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http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S0212-16112012000300027

DOI: 10.3305/nh.2012.27.3.5578

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Original

Relationship between body mass index with dietary fiber intake and skinfolds-differences among bodybuilders who train during morning and nocturne period

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Abstract

Background: The prevalence of overweight individuals has increased in recent years. Moreover, the importance of a healthy diet is associated with the practice of physical activity and attempt to verify the achievement of physical exercise influences on food choice. However, it relationship between food intake and physical activity have not been studied.

Aim: To evaluate if the period in which the trainings are conducted, morning and nocturne, interfere qualitatively and quantitatively in food consumption as well as verify possible associations between anthropometric profiles and dietary habits.

Methods: We collected data from 33 adult volunteers, between men and women, practitioners of bodybuilding. **Results:** A total of 33 volunteers were interviewed (18 (54.5%) were men and 15 (45.5%) were women). Regarding anthropometric data, it turns out that that the volunteers of the two periods had similar characteristics, differentiating only weight. The consumption of nutritional supplements was observed in 30.77% of the practitioners in the morning period vs. 35% for the nocturne. Considering macronutrient intake, there was a significant difference in the consumption of protein between the periods. The consumption during nocturne period was greater (126 ± 5% of the daily requirement) than the morning period (115.7 ± 2%). As for micro-nutrients, calcium intake was greater among men when compared to women. There was a positive correlation between the BMI, and arm circumference for practitioners of the morning period.

Conclusion: This study show that the practitioners who train in the morning have quietly better eating habits than those in the nocturne period, however both are inappropriate.

(Nutr Hosp. 2012;27:929-935)

DOI:10.3305/nh.2012.27.3.5578

Key words: Food intake. Bodybuilders. Dietary fibers. Skinfolds. Body mass index.

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Recibido: 27-I-2012.

Aceptado: 5-II-2012.

RELACIÓN ENTRE EL ÍNDICE DE MASA CORPORAL CON LA INGESTA DE FIBRA DIETÉTICA Y PLIEGUES DE LA PIEL; LAS DIFERENCIAS ENTRE LOS CULTURISTAS QUE SE ENTRENAN DURANTE EL PERÍODO DE LA MAÑANA Y NOCTURNO

Resumen

Antecedentes: La prevalencia de individuos con sobrepeso ha aumentado en los últimos años. Además, la importancia de una dieta saludable se asocia con la práctica de actividad física y los intentos de lograr la realización de esta actividad influyen en la elección de la dieta. Sin embargo, la relación entre la ingesta dietética y la actividad física no se ha estudiado.

Objetivo: Evaluar si el periodo en que se realiza el entrenamiento, diurno y nocturno, interfiere cualitativa y cuantitativamente en el consumo de alimentos, así como comprobar posibles asociaciones entre los perfiles antropométricos y los hábitos dietéticos.

Métodos: Recogimos los datos de 33 adultos voluntarios, hombres y mujeres, culturistas. **Resultados:** se entrevistó a un total de 33 voluntarios (18 (54,5%) hombres y 15 (45,5%) mujeres). Con respecto a los datos antropométricos, los voluntarios de ambos periodos tenían características similares, diferenciándose sólo por el peso. El consumo de suplementos nutritivos se observó en el 30,77% de los culturistas de la mañana frente al 35% de los de la noche. Con respecto al consumo de macronutrientes, hubo una diferencia significativa en el consumo de proteínas entre ambos periodos. El consumo durante el periodo de la noche fue mayor (126 ± 5% de las necesidades diarias) que el de la mañana (115,7 ± 2%). Para los micronutrientes, el consumo de calcio fue superior entre los hombres en comparación con las mujeres. Hubo una correlación positiva entre el IMC y la circunferencia del brazo en los culturistas de la mañana.

Conclusión: Este estudio demuestra que los culturistas que se entrenan durante el día tienen hábitos dietéticos más saludables que aquellos que lo hacen por la noche, aunque en ambos son inapropiados.

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Palabras clave: Ingesta dietética. Culturistas. Fibras procedentes de la dieta. Pliegues cutáneos. Índice de masa corporal.

