pas chez les femmes. En outre, on peut souligner que le NAP

ne se modifie pas au cours de l'âge et il ne évalue pas isolément l'IMC. Par conséquent, on peut croire que d'autres facteurs comme une mauvaise alimentation pourrait être la responsable de l'obésité abdominale.

MOTS-CLES: Indice de masse corporelle. Activité physique. Adiposité abdominale.

**RELACIÓN ENTRE EL NIVEL DE ACTIVIDAD FÍSICA, EL ÍNDICE DE MASA CORPOREA Y LA CIRCUNFERENCIA DE LA CINTURA DE LOS HABITANTES DE LA REGIÓN DE VALE DO SINOS/RS**

**RESUMEN**

El objetivo del estudio, de abordaje descriptivo y corte transversal, fue correlacionar el Nivel de Actividad Física (NAF) y el Índice de Masa Corporal (IMC) con los modelos de riesgo a la salud determinados por la circunferencia de la cintura en individuos que habitan en el Vale do Sinos, Río Grande del Sur (RS). La muestra fue compuesta por 978 individuos de ambos los géneros, de 18 a 80 años, que residen en la región del Vale do Sinos, seleccionados por conveniencia. Para la variable NAF, se utilizó el Cuestionario Internacional de Actividad Física (IPAQ), formato corto, para el IMC en la variable antropométrica Masa Corporal Total (MCT) fue utilizada una báscula de equilibrio, de marca Wellmy con precisión de 100g, y un estadiómetro de la misma marca con precisión de 0,1 cm. En la variable antropométrica Circunferencia de la Cintura (CC) se utilizó una cinta antropométrica marca Sanny con precisión de 0,1 cm. Se adoptaron, para relación circunferencia de la cintura y riesgo a la salud, puntos de corte prescritos por la Federación Internacional de Diabetes (FID) que determina como Clase I (Hombres - 94,0 cm y Mujeres - 80 cm) y la Organización Mundial de la Salud (OMS) como Clase II (Hombres - 120,0cm y Mujeres - 88,0 cm). Para análisis estadístico se utilizaron el teste qui-cuadrado y la Regresión Linear teniendo como programa de análisis el SPSS, versión 12.0, considerando $p<0,05$. Se encontraron, en el género masculino, relaciones significativas entre los individuos clasificados como MA y CC clase I ($p<0,05$), no presentando la misma correlación entre las otras clases. El mismo análisis no demostró correlación por parte del género femenino. Cuando verificada la relación de IMC con NAF no se encontró correlación en ninguno de los géneros. Lo mismo ocurrió para IMC y NAF con la edad. Se concluye que para los hombres sólo el Nivel de Actividad Física en clase de mayor gasto energético, es decir, MA, posee fuerte relación con la disminución de la adiposidad abdominal, no siendo ello, parámetro para el género femenino. Se concluyó también, que el NAF no es diferente durante el transcurrir de la edad y no determina, aisladamente, el IMC, llevando a creer que otros factores como la mala alimentación, por ejemplo, pueda ser la responsable por el grado de obesidad abdominal.

PALABRAS CLAVE: Índice de Masa Corporal. Actividad Física. Gordura Abdominal.

**RELAÇÃO ENTRE NÍVEL DE ATIVIDADE FÍSICA, ÍNDICE DE MASSA CORPORAL E CIRCUNFERÊNCIA DA CINTURA DE MORADORES DA REGIÃO DO VALE DO SINOS - RS**

**RESUMO**

O objetivo do presente estudo, de característica descritiva de corte transversal, foi correlacionar o Nível de Atividade Física (NAF) e Índice de Massa Corporal (IMC) com padrões de riscos à saúde determinados pela circunferência da cintura em indivíduos residentes do Vale do Sinos, RS. A amostra foi composta de 978 indivíduos de ambos os gêneros, de 18 a 80 anos, residentes na região do Vale do Sinos - RS, selecionados por conveniência. Para a variável NAF, foi utilizado o Questionário Internacional de Atividade Física (IPAQ), versão curta, para o IMC na variável antropométrica Massa Corporal Total (MCT) foi utilizado uma balança de equilíbrio marca *Wellmy* com precisão de 100g e um estadiômetro da mesma marca com precisão de 0,1 cm. Na variável antropométrica circunferência da Cintura (CC) foi utilizado uma fita antropométrica marca *Sanny* com precisão de 0,1 cm. Foram adotados para relação CC e risco à saúde pontos de corte prescritos pela Federação Internacional de Diabetes (Homens = 94,0 cm e Mulheres = 80 cm) e OMS (Homens = 120,0 cm, Mulheres = 88,0 cm). Para propósito de análise, denominou-se classe I os valores prescritos pela FID e classe II os da OMS. Foi utilizado o teste estatístico Qui - quadrado e a Regressão Linear tendo como programa de análise SPSS, versão 12.0, considerando $p<0,05$, para a análise dos dados. Foram encontrados, no gênero masculino, relações significativas entre os indivíduos classificados como MA e CC classe I ($p <0,05$), não apresentando a mesma correlação entre as outras classes. A mesma análise não demonstrou correlação por parte do gênero feminino. Quando verificado a relação de IMC com NAF não foram encontrados correlação em ambos os gêneros. O mesmo se deu para IMC e NAF com a idade. Pode-se concluir que para os homens somente o Nível de Atividade Física em classe de maior gasto energético, isto é, MA, possui forte relação com a diminuição da adiposidade abdominal, não sendo este, parâmetro para o gênero feminino. Concluiu-se, também, que o NAF não difere com o transcorrer da idade e não determina isoladamente o IMC levando a acreditar que outros padrões como a má alimentação possa ser a responsável pelo grau de obesidade abdominal.

PALAVRA CHAVE: Índice de Massa Corporal. Atividade Física. Gordura Abdominal.