DYSLIPIDEMIA PREVALENCE AND ITS RELATION WITH OXYGEN CONSUMPTION AMONG PUBLIC SERVANTS

Prevalência de dislipidemia e sua relação com consumo de oxigênio entre servidores públicos

Prevalencia de dislipidemia y su relación con el consumo de oxigeno em funcionarios

William Amorim[1]
Renata Aparecida Rodrigues de Oliveira[1]
Michelle Silveira Breguez[1]
Paulo Roberto dos Santos Amorim[1]
João Carlos Bouzas Marins[1]

ABSTRACT

Objective: To determine the prevalence of dyslipidemia and its relation with maximal oxygen uptake (VO_{2max}) in public servants. **Methods:** Cross-sectional study conducted in 2010 with 107 technical and administrative servants of one university, by means of anthropometric measures (height and weight), submaximal treadmill test for assessment of cardiorespiratory parameter (VO_{2max}), collection of total cholesterol (TC) and triglycerides (TG). In the statistical treatment of data, were applied the descriptive analysis, prevalence of TC, TG and VO_{2max}, Pearson correlation and non-paired Student's t-test. **Results:** The final sample comprised 101 servants (46.6 ± 10.4 years old). The mean TC was 197 ± 40.2mg/dl, with 51 (50.5%) presenting borderline and "high" values, and mean TG 121 ± 66.6mg/dl, with 25 (24.8%) borderline and "high" values. The VO_{2max} of 56 (55.5%) servants were classified as "Good" and 37 (36.6%) as "Excellent". Men had a statistically significant correlation only between TG and VO_{2max} (r= -0,45; p<0.01), whereas among the women there was correlation between TC and VO_{2max} (r= -0.37; p<0.05). **Conclusion:** Dyslipidemia prevalence showed to be high in the studied population, mainly in male gender. It was found an inverse correlation between the variables TG and VO_{2max} in men and TC and VO_{2max} in women. However, the observed variables obtained a regular relation in the evaluated servants.

Descriptors: Cholesterol; Triglycerides; Oxygen Consumption; Cardiovascular Diseases.

RESUMO

Objetivo: *Determinar a prevalência de dislipidemia em servidores públicos e sua relação com o consumo máximo de oxigênio ($VO_{2máx}$).* **Métodos:** *Estudo transversal, realizado em 2010, com 107 servidores técnico-administrativos de uma universidade, através de medidas antropométricas (estatura e peso), teste de esteira submáximo para avaliação do parâmetro cardiorrespiratório ($VO_{2máx}$), coleta de colesterol total (CT) e triglicerídeos (TG). Utilizou-se, no tratamento estatístico dos dados, a análise descritiva, o cálculo das prevalências de CT, TG e $VO_{2máx}$, a correlação de Pearson e o teste t de Student não pareado.* **Resultados:** *A amostra final compreendeu 101 servidores (46,6 $\pm$ 10,4 anos). Os avaliados obtiveram média de CT 197$\pm$ 40,2mg/dl, com 51 (50,5%) apresentando valores limítrofes e "altos", e média de TG 121$\pm$66,6mg/dl, com 25 (24,8%) valores limítrofes e "altos". O $VO_{2máx}$ de 56 (55,5%) avaliados foi classificado como "Bom" e 37 (36,6%) como "Excelente". Os homens obtiveram correlação estatisticamente significante apenas entre TG e $VO_{2máx}$ (r = - 0,45; p<0,01), enquanto, entre as mulheres, a correlação foi do CT com $VO_{2máx}$ (r = -0,37; p<0,05).* **Conclusão:** *A prevalência de dislipidemias se mostrou elevada na população estudada, principalmente entre o sexo masculino. Encontrou-se uma correlação inversa entre as variáveis TG e $VO_{2máx}$ nos homens e entre CT e $VO_{2máx}$ nas mulheres. Contudo, as variáveis em questão obtiveram uma relação regular nos servidores avaliados.*

Descritores: *Colesterol; Triglicerídeos; Consumo de Oxigênio; Doenças Cardiovasculares.*