Introduction

The prevalence of overweight individuals has increased in recent years. This fact is mainly due to changes that have occurred, both in food and eating habits with the arrival of industrialization.¹⁻⁴

Currently, with the rush of everyday life there was an increase in the adoption of frozen industrialized products such as hamburger, meatballs, potatoes, and most of which as process of cooking, frying, which is further compounded if these foods are added to ketchup and mustard.^{1,5}

Formerly, many people worked in agricultural activities, today, for example, occupy positions in companies, where are most of the time sitting in front of the computer, as well as the moments of leisure, often happens in hours to television.⁶

The practice of physical activity is important in controlling the development of chronic-degenerative diseases, non-communicable diseases such as obesity, diabetes mellitus, cardiovascular diseases, hypertension and cancer Besides, the physical inactivity, smoking and diet are considered risk factors for cardiovascular diseases.⁷⁻¹⁰

The World Health Organization (WHO) established as beneficial to health, the practice of at least 30 minutes a day of physical activity and the adoption of a balanced diet.¹¹

Concerning people who desire to lose weight, rather than to adopt the reeducation of eating habits, mostly adheres to a diet of very low energy value losing weight quickly, but regain it in a short term. This way, take up the diet and thus follows a cycle.¹²

The relationship between nutrition and physical activity practice is great important since adequate diet improves the performance of the organism and therefore the physical fitness and quality of life.^{3,13,14}

Considering the importance of a healthy diet is associated with the practice of physical activity and attempt to verify the achievement of physical exercise influences on food choice after it, this study turns to individuals who engage in physical activity at a fitness center, in different shifts.

Thus, the purpose of this study was to evaluate if the period in which the trainings are conducted, morning and nocturne, interfere qualitatively and quantitatively in food consumption as well as verify possible associations between anthropometric profiles and dietary habits.

Methodology

Individuals and methods

The study was conducted in a fitness center located in the East zone of São Paulo city, in which there is an average population of 11,016.703 habitants.¹⁵ This study was approved by the Human Research Ethics

Committee of the University of Mogi das Cruzes (CEP/UMC).

We collected data from 33 adult volunteers, between men and women, practitioners of bodybuilding.

Anthropometric evaluation

The volunteers were subject to an assessment of anthropometric measures of height, weight, arm circumference and the skinfolds thickness such as, tricipital, suprailiac, subscapular abdominal and thigh.¹⁶⁻¹⁹

Body mass index (BMI) was calculated from the weight and height (m)² and classified according to the reference standards of the World Health Organization.²⁰

The percentage of body fat was calculated through Faulkner.²¹

Dietetic evaluation

For the analysis of food intake the 24 hours recall method was used which corresponds to a food recall referring to a day preceding the day of the interview, and consists of times that meals were held and the foods eaten. The food frequency questionnaire method corresponds to a list of foods, which show the frequency of the foods consumption, in options such as: daily, weekly and monthly and does not consume was also used.

The calculations of the nutritional supplements were performed with the aid of Nutrisurvey Software²² and the results compared to dietary recommendations.²³

Statistical analysis

Kolmogorov-Smirnov test was applied and showed that the data of this study were distributed normally. Thus, the variables were expressed by descriptive analysis (mean and standard deviation). The t-test was used to check possible differences between the training periods. Linear relationships were estimated using Pearson correlation to examine the associations of the BMI with dietary fiber intake and skinfolds. An α level of $p \leq 0.05$ was considered significant. The statistical analysis were performed by STATISTICA software, version 6.0.

Results

Anthropometric and nutritional profile among bodybuilders practitioners in the morning and nocturnal periods

A total of 33 volunteers were interviewed (18 (54.5%) were men and 15 (45.5%) were women). Of these, 13 were training in the morning period and 20 were from the nocturne period.

