98 - ATHEROSCLEROTIC RISK IN ADOLESCENTS WITH DIFFERENT $VO_{2máx}$ LEVELS

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INTRODUCTION

The aerobic power ($VO_{2máx}$) is admittedly as the most important physical fitness component associated to health (BARANOWSKI et al., 1992). The fact is that, when there is improvements in the cardiorespiratory fitness, besides of the cardiovascular function improvement, occur simultaneously biochemists and hemodinamics alterations as: blood pressure reduction; LDL-C and triglycerides reduction; HDL-C and glucose tolerance increase, which are basic mechanisms of the individual health (BOREHAM; RIDDOCH, 2001).

Reaffirming these findings, prospective studies demonstrated that, in adults, high cardiorespiratory fitness takes the atherosclerotic disease reduction, stroke, hypertension and diabetes mellitus (GUNNELL et al., 1998; HELMRICH et al., 1991; WANNAMETHEE; SHAPER, 1992).

Blair et al. (1996) reported that adults with low $VO_{2máx}$ levels presented mortality risk increased in 1.5 times for men and 2.1 times for women, and they demonstrated that improvements in the cardiorespiratory fitness by aerobic training reduced in 50% the mortality risk.

In other hand, differently of the adult population, there are few and contradictory studies about the atherosclerotic risk factors associated with the cardiorespiratory fitness in children and adolescents (ANDERSEN et al., 2003; BOREHAM; RIDDOCH, 2001; BOUZIOTAS et al., 2004; MAFFEIS et al., 2001; NIELSEN; ANDERSEN, 2003; THOMAS et al., 2005).

Based in these facts, to test the hypothesis that adolescents with high $VO_{2máx}$ levels present lesser risk than your pairs with low $VO_{2máx}$, the present study had as objective to compare the atherosclerotic risk factors in male adolescents with different $VO_{2máx}$ levels.

METHODS

Sample: The random sample was composed for male adolescents, with ages between 12 to 16 years old (14,95 ± 1,30 years), registered in the net public education of the São Mateus do Sul city, Paraná, Brazil, in the 2006 school year.

The sample size was calculated in accordance with the following procedure: a) males total number (1260 adolescents); b) 95% confidence interval; c) 5% sample error and 20% prevalence (LUIZ; MAGNANINI, 2000). The 20% prevalence was adopted considering that the distribution of the risk factors found in many national studies with young individuals presents inferior values to 20%. Following the sample procedure, the minimum sample was estimated in 112 adolescents. To prevent problems with missing data, we increased in 10% of the subjects evaluated.

Before testing began, all individuals and their corresponding guardians were informed of all procedures involved in this research and filled out an authorization term and release form consenting to the used of their data. This research was approved by the Federal University of the Paraná the Ethics Committee, resolution 196/96.

With the objective of to verify if the subject presented cardiovascular disease familiar history, was directed to the parents, together with the authorization term, a brief questionnaire. Familiar history positive was considered when the subject presented at least one of the following situations: diabetics parents, cardiovascular disease recognized or sudden death. The absence of these pointers was used as criterion for participation in the study.

Instruments and Procedures: To measure the height was used the "WCS" stadiometer with scale of 0.1 cm. The weight was evaluated using a "PLENNA" digital balance, with resolution of 100g. The body mass index (BMI) was calculated by the mathematical formula: BMI=[weight(kg)/stature(m)^2].

For the $VO_{2máx}$ prediction, the indirect test proposed by Legér (1988) was used. This test consists of running back and forth over a delineated distance of 20 meters, was employed. The subject being evaluated runs in time with a rhythmic sound that determines the velocity he is to run. The frequency of the sound increases progressively at a rate of 0.5 km/h each minute, starting at 8,5km/h and finishing when the individual can not longer accompany the velocity of the rhythm. The last successful stage is then recorded and a mathematical formula, which takes into account the age (A) and the velocity (V) of the final completed stage in order to reach the VO_2max. VO2máx = 31,025 + 3.238*V - 3.248*A + 0.1536*V*A

This test was validated as maximum aerobic power preditor in young people (BOREHAM et al., 1990; DUARTE; DUARTE, 2001) and reliable with a score of r=0,89 for children and adolescents (LÉGER et al., 1988).