1) Federal University of Viçosa (*Universidade Federal de Viçosa - UFV*) – Viçosa-MG - Brazil

RESUMEN

Objetivo: *Determinar la prevalencia de dislipidemia en funcionarios y su relación con el consumo máximo de oxígeno (VO$_{2máx}$).* **Métodos:** *Estudio trasversal realizado en el 2010 con 107 funcionarios técnico-administrativos de una universidad a través de medidas antropométricas (altura y peso), prueba submaxima en la cinta para la evaluación del parámetro cardiorrespiratorio (VO$_{2máx}$), análisis del colesterol total (CT) y triglicéridos (TG). Se utilizó para el tratamiento estadístico de los datos, el análisis descriptivo, el cálculo de las prevalencias de CT, TG y VO$_{2máx}$, la correlación de Pearson y la prueba t-Student no pareado.* **Resultados:** *La muestra final fue de 101 funcionarios (46,6 $\pm$ 10,4 años). Aquellos que fueron evaluados tuvieron media de CT de 197$\pm$ 40,2mg/dl, con 51 (50,5%) presentando valores limítrofes y "elevados" y media de TG de 121$\pm$66,6mg/dl, con 25 (24,8%) valores limítrofes y "elevados". El VO$_{2máx}$ de 56 (55,5%) funcionarios fue clasificado como "bueno" y 37 (36,6%) como "excelente". Los hombres obtuvieron correlación estadísticamente significativa apenas entre el TG y el VO$_{2máx}$ (r = - 0,45; p<0,01), mientras que en las mujeres, la correlación fue entre el CT y el VO$_{2máx}$ (r = - 0,37; p<0,05).* **Conclusión:** *La prevalencia de dislipidemias se mostró elevada en la población estudiada, principalmente en el sexo masculino. Se encontró una correlación inversa entre las variables TG y VO$_{2máx}$ en los hombres y entre el CT y el VO$_{2máx}$ en las mujeres. Sin embargo, las variables en cuestión obtuvieron una relación regular en los funcionarios investigados.*

Descriptores: *Colesterol; Triglicéridos; Consumo de Oxígeno; Enfermedades Cardiovasculares.*

INTRODUCTION

Cardiovascular diseases are the leading causes of morbidity and mortality in Brazil and the Western world and they include acute myocardial infarction, heart failure, ischemic cardiomyopathy or sudden death[1]. The atherosclerosis, one of the main characteristics of these diseases, begins in childhood as deposits of fats in the inner layers of artery walls, blocking the flow of blood[2].

Dyslipidemia is one of the main risk factors leading to atherosclerosis. It is a condition marked by abnormal concentrations of lipids in the blood and represents a risk factor to health[1]. Dyslipidemia can be caused by a genetic factors; however, in most cases it is caused by both genetic factors and environmental factors associated with lifestyle – eating habits and lack of physical activity[1,3].

Diagnostic assessments – performed using questionnaires – show that civil servants of the university present cardiovascular risk classified as "moderate risk" and a prevalence of hypercholesterolemia ranging from 30% to 46%[4,5]. These levels corroborate the findings of another

study that presented cholesterol levels above 200 mg/dl in 38% of the men and 42% of the women participating in the research[1]. On the other hand, another study on the prevalence of coronary risk factors (CRF)[6] found high levels of cholesterol in only 5.6% of the population of the state of Rio Grande do Sul but the reasons were not identified in the study.

The benefits of regular physical activity are: improvement of lipid profile, such as an increase in the serum concentrations of HDL (high-density lipoprotein) and the reduction in the levels of Triglycerides (TG) and Total Cholesterol (TC)[7-9]. The reduction of blood cholesterol has been acknowledged as an effective intervention to reduce the rates of coronary artery disease morbidity and mortality[1]. Lifestyle changes are recommended to lower cholesterol levels rather than drug treatments[10].