Table I
Anthropometric and food variables

<i>Variables</i>	<i>Morning period ME ± SD</i>	<i>Nocturne period ME ± SD</i>	<i>Test t</i>
Age (years)	33.6 ± 7.0	30.6 ± 12.5	0.043*
Body weight (kg)	72.0 ± 16.0	67.1 ± 9.6	0.044*
Body mass index (kg/m ²)	24.7 ± 3.3	23.5 ± 2.5	0.257
Abdominal skinfold (mm)	21.0 ± 7.0	20.1 ± 3.7	0.011*
Suprailiac skinfold (mm)	16.1 ± 7.4	16.5 ± 5.2	0.174
Subscapular skinfold (mm)	12.3 ± 4.1	14.3 ± 3.8	0.689
Triceps skinfold (mm)	14.5 ± 6.2	14.8 ± 5.2	0.493
Arm circumference (cm)	29.6 ± 3.9	28.0 ± 3.1	0.368
Thigh skinfold (mm)	16.3 ± 2.7	16.5 ± 5.4	0.031*
Body fat (%)	15.6 ± 3.0	16.0 ± 2.3	0.299
Lean mass (kg)	11.3 ± 3.7	10.7 ± 2.1	0.034*
Fat mass (kg)	60.7 ± 13.3	56.4 ± 8.3	0.049*
Caloric intake (kcal)	1,939.0 ± 691.2	2,072.0 ± 886.7	0.379
Carbohydrate (g)	272.0 ± 106.7	296.5 ± 147.2	0.255
Protein (g)	86.4 ± 22.6	90.5 ± 41.7	0.033*
Fat (g)	59.8 ± 31.5	61.8 ± 30.5	0.864
Fiber (g)	4.7 (1.5-53.4)	3.7 (1.2-43.1)	0.197
Vitamin A (mg)	470.5 ± 162.5	480.7 ± 305.8	0.029*
Vitamic C (mg)	569.6 (258.0-1,394.0)	404.1 (103.4-2,514.5)	0.091
Calcium (mg)	686.3 ± 397.3	531.0 ± 516.7	0.353

*test t p < 0.05 vs. morning period.

None practitioner in the morning referred the use of tobacco. At the nocturne period 2 (10%) of the practitioners reported the use of tobacco.

The ingestion of alcoholic beverage by individuals of the morning period was 30.7%, being the most consumed drink beer (75%), followed by vodka (25%) and Scotch whisky (25%), with the majority (75%) frequency of once a week, and the rest every 15 days. During nocturne period 60% of the volunteers ingested alcohol, being the beer also the most consumed (91.6%) followed by vodka (25%) and wine (16.6%). Of these, 50% consumed it once a week, (8.3%) every 15 days, 8.33% 4 times per week and the remainder, from 2 to 4 times per month.

Regarding anthropometric data, it turns out that that the volunteers of the two periods had similar characteristics, differentiating only weight, which was significantly lower for practitioners of physical activity during nocturne period (67.1 ± 9.6 kg) compared to the morning period (71.9 ± 16.0 kg) (table I).

The consumption of nutritional supplements was observed in 30.77% of the practitioners in the morning period vs. 35% for the nocturne.

Of assessed, 55% of men and only 6% of women consumed nutritional supplements. The supplements most consumed by men were creatine (33.3%), Animal Pack (Proteic supplement) 11.1%, Whey protein and Branched Chain Amino Acids (BCAA) 5.5%. And only

one woman (6.6%) referred consumption of nutritional supplement, and this was the Conjugated Linoleic Acids.

It was observed an increase in the caloric (105 ± 25.9) and protein intake (20.3 ± 6.3 g) of the practitioners that ingested whey protein and animal pack. Although this fact approximates the caloric intake to the energy requirements, it can aggravate the dietary protein levels.

Most men (54.5%), ingested proteins on their own, followed by an indication of physical educator (36.3%).

Food frequency among bodybuilder's practitioners in accordance to training period

Regarding caloric intake, the practitioners of both periods had consumption lower than the recommendation (table I).

Considering macronutrient intake, there was a significant difference in the consumption of protein between the periods. The consumption during nocturne period was greater (126 ± 5% of the daily requirement) than the morning period (115.7 ± 2%).

As for micro-nutrients, calcium intake was greater among men (65.6 ± 58.3% of the daily recommendation) when compared to women (29.6% of 50.4 ± daily recommendation).

