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ORIGINAL ARTICLE

COST OF TREATMENT AND RISK FACTORS IN DIABETIC PATIENTS, ACCORDING TO THERAPEUTIC OUTLINE

CUSTO COM TRATAMENTO E INDICADORES DE RISCO EM PACIENTES DIABÉTICOS, SEGUNDO ESQUEMA TERAPÊUTICO

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ABSTRACT
Objective: To evaluate, according to a therapeutic outline, the cost of treatment and health indicators. **Methods:** We studied 121 diabetic patients (49 male and 72 female; 60+8 years of age). The therapeutic scheme consisted of the use of medications, physical exercise and diet. Medical costs were converted into monetary value (Reais). In addition it was analyzed: blood pressure, body composition and coronary risk. Statistical analysis was performed by the χ^2 test, Student's t test and ANOVA. **Results:** Group *Exercise/Medications* showed less expenditure on general practitioner and lower blood pressure; *Diet/Medication* Group (DMG) showed lower costs with medical specialists and lower index for body mass index and coronary risk. **Conclusion:** Observance to appropriate therapeutic outline may be determinant for indicators of risk and cost.
Keywords: Therapeutic. Health Investment. Diabetes Mellitus.

INTRODUCTION

The *diabetes mellitus* (DM) represents a group of dysfunctions characterized by chronic hyperglycemia and other metabolic abnormalities, as, for instance, deficiency in the use of insulin (KUZUYA et al., 2002). In the last 40 years, the incidence of DM and the expenses with its treatment have been increasing in an alarming way in different population groups (WANG; DIETZ, 2000; ANDERSON, 2002; CHENOWETH; LEUTZINGER, 2006). The International Federation of Diabetes (2003; 2008) estimates that, worldwide, 194 million individuals (5.1% of the whole adult population) might have the disease and that the number will reach 333 million (6.3% of the adults) in 2025, and that in 2008 the global expenses with treatment and prevention of the disease and its complications summed 232 billion dollars in 2007.

In Brazil, according to information supplied by the Basic Health System - SUS (BRAZIL, 2004), 7.6% of the entire Brazilian population and 19.7% of the population from São Paulo between 30 and 69 years of age have the disease. SICHIERI et al. (2007), analyzing the database of SUS identified that, in 2001, approximately US$ 10 million were directed to the treatment of DM in the country.

The therapeutic outline used for treatment of the disease, according to the Brazilian Society of Diabetes (2007), should be accomplished initially with nonmedicative interventions, such as the habitual practice of physical activities and diet. The medical resources should be used to control the glycemic levels when the nonmedicative treatment shows to be inefficient.

The literature points lack of information concerning the health benefits of each one of those therapeutic programs. Thus, the objective of the present study was to evaluate,

according to therapeutic program adopted by the patients with type 2 diabetes mellitus (DM2): (i) the expenses with the treatment and (ii) indicators of health.

METHODS

Casuistry

The study, of descriptive character, was accomplished in Bauru - SP. The 121 appraised patients were registered in two s of the city and they were appraised after screening accomplished by the respective nurses, who analyzed the medical records and the patient's availability to participate in the data collection. The inclusion criteria adopted were: (i) to be patient diagnosed with type DM2; (ii) to have medical records for at least one previous year in the basic health unit (UBS); (iii) to sign the consent term (Committee of Ethics in Research of the Institute of Bioscience of UNESP of Rio Claro; process number: 6898-2008).

Therapeutic outline

In the present work it was sought to evaluate if the patients made use of medicamentous treatment, if they were going on a diet, and/or if they performed physical activities. Thus, the therapeutic outline was characterized: (i) by the use of medication, (ii) by the practice of physical activity and (iii) by the engagement in food recommendations.

By the analysis of the medical records it could be verified that all the subjects made use of medication. For the evaluation of patients submitted to the diet, it was determined if they had followed some type of specific feeding for control of the glycemia (prescribed by doctor or nutritionist). The habitual practice of physical activities was assessed by the questionnaire of Baecke et al. (1982), filled out through interview. That questionnaire contained 16 questions, distributed in three different domains: 1) - work; 2) - sports and occupation on leisure time; and 3) –locomotion. Each answer for the 16 questions possesses a no dimensioned score, which, at the end was added to compute the physical activity in each domain. For that analysis the total score was used (sum of the three types of physical activity) that represents the habitual physical activity. In a previous methodology (GUEDES et al., 2006), the total score was stratified in quartile (Quartile 1 = score < 5.25; Quartile 2 = score > 5.25 and < 6.25; Quartile 3 = score > 6.25 and ≤ 7.25; Quartile 4 = score > 7.25). For the present study it was considered as sufficiently active just the patients that were in the 4th quartile of physical activity (score > 7.25 [n = 32]).