Therefore, scientific literature has reported a relationship between maximum oxygen consumption (VO$_{2max}$) and cardiovascular risk[11-14]. Thus, VO$_{2max}$ can be related to low levels of low-density lipoprotein (LDL-C), triglycerides (TG) and "great" levels of high-density lipoprotein (HDL-C). There are several methods of measurement of VO$_{2max}$, such as treadmill walking and running with various protocols that are chosen according to the characteristics of the person or group to be assessed[15].

Walking protocols are scientifically supported by the fact that they can adapt to people with poor physical fitness since the metabolic demand is identical during the test[15]. A submaximal test for estimated VO$_{2max}$ could be a powerful tool for the association of physical fitness with better cholesterol and fractions profile.

Therefore, the studies that assess CRF enable the planning for prevention of such diseases – decreasing expenditures with health insurances and long-term treatments – and suggests physical activity as a preventive method and non-drug treatment that can be applied to any group of workers.

Given that, this study aimed to determine the prevalence of dyslipidemia among civil servants and its relationship with maximal oxygen consumption.

METHODS

This is a cross-sectional study conducted during the first semester of the year 2010 with a random sample of 107 civil servants of both sexes (5% of the total population) working as technical administrators of the Federal University of Viçosa (UFV). All the participants were volunteers in the study and their personal information was safeguarded.

Data collection took place in the Human Performance Laboratory, located in the Physical Education Department

of the UFV. The development of this study comprised five stages: 1) development of an information campaign; 2) registration of interested people; 3) signing the informed consent; 4) anthropometric measurements (height and weight)[16], submaximal treadmill test[17] for estimated VO_{2max} and measurement of TC and TG; 5) relevant results were disclosed individually. All the protocols were applied by Physical Education undergraduate students.

Height was measured using a Sanny™ stadiometer with a precision of 1mm. Individuals stood with their back to the measuring tape and put their ankles together. Weight was measured using a Filizola™ ID-M150/4 scale with a precision of 100 g. The participants wore light clothes and were barefoot.

The testing for estimated VO_{2max} comprises a three-minute warm-up, four minutes of main test followed by a three-minute recovery. During the main part of the test, the speed varied between 4.8 km/h and 6.4 km/h, with an inclination of 5%, according to the person's physical fitness. Heart rate was controlled during the test in a 5-second interval using Polar™ monitor. Blood pressure was measured four times during the test using a Mercury sphygmomanometer. The VO_{2max} was classified as "very poor", "poor", "fair", "good" and "excellent"[18].

The volunteers were requested to bring a recent blood test containing the values of TC and TG. In case they did not have any previous tests, they were requested to perform one in the Division of Health of the UFV – a fact that occurred with 30 individuals.

The levels of TC and TG were classified according to the Brazilian Society of Cardiology (SBC)[3] as: "great" (<200 mg/dl), "borderline" (200 a 239 mg/dl) and "high" (≥240 mg/dl); and "great" (<150 mg/dl), 'borderline" (150 to 200 mg/dl), "high" (201 to 499 mg/dl) and "very high" (>499 mg/dl), respectively.

Data analysis was performed in the statistical program Sigma Stat 3.5 using a descriptive analysis and calculation of prevalences of TC, TG and VO_{2max}. Pearson's correlation was used for the variables TC, TG and VO2max, and the unpaired Student's t-test was used to compare the sexes.

All the statistical analyses adopted a significance level of p<0.05.

This current research was approved by the Research Ethics Committee of the UFV (No. 020/2010/Ethics Committee) under Opinion No. 196/96 that rules researches with human beings.

RESULTS

Of all the 107 participants, 5 did not perform the blood test or participate in the submaximal test, and 1 did not perform the triglycerides test. Therefore, the final sample comprised 101 civil servants – 41 (40.6%) women and 60 (59.4%) men – with an average age of 46.6+10.4 years. The total sample presented an average BMI of 24.6+3.1 kg/m², with an average BMI of 23.7+3.4 kg/m² for women and 25.3+2.7 kg/m² for men.

The descriptive data of the current study are presented in Table 1 for both sexes. It can be noticed that men presented TC, TG and VO_{max2} values higher than the ones presented by women; however, only the levels of VO_{2max} showed a significant difference (p<0.01).