Table II
Food frequency of food groups in accordance to training period

<i>Foods</i>	<i>Daily (%)</i>	<i>Weekly (%)</i>	<i>Monthly (%)</i>	<i>Never (%)</i>
<i>Dairy products</i>				
(M)	76.9	15.3	7.6	7.6
(N)	55.0	10.0	10.0	25.0
<i>Yellow cheese</i>				
(M)	15.3	46.1	23.0	15.3
(N)	10.0	40.0	35.0	15.0
<i>White cheese</i>				
(M)	0.0	30.7	61.5	7.6
(N)	5.0	25.0	25.0	45.0
<i>Fried food</i>				
(M)	0.0	15.3	30.7	53.8
(N)	10.0	45.0	20.0	25.0
<i>Bean</i>				
(M)	69.2	7.6	7.6	15.3
(N)	80.0	20.0	0.0	0.0
<i>Red meat</i>				
(M)	15.3	84.6	0.0	0.0
(N)	40.0	50.0	5.0	5.0
<i>Lard meat</i>				
(M)	0.0	15.3	53.8	30.7
(N)	0.0	5.0	50.0	45.0
<i>Chicken meat</i>				
(M)	7.6	92.3	0.0	0.0
(N)	35.0	65.0	0.0	0.0
<i>Fish meat</i>				
(M)	0.0	30.7	46.1	23.0
(N)	0.0	50.0	15.0	35.0

M: Morning; N: Nocturne.

Regarding food choices, the bodybuilders practitioners of the nocturne period, reported a daily (10%) and weekly (45%) fried food intake higher than the participants in the morning period (0% and 15.3%, respectively). The daily consumption of milk in the morning period was higher (76.9%) in comparison with the nocturnal (55%). The frequency intake of yellow cheese was also greater in the practitioners in the morning period (15.3% daily, and 46.1% weekly) than the nocturne (10% and 40%, respectively). The percentage of participants who do not consume white cheese was lower in the morning (7.6%) than in the nocturne (45%) (table II).

Moreover, the daily consumption of beef was higher during nocturne period (40%) vs. 15.3% in the morning (table II). There was an increased daily (80%) and weekly (20%) consumption of beans during nocturne period when compared to the morning (69.2% and 7.6%, respectively).

Correlations of body mass index with dietary fiber intake and others anthropometric indicators between bodybuilder's practitioners who training during the morning and nocturne period are shown in figure 1.

There was a positive correlation between the BMI, and arm circumference for practitioners of the morning period. Similarly was correlation between BMI and iliac crest and biceps skinfolds (fig. 1). A positive correlation between the BMI and subscapular, abdominal, and iliac crest skinfolds was also observed in the bodybuilders of the nocturne period (fig. 2).

There was no significant difference in fiber intake between the morning and nocturnal periods. The consumption was below of the daily requirements (from 15 to 30 g) in both periods (9 g in the morning and, 8.8 g in the nocturne period).

However, it was found in the practitioners of the morning period an inverse correlation between fibers and BMI. As for the nocturne period there was no significant correlation between fiber intake and BMI (figs. 1 and 2).

Discussion

In the present study we compared the food consumption of bodybuilder's practitioners who training in the morning and nocturne periods, as well as, verify the