In that way, to analyze the differences among the therapeutic outlines, the sample was subdivided in four groups: 1) medication (GM); 2) diet + medication (GDM); 3) - exercise + medication (GEM); and 4) - diet + exercise + medication (GDEM).

Risk indicators

The resistance and the body reactance (in SZ) were used to obtain the body composition, measured with the use of a portable analyzer (BIA Analyzer -101Q, RJL Systems, Detroit, USA). The used protocol was proposed by Heyward and Stolarczyk (2000), and the percentile of body fat (%GC-BIA) was calculated by the use of two equations specifically for genre, elaborated by Sun et al. (2003). The score of coronary risk was obtained through the questionnaire developed by the American Heart Association (2003), which takes into consideration different indicators - such as age, sex, smoking, weight excess, physical inactivity, the family history of heart disease and the last glycemia, cholesterol and arterial hypertension exams -, and, at the end, it sums the values found for each considered variable: the larger the final score, the greater is the coronary risk. The values of the waist-to-hip ratio (WHR) were also used as indicators of coronary risk and they were collected according to the protocol proposed by Lohman et al. (1988). The body mass index (BMI

[kg/m^2]) was used as indicator of nutritional condition. The existence of overweight (BMI 25-29.9 kg/m^2) and obesity (BMI >30 kg/m^2) was defined with the use of BMI (WORLD HEALTH ORGANIZATION, 2000). The cut-off scores used to indicate high values of WHR they were extracted from Pereira's et al study (1999). The measurement of the systolic blood pressure (SBP) and diastolic blood pressure (DBP) at rest was accomplished according to the protocol of V Brazilian Guideline of Arterial Hypertension (2007), and it was also calculated the mean blood pressure (MBP) of the patients. Finally, the presence of the arterial hypertension was defined by values of SBP >140 mmHg and/or DBP >90 mmHg.

Procedures of analysis of the health costs

To estimate the costs with the treatment of DM2, the total expenses of the BHU (TC-BHU) with each patient was assessed through the services that were registered in the medical records. It was sought to obtain the following information: medication supplied by the BHUs, lab exams accomplished (most requested: glycemia; glycosylated hemoglobin; creatinine; urine I; uric acid; potassium; triglycerides, cholesterol, low and high density lipoprotein; thyroid-stimulating hormone; creatine kinase) and the number of consultations, one year prior to the date of the evaluation. To transform the procedures in currency, the SUS table was used for the values of the lab exams and for the doctor's fee. Receipts obtained in the BHUs were used to compute the values of the medication. A previous study accomplished in the same city was also used as a reference for values of doctor's appointments (general practitioner), nursing visit and nutritionist's consultation (ROLIM; AMARAL; MONTEIRO, 2007). The cost indicators were subdivided into seven categories: 1 - Exams, 2 - Medication (2.1 for DM2 and 2.2 for other diseases), 3 – General Practitioner, 4 - Specialist (gynecologist not included), 5 - Gynecologist, 6 - Nutritionist and 7 - Total Expense.

Additionally, the total amount pointed by the indicators was ranked and stratified in quartile, to indicate "high cost" (for there is no cut-off not in the literature).

Statistical analysis

The descriptive statistics was composed of mean values, standard deviation and mean standard error. The variance analysis (ANOVA one way [test post hoc of Tukey]) and the test t of Student compared mean values. The Chi square test was used to analyze the existence of associations among the categorical variables. In all the analyses the adopted percentile was 5% of significance and the procedures were accomplished in the software SPSS 13.0.

RESULTS

Data from 121 diabetics type 2 individuals of both genre was analyzed (49 men [40.4%] and 72 women [59.6%]), average 60±8 years old (from 32 to 75 years). When the medical records were analyzed, it was observed that only 31.4% (n=38) presented controlled glycemia (<126 mg/dL) and 36.4% (n = 44) use insulin. There was no significant association of the therapeutic outline with the glycemic control ($p = 0.620$) or insulin use ($p = 0.620$).