Regarding VO_{2max}, none of the participants was classified as "very poor" and "poor"; however, fair values were found in 6 (14.6%) women and 2 (3.3%) men. The VO_{2max} of 56 (55.5%) participants was classified as "good" and 37 (36.6%) as "excellent". Among women, 28 (68.3%) presented "good" values and 7 (17.1%) presented "excellent" values. Among men, the same classification was applied for 28 (46.7%) and 30 (50%) participants, respectively. With regard to age group, the VO_{2max} decreased with ageing.

The levels of TC were "high" among 12 (11.9%) participants – 7 (11.6%) men and 5 (12.2%) women. High levels of TG were found among 13 (12.9%) participants – 9 (15%) men and 4 (9.8%) women. Values classified as "very high" were not found in this study (Table II). Considering the age group, TC and TG increased with ageing; however, TC presented the highest values in people who were 46 years old and older while the highest values of TG were found in the age group 40-50 years old, with a tendency to be reduced from this age.

Table I – Descriptive analysis of variables assessed among employees of a Federal University. Viçosa-MG, 2010.

	Male (n=60)		Female (n=41)		General (n=101)	
	Mean	SD	Mean	SD	Mean	SD
Cholesterol (mg/dl)	198	41.8	196	38.1	197	40.2
Triglycerides (mg/dl)	131	68.9	108	61.2	121	66.6
VO2 ml(kg.min)-1	43	6.2	36	6.1*	41	7.1

SD: standard deviation; $VO2_{max}$: Maximal Oxygen Consumption
* Significant difference regarding male gender (p<0.01).

Figure 1 shows the biochemical parameters (TC and TG) and VO_{2max} of servants, presenting only the statistically significant correlations (p<0.05). There was no correlation between TC and VO_{2max} among men and between TG and VO_{2max} among women.

Table II – Classification of employees according to total cholesterol and triglycerides levels. Viçosa-MG, 2010.

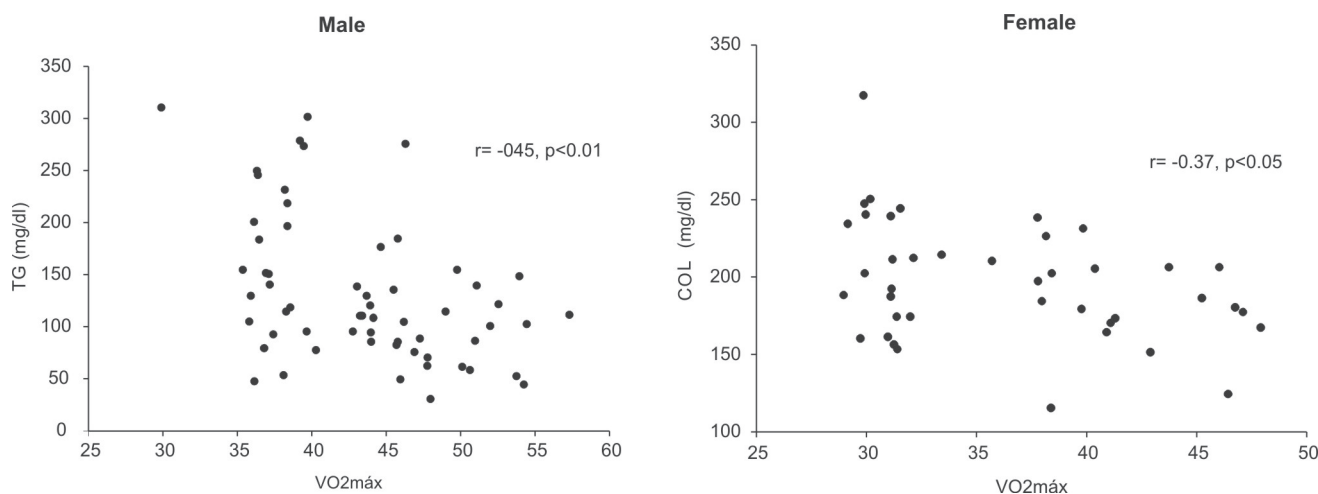|		Female		Male		All	
Total Cholesterol							
Great	<200	22	53.7%	28	46.7%	50	49.5%
Borderline	200-239	14	34.1%	25	41.7%	39	38.6%
High	>240	5	12.2%	7	11.6%	12	11.9%
Triglycerides							
Great	<150	34	82.9%	42	70.0%	76	75.2%
Borderline	150-200	3	7.3%	9	15.0%	12	11.9%
High	201-499	4	9.8%	9	15.0%	13	12.9%