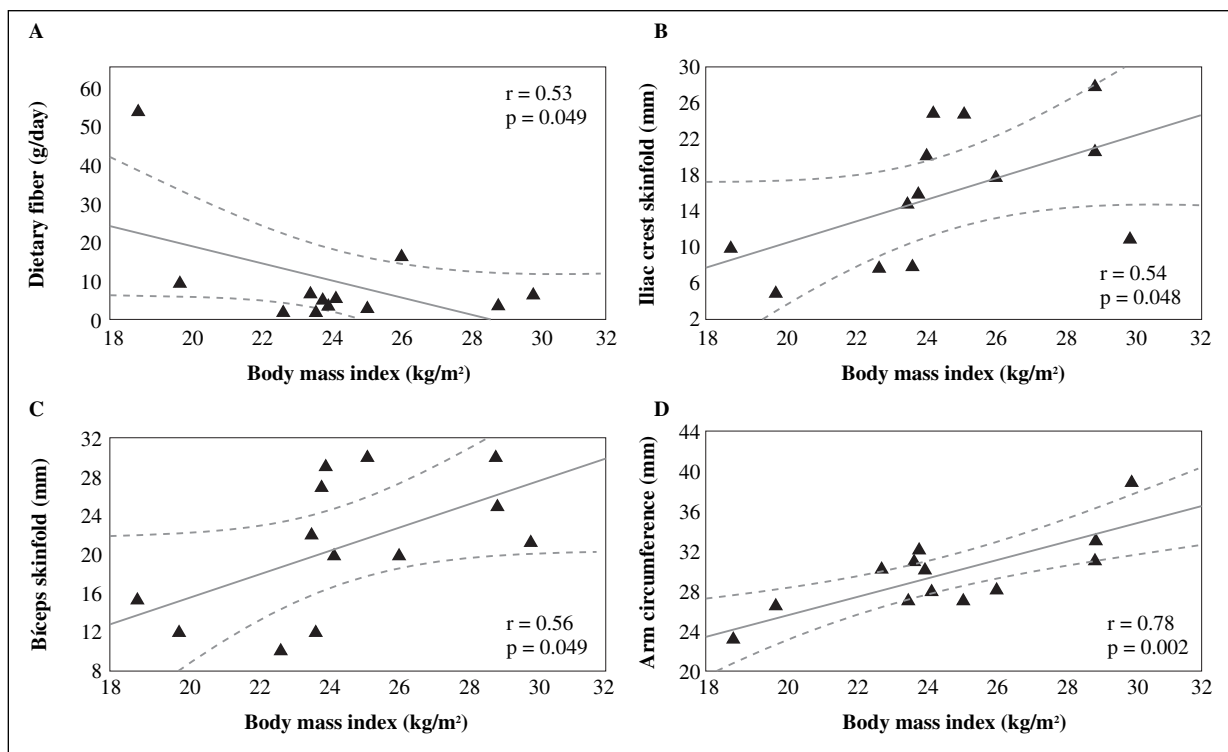


Fig. 1.—Correlations of body mass index with dietary fiber intake (A), iliac crest (B) and biceps skinfold (C) and arm circumference (D) between individuals who training during the morning period. $p < 0.05$ was considered as significant.

associations between anthropometric profile and dietary habits.

The food consumption among the practitioners did not achieve the carbohydrate daily requirements in both periods; as well as between the sexes ($72.8 \pm 27\%$, morning; $82.0 \pm 38\%$, nocturne; $81.7 \pm 37\%$, male; $75.0 \pm 30\%$, female). According to Sousa & Tirapegui this is also observed among professional athletes.²⁴

Sousa & Tirapegui²⁴ have shown that male and female athletes of various sports had carbohydrate consumption below the nutritional requirements, which can be a reflection about the food taboo that carbohydrate intake increases the body weight and fat mass.

According to Panza et al.,²⁵ due to the influence of the media, it creates an exaggerated fear of becoming fat, which can result in eating disorders among athletes which justifies this low intake of carbohydrate.

In this study the male bodybuilder's practitioners have shown an excessive consumption of proteins through diet, as well as, a high consumption of dietary supplements with the intention to increase muscle mass. In the study of Araújo & Soares²⁶ with practitioners of a fitness center of Belém, Pará State, Brazil was also found differences in consumption of supplements, being higher in men (42%) than women (23%). In the present study, we found that the most supplements reported by the practitioners were whey protein, BCAA, Animal Pack and creatine. Similar findings

was observed in the study of Sabino, Luz & Carvalho²⁷ with bodybuilders of Rio de Janeiro. These protein supplements increase the amounts of protein to the diet that has already hyperproteinic.

The consumption of protein must be 1.0 g/kg body weight/day, there is no need for an additional consumption, being valid an extra consumption of 1.6 to 1.7 g/kg body weight/day just for strength athletes.^{24,25}

According to energy intake, the quantity consumed was below of requirements for both men and women. Although the requirement are different for both genders, the quantity consumed did not compose large difference, for e.g. $1,716.2 \pm 634.5$ kcal for female, and $2,272.3 \pm 862.4$ kcal for male. Likewise, de Sousa et al.²⁸ related that an inadequate intake of nutrients contributes to the decrease in performance during exercise.

Regarding to micronutrients intake, we found low calcium consumption. It is of great relevance, since this mineral is of paramount importance to maintain bone mineral density and prevent osteoporosis.²⁹ In both periods calcium intake was below of recommendation, but the practitioners of the morning period presented greater consumption probably due to the higher calcium source frequency intake, such as milk and cheese.

The nocturne period presented greater intake of iron, which can be justified by higher consumption of beef, in comparison with the morning period.