When analyzed the expenses in currency (real), considered the formed groups, there were no mean difference for: exams, medication (either for those destined to the treatment of DM2 or to the treatment of other diseases), nutritionist, nursing, gynecologist and total expenses. The results for general physician indicated that the GEM group (average ± standard error: 8.2±1.8) it introduced minor total expense when compared to the GDM group (average ± standard error: 17.5±1.5). In the same way, when analyzed the values referring to costs with specialist doctors, the groups GDM (average ± standard error: 0.24±0.2) and GDEM did not

present expenses or they presented the smallest values when compared to the group GM (average ± standard error: 2.08±0.5).

Table 1 presents, according to the therapeutic outline, the percentile values of the individuals positioned in the highest quartile for each cost variable. There were significant differences only for the cost with medication destined to the treatment of other diseases not DM2 (p = 0.048), in which the group GEM presented the smallest proportion and the groups GM and GDM, the largest.

Table 1 - Percentile values of the individuals positioned in the highest quartile for each cost variable according to the therapeutic outline (test Chi-square) - Bauru - 2009

	Therapeutic outline				
Health procedures (reais R$)	GM (n=48)	GDM (n=41)	GEM (n=13)	GEDM (n=19)	P
Exams	27.1%	31,7%	7.7%	15.8%	0.184
Medicatiom	18.8%	34.1%	7.7%	31.6%	0.521
For DM2	18.8%	34.1%	15.4%	31.6%	0.521
For other diseases	29.2%	31.7%	7.7%	10.5%	0.048
General physician	18.8%	39.0%	7.7%	21.1%	0.883
Nutritionist	27.1%	31.7%	7.7%	15.8%	0.170
Nursing	20.8%	39.0%	15.4%	42.1%	0.250
Specialist	27.1%	31.7%	0.0%	15.8%	0.200
Gynecologist	18.8%	39.0%	15.4%	21.1%	0.882
Total	18.8%	34.1%	15.4%	31.6%	0.521

DM2 = diabetes mellitus type 2; GM = Medication; GDM = Diet+ Medication; GEM = Exercise+Medication; GDEM = Diet+Exercise+ Medication.

Table 2 established comparisons among the mean values of different risk indicators in agreement with the adopted therapeutic outline. The results evidenced that the group that makes use of medication+diet (GDM), when compared to the group that makes use of medication alone (GM), presented values of BMI and coronary risk 10.2% and 12.8% lower, respectively. When the MBP was analyzed, the individuals that make use of medication, diet and physical exercise (GEDM) presented a rate 8.4% lower than the ones that just make use of medication (GM).

The presence of excess of weight/obesity was identified in 81.8% of the individuals, and high values of WHR in 86.8% of them. On the other hand, there was no significant association between therapeutic outline and excess of weight/obesity (p = 0.509) or high values of WHR (p = 0.921).

Table 2 - Average and standard deviation of risk indicators according to the therapeutic outline and respective results in the variance analysis (ANOVA one way) - Bauru – 2009.

	Therapeutic Outline				
	GM (n=48)	GDM (n=41)	GEM (n=13)	GEDM (n=19)	P
BMI (kg/m^2)	32.2±6.8	28.9±6.7$^{(A)}$	30.2±4.6	30.3±5.6	0.048
WM (cm)	102.7±13.7	99.4±14	98.6±12	100±11	0.627
WHR (m)	0.94±0.07	0.95±0.07	0.96±0.10	0.95±0.07	0.939
%GC-BIA	37.3±10	33.7±10	37.6±7.6	33.6±10	0.262
Coronary Risk	31.2±5.5	27.7±6.3$^{(A)}$	28.6±5.1	28.4±5.1	0.030
SBP (mmHg)	145.4±22.6	137.3±20.6	143.1±26	131.5±20	0.096
DBP (mmHg)	89.7±11.9	86.8±12.3	87.6±11.6	83.1±10.5	0.220
ABP (mmHg)	108.3±14	103.6±14	106.1±15	99.2±12 (A)	0.049

GM= medication group; GDM= Medication+Diet; GEM= Medication+Exercíse; GDEM= Medication+Exercise+Diet; (A)= Differ from GM; BMI= body mass index; WM= Waist measurement; WHR= waist-to-hip ratio; SBP=Systolic blood pressure; DBP= dyastolic blood pressure; ABP= average blood pressure.