Figure 1 – Correlation between Triglycerides and VO_{2max} among men and Total cholesterol and VO_{2max} among women. Viçosa-MG, 2010.
VO_{2max}: Maximal Oxygen Consumption.

DISCUSSION

The prevalence of dyslipidemia in this current study was high, mainly among men. It was found that 50.5% of the participants presented altered values of TC ("borderline" and "high") and 24.8% presented altered values of TG. These values become worrisome as the participants get older and the CRF increase.

A study comparing the lipid profiles of a Riverside population and urban population in the north of Brazil showed that the Riverside population presented lower levels of TC, possibly due to healthier eating habits, rich in monounsaturated and polyunsaturated fats[19]. Despite this, the two populations presented levels that were higher than the ones found among the civil servants assessed in this research.

It is worth saying that the current research found a great number of women with high levels of TC. This number can increase even more overtime due to ageing and menopause[20] because it is known that the quantity of estrogen drops after menopause and this hormone improves the lipid profile, helping to prevent atherosclerosis[3].

When analyzing the age factor, the levels of TC increased with age, reaching peak levels after the age of 46 in both sexes. A progression in the plasma levels of TC and other variables are expected with ageing[1,3,6,21]; it is a natural event, and it is caused by physiological deficits overtime. However, these levels can be kept stable and adequate with the practice of regular physical activity and controlled nutrition. This behavior must be kept in all age groups but emphasized in more advanced ages, when the regulation of TC levels should be performed primarily by healthy behaviors and – if necessary – medications.

Despite the high levels of TC, the average value of TG found in this study is appropriate, taking into consideration that this is a population with an average age of 46.6 years. Thus, it is important to keep these levels to avoid an increased CRF overtime. It is known that the TG are structures formed by combining three fatty acids with a molecule of glycerol – one of the most important forms of energy storage by the organism – found in adipose and muscular tissues[1]. The storage is directly influenced by nutrition, level of physical activity, age, sex, and genetic characteristics[1,3,8,22,23].

A study comparing TG levels between the riverside population and the urban population found similar results; however, the urban population presented average levels of high concentrations of TG (above 150mg/dl) in a great number of its participants[19]. Considering that this current study was conducted in a university located in the countryside of Minas Gerais, the lower levels found in the urban population may be associated with the different lifestyles between the populations.

TG also presented a tendency to increase with ageing, reaching peak levels between 40 and 50 years old. This finding becomes worrisome because after the age of 40, ageing becomes a factor that increases the cardiovascular risk every year[1]; despite this, TG levels tended to drop among the participants who were over 50 years old. This can be explained by people's concern to controlling the nutrition and regulating CRF; otherwise, the levels would increase, and the individual risk with high levels of TG would be worrisome for the servants' health. Another factor that can explain the fact that older people have lower levels of TG is the survival of those with lower levels, because people with high levels of TC, TG and other variables increase the cardiovascular risk and tend to live shorter lives[11,15-17].

Regarding aerobic capacity (VO_{2max}), lower levels have been considered an important predictor of premature morbidity and mortality among healthy adults[24], and – in addition to other factors – it can aggravate the situation. Most of the participants presented appropriate levels of cardiorespiratory capacity – even with an average age of 46.6+10.4 – that led authors to believe in an overestimation of VO_{2max} values obtained in the stress test. Moreover, when comparing the results of this research to the results of another study conducted with healthcare workers, the values found in this current study are way superior. Lower levels could be found in 56% of men and 23% of women among the healthcare workers, while in this research – using a classification that takes into account the age – no "very poor" and "poor" values were found.