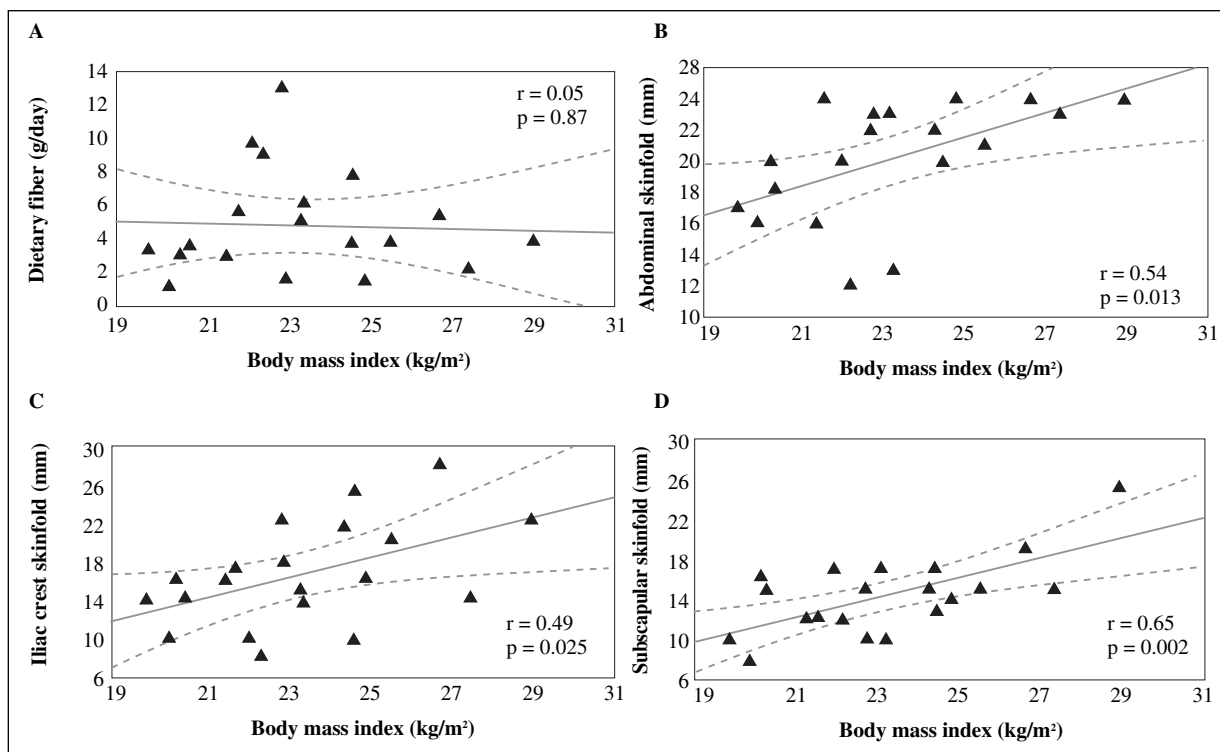


Fig. 2.— Correlations of body mass index with dietary fiber intake (A), abdominal circumference (B), iliac crest (C) and subscapular skinfold (D) between individuals who training during the nocturne period. $p < 0.05$ was considered as significant.

The low consumption of fiber in the two periods is also worrying, the fibers are important to improve the intestinal transit and according to Ramos³⁰ study the inclusion of fiber in the diet is beneficial to reduce the low-density lipoprotein (LDL), and frequently is associated with weight loss in patients with hypercholesterolemia and obesity.³¹

There is a significant difference in the quality of food choices between different shifts would be interesting to indicate a specific time for physical activity for people who want to lose weight and/or maintain a healthy lifestyle. However, according to this study, although the bodybuilders practitioners in the morning presented a more satisfactory food habit than to the nocturne period, both are inadequate, which leads to believe that it would be necessary to conduct a long-term nutritional intervention with the practitioners of both periods.