Figure 1 presents the association between the therapeutic outline and the occurrence of arterial hypertension. Although the occurrence of arterial hypertension has been high in all groups (total prevalence of 67.8%), it was observed that the group GM presented the higher occurrence of the event and that the group GEDM presented the lower (p = 0.008).

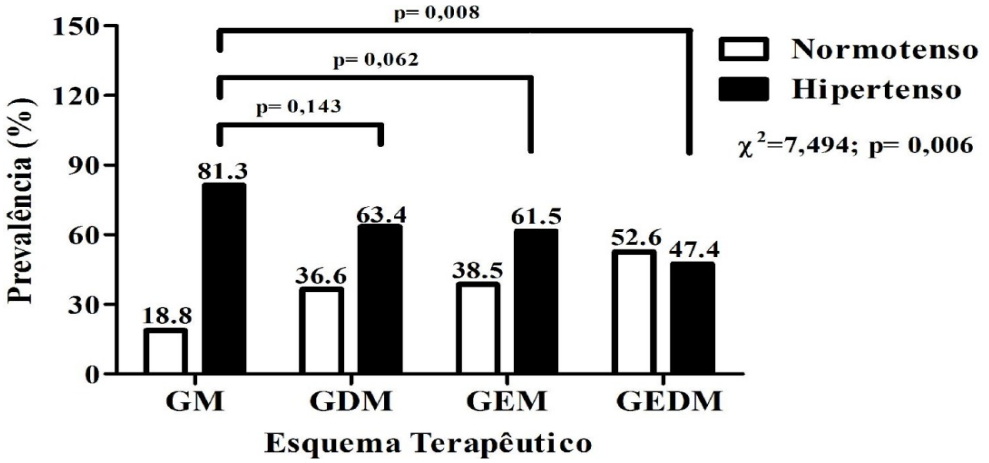

Figure 1 - Association between the therapeutic outline and the occurrence of arterial hypertension (chi-square test) - Bauru-SP - 2009.
GM= Medication; GDM= Medication+Diet; GEM= Medication+Exercíse; GDEM= Medication+Exercise+Diet

DISCUSSION

A research accomplished in the South of Brazil (ASSUNÇÃO et al.. 2001) evaluated patients from the basic health care system and it verified that 75% of the individuals said to have received diet prescription, physical exercise and medication, while 26.4% were making use of the medication. Among those patients, 41% had their glycemia under control. The results of our study are not in agreement with those above mentioned, therefore 15.7% of the assessed diabetic individuals made use of diet, physical exercise and medication and all of them were under medication. Besides. only 31% of the interviewees in our study presented controlled glycemia. In a general way, independently of the adopted outline, these information evidence that the patients' glycemic control assisted in the public health services presents low effectiveness.

In the present research all the interviewees make use of medication; however there are evidences that the medicamentous control of the glycemia in the patients with DM2, in spite

of reducing substantially the risk of microvascular complications, it does not reduce the risk of macrovascular diseases (UNITED KIGDOM PROSPECTIVE DIABETES STUDY GROUP. 1998), showing that the medicamentous treatment is insufficient and evidencing the importance of combinations involving diet and exercise.

In what refers to the use of medication and the practice of physical activity, the only publication found in the literature related to the Brazilian trial observes that sedentary individuals consume more medication than those physically active, and that this effect is maintained among diabetics and hypertensive individuals (BERTOLDI et al.. 2006); furthermore, no references were found regarding the reduction of the cost in other health services other than the use of medication. In the same line, Di Loreto et al. (2005) analyzed the impact of the energetic demand from the practice of physical activities in the diabetes type 2, and, after two years of follow-up they observed that the expense per person with medication had decreased significantly. Our results agree partially with those ones, once, when analyzed the expenses according to the therapeutic outline, GEM presented the smallest values for general physician and medication for the treatment of other diseases rather than DM2. Furthermore, the group of patients that only makes use of the diet and medication (GDM), in spite of having presented the smallest expense value with specialist doctors it also presented, although without significance, the largest number of variables with the largest cost values. This shows that the patients who practice physical activity present greater economy in the treatment of the disease. If analyzed separately the total cost of the groups GM (R$ 248.40) and GEM (R$ 176.20), it is noticed that the ones that opt for physical exercise they cost, on average, R$ 72.00 less than those just submitted to the medicamentous treatment.