In this current study, VO_{2max} levels dropped with ageing – following the known standard – due to changes in skeletal muscle oxidative capacity and its capillarization, and also because of the heart function performance[26]. The VO_{2max} data obtained in this research corroborate the data of a classic research[27] conducted with 93 men aged from 6 to 91 years that designed the curve of decline of aerobic capacity of individuals assessed in the 30's. In this study[27], the average values of VO_{2max} start to decline from the age of 17 to older ages, corroborating with this current study that reports the same decline of cardiovascular function.

A study conducted with 208 healthy women aged 49-79 years found a deficit in aerobic capacity with ageing and after menopause, mainly among those with high levels of total and central adiposity and little muscle mass[28]. Therefore, women should have more rigorous behavior regarding the maintenance of VO_{2max} levels because after the menopause these values tend to be harder to control.

Thus, the findings and behaviors regarding VO_{2max} show that the age is a predictor of physical fitness. In order to avoid its decline, it is necessary to keep practicing physical activity at all ages – from child to elders – so that, as time goes by, the body can reduce the effect of ageing in the aggravation of CRF.

Some studies have proved the inverse relationship between the levels of TC and VO_{2max} among men and women[7,11,29,30], associating these results with the dietary control[21]. Other studies conducted with adults show the effects of the reduction of TC levels through the practice of physical activity and, in some cases, allied to nutrition control[31-33]. Just like the TC, TG levels tend to drop with the regular practice of physical activity and dietary control[32-34], agreeing with the guidelines for Cardiac Rehabilitation of the Brazilian Society of Cardiology[30].

In this current study, the TC was inversely correlated with VO_{2max} only among women (r = -0.37; p<0.05) and presented no statistical significance among men. TG presented inverse correlation among men only (r = -0,45; p<0.01). Thus, the results show that some cases of high levels of TC among women and high levels of TG among men are correlated with low levels of VO_{2max}. Although the correlations found in this study are not considered strong, it is important to highlight that, according to a study conducted with men with and without metabolic syndrome, a very good cardiorespiratory capacity is associated with lower chances of developing components of metabolic syndrome[35].

Thus, it is important to stimulate the maintenance of this parameter.

It is necessary to verify whether the results of this study extend to all the population of university workers. If so, this could be a serious public health problem that would require urgent preventive and treatment measures. Thus, healthcare services must focus on the implementation of preventive measures such as nutrition control and regular practice of physical activity, aiming to decrease cholesterolemia, triglyceridemia and physical fitness so that they do not act as risk factors for an undesirable cardiovascular event that will decrease the servant's quality of life.

It is worth saying that this current study presented some limitations such as the reduced number of servants participating in the research. Therefore, it is important to have a bigger sample in order to confirm the striking results that were found. Besides that, the level of physical activity and dietary recall were not assessed to be compared with the concentrations of TC and TG. Also, the protocol for cardiorespiratory testing may not have been appropriate for the population, what may have caused high results.

CONCLUSION

The prevalence of dyslipidemias was high among the technical administrators of the UFV. Regarding the sex, men presented values that were higher than those presented by women. There was an inverse correlation between TG and VO_{2max} among men and between TC and VO_{2max} among women. However, these variables presented a regular correlation among the assessed population.

REFERENCES

1. Sposito AC, Caramelli B, Fonseca FAH, Bertolami MC, Afiune Neto A, Souza AD, et al. IV Diretriz brasileira sobre dislipidemias e prevenção da aterosclerose: Departamento de Aterosclerose da Sociedade Brasileira de Cardiologia. Arq Bras Cardiol. 2007;88 (Supl 1):2-19.

2. Coelho VG, Caetano LF, Liberatore Júnior RR, Cordeiro JA, Souza DRS. Perfil lipídico e fatores de risco para doenças cardiovasculares em estudantes de medicina. Arq Bras Cardiol. 2005;85(1):57-62.