The positive correlation between the arm circumference, and suprailiac and triceps skinfold, with the BMI for the practitioners of the morning period (fig. 1), as well as the positive correlation between BMI and abdominal, suprailiac, and subscapular skinfold for the practitioners of the nocturne period (fig. 2), indicate that the increase in BMI is not related to the elevation of muscle mass, but of adipose tissue, which reinforces the previous statement, which reinforces the need for nutritional intervention to these practitioners. The greater correlation between BMI and abdominal and suprailiac skinfolds of the

nocturne period, may be related with the highest percentage in the consumption of fried food and beef when compared to the practitioners who train in the morning. These foods rich in fats and adoption of consumption of hyperlipidic diets rich in saturated, trans and omega 6 fatty acids may contribute to increase body fat in the same way that increases the risk of developing of obesity and cardiovascular diseases.^{4,9,32}

In the present study, we shown inadequate intake of fibers among the participants of both periods of training. In this like, the low fiber dietary intake may enhance the risk of developing cardiovascular diseases, considering the increase in abdominal fat percentage and inflammatory process.^{3,14,33,34}

In summary, this study show that the practitioners who train in the morning have quietly better eating habits than those in the nocturne period, however both are inappropriate. Similarly behavior was observed when analyzed the genders. This finding indicates the great importance of the presence of nutritionists in fitness centers improving the quality of life and the physical performance of the sportspeople.

Although the bodybuilders practitioners who train in the morning have demonstrated better eating habits than the nocturne period, larger studies are needed to prove the existence or not of the relationship between healthier dietary choices and the practice of physical activity in morning period.