In our study a high occurrence of arterial hypertension was identified. However, this pattern was expected, once the pathological scenario of DM2 and arterial hypertension is strongly linked, for the fact that both are associated to less release of vasodilator substances in the blood vessels and subsequent endothelial dysfunction (ZANESCO; ANTUNES, 2007; TOUSOULIS et al.., 2008). When we analyze the indicators of health according to the therapeutic outline, it is observed that the group of patients that practice physical activities and make use of diet (GEDM) presented the lowest values for ABP, and less occurrence of arterial hypertension. In fact, the higher practice of physical activity has been associated to greater release of vasodilator substances and better integrity of the cellular endothelium. Furthermore, it activates the antioxidant systems and, thus, it reduces the oxidative stress, which is frequent in DM2 and it is associated to damages in the cellular endothelium (ZAGO; ZANESCO, 2006; ZANESCO; ANTUNES, 2007). Also, in well-guided diets it is also possible to introduce food with antioxidant agents (TOUSOULIS et al., 2008). Corroborating our findings, the association of diet with physical activity has been adopted by different health organizations, as a front line in the treatment of pathologies such as the arterial hypertension and DM2.

Diet, when associated to physical activities, has been indicated as an important agent in the reduction and maintenance of the body weight (DONNELLY. 2009). In our study, the group that only makes use of diet presented the smallest values of BMI and cardiovascular risk. However, all groups presented high values of BMI. This result can indicate that the diet might have been a palliative measure in the case of patient’s excessive weight. On the other hand, the patients' group that only uses medication (GM) it presented the worst values for six out of eight risk indicators analyzed. Thus, it is evidenced that non pharmacological agents, even if in an isolated way, they are also important in the control of the disease in diabetic patients.

It would be expected from the GEDM, for making use of a larger range of resources to treat the pathology, it presented the best results in all the analyzed issues. However we did not

control the previous time of practice of these components of the therapeutic outline. Such information is important because data show that the longer the time of engagement, the best are the results in physiologic indicators (FECHIO; MALERBI. 2004). Furthermore, due to the absence, in both health units of work groups to motivate and organize the adoption of non-pharmacological components of the therapeutic outline, those patients seems to choose for these components without professional follow up.

Another limitation of the present study resides in its cross-sectional design, which dos not allow the establishment evidence of causality among the analyzed variables. Thus, it is suggested for futures studies, the accomplishment of follow-up and intervention with diabetic patients.

CONCLUSION

In synthesis, our results indicate that, among bearers of DM2 assisted in public health services, the adoption of the therapeutic outline seems to be associated with better risk indicators at the health and smaller costs with treatment.

REFERENCES

ANDERSON. R. N. **Deaths**: leading causes for 2000. National Vital Statistics Reports. 2002.

ASSUNÇÃO. M. C. et al. Atenção primária em diabetes no Sul do Brasil: estrutura. processo e resultado. **Revista de Saúde Pública**. São Paulo. v. 35. n. 1. p. 88-95. 2001.

BAECKE. J. A. et al. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. **American Journal of Clinical Nutrition**. Bethesda. v. 36. no. 5. p. 936- 942. 1982.

BERTOLDI. A. D. et al. Physical activity and medicine use: evidence from a population-based study. **BMC Public Health**. London. v. 6. no. 224. 2006.

BRASIL. Ministério da Saúde. **Indicadores de morbidade e fatores de risco**. 2004. Disponível em: <http://w3.datasus.gov.br/datasus/datasus.php>. Acesso em: 1 jun. 2008.

CHENOWETH. D.; LEUTZINGER. J. The economic cost of physical inactivity and excess weight in American adults. **Journal of Physical Activity and Health**. Champaign. v. 3. no. 2. p. 148-163. 2006.

DI LORETO. C. et al. Make your diabetic patients walk: long-term impact of different amounts of physical activity on type 2 diabetes. **Diabetes Care**. Nova York. v. 28. no. 6. p. 1295-1302. 2005.

V DIRETRIZES BRASILEIRAS DE HIPERTENSÃO ARTERIAL. **Arquivos Brasileiros de Cardiologia**. São Paulo. v. 89. no. 3. p. E24-E78. 2007.

DONNELLY. J. E. et al. American College of Sports Medicine Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. **Medicine and Science in Sports & Exercise**. Madison. v. 41. no. 2. p. 459-471. 2009.