3. Santos RD. III Diretrizes brasileiras sobre dislipidemias e diretriz de prevenção da aterosclerose do departamento de aterosclerose da sociedade brasileira de cardiologia. Arq Bras Cardiol. 2001;77(Supl 3):1-48.

4. Moreira OC, de Oliveira CEP, Teodoro BG, Souza GC, Lizardo FB, dos Santos LA, et al. Fatores de risco de doença cardiovascular em técnicos administrativos da Universidade Federal de Viçosa. Bioscience Journal. 2009;25(5):133-40.

5. Moura BP, Moreira OC, Nunes N, Marins JCB. Prevalência de Fatores de Risco Coronariano em Praticantes de Atividades Aeróbicas no Campus da Universidade Federal de Viçosa-MG. Arq ciências saúde UNIPAR. 2009;12(3):213-19.

6. Gus I, Fischmann A, Medina C. Prevalência dos fatores de risco da doença arterial coronariana no Estado do Rio Grande do Sul. Arq Bras Cardiol. 2002;78(5):478-83.

7. Prado ES, Dantas EHM. Efeitos dos exercícios físicos aeróbio e de força nas lipoproteínas HDL, LDL e lipoproteína (a). Arq Bras de Cardiol. 2002;79(4):429-33.

8. Guedes DP, Gonçalves LAV. Impacto da prática habitual de atividade física no perfil lipídico de adultos; Impact of the habitual physical activity on lipid profile in adults. Arq bras endocrinol metab. 2007;51(1):72-8.

9. Stabelini Neto A, Bozza R, Ulbrich AZ. Fatores de risco para aterosclerose associados à aptidão cardiorrespiratória e ao IMC em adolescentes; Atherosclerotic risk factors associated with cardiorespiratory fitness and BMI in adolescents. Arq bras endocrinol metab. 2008;52(6):1024-30.

10. Antonopoulos S. Third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III) final report. Circulation. 2002;106(3143):3421.

11. Nizzo W, Meres Filho MA, Cardoso AM, Fortes MSR, Silva MAG, Dantas EHM. Efeitos da continuidade do treinamento da hidrocinesioterapia sobre o perfil lipídico, a composição corporal eo VO2máx de mulheres ativas na pós-menopausa; Effects of the continuation of hydrotherapy training on the lipids profile, body composition and VO2max in active and post-menopausal women. Fisioter Bras. 2008;9(2):112-8.

12. Chomistek AK, Chasman DI, Cook NR, Rimm EB, Lee IM. Physical activity, genes for physical fitness, and risk of coronary heart disease. Medicine and science in sports and exercise. 2013; 45(4):691-7.

13. Lion LAC, Cruz P, Albanesi Filho F. Avaliação de programa de reabilitação cardíaca. Análise após 10 anos de acompanhamento. Arq Bras Cardiol. 1997;68(1):13-9.

14. Guedes DP, Guedes J. Atividade física, aptidão cardiorrespiratória, composição da dieta e fatores de

risco predisponentes às doenças cardiovasculares. Arq Bras Cardiol. 2001;77(3):243-50.

15. Santos TM, Furtado LFL, Ribeiro LG, Cabral LF, Novaes JS. Comparação entre as modalidades de caminhada e corrida na predição do consumo máximo de oxigênio; Comparison between the gait and running modalities in the oxygen maximal uptake prediction. Rev Bras Med Esporte. 2008;14(5):412-5.

16. International Society for the Advancement of Kinanthropometry - ISAK. International standards for anthropometric assessment. Adelaide, Australia: National Library of Australia; 2001.

17. Ebbeling C, Ward A, Puleo E, Widrick J, Rippe J. Development of a single-stage submaximal treadmill walking test. Medicine and science in sports and exercise. 1991;23(8):966.

18. American College of Sports Medicine. Guidelines for graded exercise testing and exercise prescription. 2nd. Philadelphia: Lea & Febiger; 1980.