References

1. Mendonça CP, Anjos LA. Aspectos das práticas alimentares e da atividade física como determinantes do crescimento do sobrepeso/obesidade no Brasil. *Cad Saúde Pública* 2004; 20 (3): 689-709.
2. Pimentel GD, Mota JF, Oyama LM. Oxintomodulina e obesidade. *Rev Nutr* 2009; 22 (5): 727-37.
3. Pimentel GD, Arimura ST, de Moura BM, Silva ME, de Sousa MV. Short-term nutritional counseling reduces body mass index, waist circumference, triceps skinfold and triglycerides in women with metabolic syndrome. *Diabetol Metab Syndr* 2010; 10; 2: 13.
4. Pimentel GD, Lira FS, Rosa JC, Oliveira JL, Losinskas-Hachul AC, Souza GI et al. Intake of trans fatty acids during gestation and lactation leads to hypothalamic inflammation via TLR4/NF Bp65 signaling in adult offspring. *J Nutr Biochem* 2011; 23(3):265-71.
5. Pimentel GD, Zemdegs JC. Foods and nutrients modulates the release of anorexigenic gastrointestinal hormones. *Acta Med Port* 2010; 23 (5): 891-900.
6. Wanderley EN, Ferreira VA. Obesidade: uma perspectiva plural. *Ciênc Saúde Col* 2010; 15 (1): 185-94.
7. Sigal RJ, Kenny GP, Wasserman DH, Castaneda-Sceppa C, White RD. Physical Activity/Exercise and Type 2 Diabetes: A consensus statement from the American Diabetes Association. *Diabetes Care* 2006; 29 (6): 1433-8.
8. Lira FS, Rosa JC, Pimentel GD, Souza HA, Caperuto EC, Carnevali LC Jr et al. Endotoxin levels correlate positively with a sedentary lifestyle and negatively with highly trained subjects. *Lipids Health Dis* 2010; 4 (9): 82.
9. Zemdegs JCS, Corsi LB, Coelho LC, Pimentel GD, Hirai AT, Sachs A. Lipid profile and cardiovascular risk factors among first-year Brazilian university students in São Paulo. *Nutr Hosp* 2011; 26 (3): 553-9.
10. Lira FS, Yamashita AS, Rosa JC, Tavares FL, Caperuto E, Carnevali Jr LC et al. Hypothalamic inflammation is reversed by endurance training in anorectic-cachectic rats. *Nutr Metab (Lond)* 2011; 8 (1): 60.
11. Ministério da Saúde: Programa Nacional de Promoção da Atividade Física "Agita Brasil": Atividade física e sua contribuição para a qualidade de vida. *Rev Saúde Pública* 2002; 36 (2): 254-6.
12. Bernardi F, Cichelero C, Vitolo MR. Comportamento de restrição alimentar e obesidade. *Rev Nutr* 2005; 18 (1): 85-93.
13. American Canadian Association Dietitians of Canada. Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance. *J Am Diet Assoc* 2009; 109 (3): 509-27.
14. Pimentel GD, Portero-McLellan KC, Oliveira EP, Spada AP, Oshiiwa M, Zemdegs JC et al. Long-term nutrition education reduces several risk factors for type 2 diabetes mellitus in Brazilians with impaired glucose tolerance. *Nutr Res* 2010; 30 (3): 186-90.
15. Instituto Brasileiro de Geografia e Estatística. Disponível em: <<http://www.ibge.gov.br/cidadesat/default.php>> Acesso em: 20 abr. 2007.
16. Frisancho AR. Anthropometric standards for the assessment of growth and nutritional status. ed. United States of America: The University of Michigan Press, 1990; 189.
17. Callaway CW, Chumlea WC, Bouchard C, Himes JH, Lohman TG, Martin AD, et al. Circunferências. In: Lohman TG, Roche AF, Martorell R. Anthropometric standardizations reference manual. Champaign, IL: Human Kinetics 1998; 39-53.
18. Harrison GG, Buskirk ER, Lindsay CJE, Johnston FE, Lohman TG, Pollock ML et al. Skinfold Thicknesses and measurement technique. In: Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, H. Human Kinetics 1998; 55-70.
19. Jackson AS, Pollock ML. Generalized equations for predicting body density of men. *Br J Nutr* 1978; 40 (3): 497-504.
20. World Health Organization (WHO): Obesity: preventing and managing the global epidemic. In: Report of the WHO Consultation on Obesity. Geneva: World Health Organization; 1998.
21. Faulkner JA. Physiology of swimming and diving. Baltimore: Academic Press 1968; 415-46.
22. Software Nutrisurvey. Disponível em: www.nutrisurvey.de. Acesso em: 10 ago. 2007.
23. Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. Washington (DC): National Academy Press; 2005.
24. Sousa MV, Tirapegui J. Os atletas atingem as necessidades nutricionais de carboidratos em suas dietas? *Nutrire* 2005; 29 (1): 121-40.
25. Panza VP, Coelho MSPH. Consumo alimentar de atletas: reflexões sobre recomendações nutricionais, hábitos alimentares e métodos para avaliação do gasto e consumo energéticos. *Rev Nutr* 2007; 20 (6): 681-92.
26. Araújo ACM, Soares YNG. Perfil de utilização de repositores protéicos nas academias de Belém, Pará. *Rev Nutr* 1999; 12 (1): 5-19.
27. Sabino C, Luz MT, Carvalho MC. O fim da comida: suplementação alimentar e alimentação entre frequentadores assíduos de academias de musculação e fitness do Rio de Janeiro. *Hist Ciênc Saúde-manguinhos* 2010; 17 (2): 343-56.
28. De Sousa MV, Madsen K, Simões HG, Pereira RM, Negrão CE, Mendonça RZ et al. Effects of carbohydrate supplementation on competitive runners undergoing overload training followed by a session of intermittent exercise. *Eur J Appl Physiol* 2010; 109 (3): 507-16.
29. Meier C, Kraenzlin ME. Calcium supplementation, osteoporosis and cardiovascular disease. *Swiss Medical Weekly* 2011; 141: w13260.
30. Ramos SC, Fonseca FA, Kasma SH, Moreira FT, Helfenstein T, Borges NC et al. The role of soluble fiber intake in patients under highly effective lipid-lowering therapy. *Nutr J* 2011; 10: 80.
31. (Food Guide of the Brazilian population, Ministry of health, 2005).
32. Pimentel GD, Dornellas AP, Rosa JC, Lira FS, Cunha CA, Bolarine VT, et al. High-fat diets rich in soy or fish oil distinctly alter hypothalamic insulin signaling in rats. *J Nutr Biochem* 2011; 23(3):265-71.
33. Pimentel GD, Zemdegs JC, Theodoro JA, Mota JF. Does long-term coffee intake reduce type 2 diabetes mellitus risk? *Diabetol Metab Syndr* 2009; 1 (1): 6.
34. Keast DR, O'Neil CE, Jones JM. Dried fruit consumption is associated with improved diet quality and reduced obesity in US adults: National Health and Nutrition Examination Survey, 1999-2004. *Nutr Res* 2011; 31 (6): 460-7.