FECHIO. J. J.; MALERBI. F. E. Adesão a um programa de atividade física em adultos portadores de diabetes. **Arquivos Brasileiros de Endocrinologia e Metabologia**. São Paulo. v. 48. n. 2. p. 267-275. 2004.

FEDERAÇÃO INTERNACIONAL DE DIABETES. **Atlas do diabetes. 2003**. Disponível em: <http://www.idf.org/e-atlas>. Acesso em: 1 jun. 2008.

FEDERAÇÃO INTERNACIONAL DE DIABETES. **Atlas do diabetes. 2008**: ECONOMIC IMPACTS. Disponivel em: <http://www.eatlas.idf.org/indexd894.html>. Acesso em: 21 de maio 2009.

GUEDES. D. P. et al. Reprodutibilidade e validade do questionário Baecke para avaliação da atividade física habitual em adolescentes. **Revista Portuguesa de Ciências do Desporto**. Porto. v. 6. n. 3. p. 265-274. 2006.

HEYWARD. V. H.; STOLARCZYK. L. M. **Avaliação da composição body aplicada**. São Paulo: Manole. 2000.

KAVEY. R. E. et al. American Heart Association. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. **Circulation**. Dallas. v. 107. no. 11. p. 1562-1566. 2003.

KUZUYA. T. et al. Report of the Committee on the classification and diagnostic criteria of diabetes mellitus. **Diabetes Research and Clinical Practice**. Amsterdam. v. 55. no. 1. p. 65-85. 2002.

LOHMAN. T. G. **Anthropometric Standardization Reference Manual**. Champaign: Human Kinetics Books. 1988.

PEREIRA. R. A.; SICHIERI. R.; MARINS. V. M. Waist:hips girth ratio as a predictor of arterial hypertension. **Cadernos de Saúde Publica**. Rio de Janeiro. v. 15. n. 2. p. 333-344. 1999.

ROLIM. R. M. C.; AMARAL. S. L.; MONTEIRO. H. L. Hipertensão e exercício: Custos do tratamento ambulatorial. antes e após a adoção da pratica regular e orientada de condicionamento físico. **Hipertensão**. São Paulo. v. 10. no. 2. p. 54-61. 2007.

SICHIERI. R. et al. Importância e Custo das hospitalizações associadas ao sobrepeso e obesidade no Brasil. **Cadernos de Saúde Publica**. Rio de Janeiro. v. 23. n. 7. p. 1721-1727. 2007.

SOCIEDADE BRASILEIRA DE DIABETES. **Tratamento e acompanhamento do diabetes mellitus**: Diretrizes da Sociedade Brasileira de Diabetes. 2007. Disponível em: <http://ww2.prefeitura.sp.gov.br//arquivos/secretarias/ s aude/programas/0007/D iretrizes_S BD_2007.p df>. Acesso em: 13 de mar. 2007.

SUN. S. S. et al. Development of bioelectrical impedance analysis prediction equations for body composition with the use of a multicomponent model for use in epidemiologic surveys. **American Journal of Clinical Nutrition**. Bethesda. v. 77. no. 2. p. 331- 340. 2003.

TOUSOULIS. D. et. al. Effects of insulin resistance on endothelial function: possible mechanisms and clinical implications. **Diabetes. Obesity and Metabolism.** Oxford. v. 10. no. 10. p. 834-842. 2008.

UNITED KIGDOM PROSPECTIVE DIABETES STUDY GROUP. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). **Lancet**. London. v. 352. no. 9131. p. 837-853. 1998.

WANG. G.; DIETZ. W.H. Economic burden of obesity in youths aged 6 to 17 years: 1979-1999. **Pediatrics**. Springfield. v. 109. no. 6. p. 1195-1200. 2000.

WORLD HEALTH ORGANIZATION. **Obesity**: preventing and managing the global epidemic: report of a WHO consultation. Geneva. 2000. WHO technical report series: 894.

ZAGO. A. S.; ZANESCO. A. Nitric oxide. cardiovascular disease and physical exercise. **Arquivos Brasileiros de Cardiologia.** São Paulo. v. 87. no. 6. p. 264-270. 2006.

ZANESCO. A.; ANTUNES. E. Effects of exercise training on the cardiovascular system: pharmacological approaches. **Pharmacology Therapeutics**. Oxford. v. 114. no. 3. p. 307-17. 2007.

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