19. Feio CMA, Fonseca FAH, Rego SS, Feio MNB, Elias MC, Costa EAS, et al. Perfil lipídico e risco cardiovascular em amazônidas. Arq Bras Cardiol. 2003;81(6):592-5.

20. Oliveira A, Mancini Filho J. Perfil nutricional e lipídico de mulheres na pós-menopausa com doença arterial coronariana. Arquivos Brasileiros de Cardiologia. 2005;84(4):325.

21. Kolankiewicz F, Giovelli FMH, Bellinaso MDL. Estudo do perfil lipídico e da prevalência de dislipidemias em adultos. RBAC. 2008;40(4):317-20.

22. Seip RL, Angelopoulos TJ, Semenkovich CF. Exercise induces human lipoprotein lipase gene expression in skeletal muscle but not adipose tissue. American Journal of Physiology-Endocrinology And Metabolism. 1995;268(2):E229.

23. Batista M, Franceschini S. Impacto da atenção nutricional na redução dos níveis de colesterol sérico de pacientes atendidos em serviços públicos de saúde. Arq Bras Cardiol. 2003;80(2):162-6.

24. Koch LG, Kemi OJ, Qi N, Leng SX, Bijma P, Gilligan LJ, et al. Intrinsic Aerobic Capacity Sets a Divide for Aging and Longevity. Circ Res. 2011;109(10):1162-72.

25. Barel M, Louzada GCA, Monteiro HL, Amaral SL. Associação dos fatores de risco para doenças cardiovasculares e qualidade de vida entre servidores da saúde. Rev Bras Educ Fís Esporte. 2010;24(2):293-303.

26. Betik AC, Hepple RT. Determinants of VO2 max decline with aging: an integrated perspective. Applied Physiology, Nutrition, and Metabolism. 2008;33(1):130-40.

27. Robinson S. Experimental studies of physical fitness in relation to age. Eur J Appl Physiol Occup Physiol. 1938;10(3):251-323.

28. Aragao FD, Abrantes CG, Gabriel RE, Sousa MF, Castelo-Branco C, Moreira MH. Effects of body composition and menopause characteristics on maximal oxygen uptake of postmenopausal women. Menopause. 2011;18(11):1191-7.

29. Kelley GA, Kelley KS, Tran ZV. Aerobic exercise and lipids and lipoproteins in women: a meta-analysis of randomized controlled trials. J Women's Health. 2004;13(10):1148-64.

30. Moraes RS, NóBREGA ACL, Castro RRT, Negrão CE, Stein R, Serra SM. Diretriz de reabilitação cardíaca. Arq Bras Cardiol. 2005;84(5):431-40.

31. Miller 3rd ER, Erlinger TP, Young DR, Jehn M, Charleston J, Rhodes D, et al. Results of the diet, exercise, and weight loss intervention trial (DEW-IT). Hypertension. 2002;40(5):612.

32. Stefanick ML, Mackey S, Sheehan M, Ellsworth N, Haskell WL, Wood PD. Effects of diet and exercise in men and postmenopausal women with low levels of HDL cholesterol and high levels of LDL cholesterol. New England Journal of Medicine. 1998;339(1):12-20.

33. Niebauer J, Hambrecht R, Velich T, Hauer K, Marburger C, Kalberer B, et al. Attenuated progression of coronary artery disease after 6 years of multifactorial risk intervention: role of physical exercise. Circulation. 1997;96(8):2534.

34. Andersen RE, Wadden TA, Bartlett SJ, Zemel B, Verde TJ, Franckowiak SC. Effects of lifestyle activity vs structured aerobic exercise in obese women. JAMA. 1999;281(4):335.

35. Laaksonen DE, Lakka HM, Salonen JT, Niskanen LK, Rauramaa R, Lakka TA. Low levels of leisure-time physical activity and cardiorespiratory fitness predict development of the metabolic syndrome. Diabetes Care. 2002;25(9):1612-8.

Mailing address:
William Amorim
Rua Argentina, 520/34 - Bloco 10
CEP: 13484-055 - Limeira - São Paulo - Brazil
E-mail: amorimwa@yahoo.com.br