The subjects were classified by quartiles in accordance with the cardiorespiratory fitness results: Low fitness = Q1; Moderate > Q1 and < Q3; High = Q3).

The blood pressure was measured following the parameters established for the "The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents (2004)". The systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured in the right arm using a sphygmomanometer of mercury column. The systolic blood pressure was defined as Korotkoff sound phase 1 and diastolic blood pressure as Korotkoff sound phase 5. The evaluation was realized after the subject to remain seated for 10 minutes in rest. Two readings were realized after 10 minutes interval, being considered the mean between the two measures. If the two measures differed in more than 2 mmHg, the protocol was repeated.

For the total cholesterol (TC) mg/dL, HDL-C mg/dL and triglycerides (TG) mg/dL concentration, was used the automatized enzymatic method (ABBOTT SPECTRUM model CCX). The VLDL-C mg/dL was calculated by formula VLDL-C = TG/5. The LDL-C mg/dL was calculated by Friedewald et al. (1972) equation (LDL-C = TC - HDL-C- TG/5).

The reference values adopted to define the atherogenic risk profile was the I Diretriz de Prevenção da Aterosclerose na Infância e Adolescência (2005).

Statistics: The data were analyzed in the SPSS 13.0 statistical software, with significance level stipulated in $p<0.05$ for all the analyses. ANOVA's one-way were calculated to compare of the dependents variables (total cholesterol, HDL-C, LDL-C, VLDL-C, triglycerides and blood pressure) between the different cardiorespiratory fitness levels. Subsequently, Tukey post-hoc test was used to locate the differences pointed in the ANOVA's.

RESULTS AND DISCUSSION

Considering the nutritional status, 16.7% of the adolescents presented overweight (IMC>85th) and 11.1% were obesity (IMC>95th). For the hemodinamics risk factors evaluated in this research, the prevalence of subjects with high systolic blood pressure was 2.8% and diastolic blood pressure 23.1%.

In relation to the lipidic profile, 19.4% of the adolescents presented total cholesterol concentrations between 150 to 169 mg/dL (limit) and 15.8% the presented TC =170 mg/dL (elevated). For the HDL-C, 60.2% of the adolescents presented low values (<45mg/dL).

For the LDL-C concentrations, 19.4% of the subjects presented limit values (100-129 mg/dL) and 2.8% elevated (=130 mg/dL). For triglycerides, 11.1% presented limit values (100-129 mg/dL) and 11.1% presented elevated values (=130 mg/dL).

The mean values of the SBP, DBP, TC, HDL-C, LDL-C, VLDL-C and TG in accordance with the $VO_{2máx}$ levels are presented in table 1.

Table1. Comparation of the atherosclerotic risk factors in accordance with $VO_{2máx}$ levels.

	HIGH		MODERATE		LOW	
	Mean	SD	Mean	SD	Mean	SD
$VO_{2máx}$ ($ml^{-1}kg^{-1}min^{-1}$)	54.62	2.04[ab]	47.79	2.61[a]	41.29	2.87[bc]
SBP (mmHg)	95.00	14.69	96.43	13.48	96.72	14.39
DBP (mmHg)	67.49	11.75	69.56	9.50	66.56	10.77
TC (mg/Dl)	128.92	26.37	137.92	25.63	145.68	32.24
HDL (mg/dL)	44.36	13.04	44.41	9.45	45.28	7.58
LDL (mg/dL)	69.18	28.24	77.05	24.44	79.68	31.61
VLDL (mg/dL)	15.26	3.15[a]	16.55	7.21[a]	20.68	7.13[bc]
TG (mg/dL)	76.16	15.97[a]	82.25	35.95[a]	103.32	35.31[bc]

Systolic blood pressure (SBP), Diastolic blood pressure (DBP); Total cholesterol (TC); triglycerides (TG). a different of the low fitnees group; b different of the moderate fitnees group; c different of the high fitnees group; p<0.05.

Systolic blood pressure (SBP), Diastolic blood pressure (DBP); Total cholesterol (TC); triglycerides (TG). a different of the low fitnees group; b different of the moderate fitnees group; c different of the high fitnees group; p<0.05.

Significant differences between the groups were detected for the $VO_{2máx}$ (F=173.68; p=0.0001), VLDL-C (F=5.04; p=0.008) and triglycerides (F=5.17; p=0.007). In relation to the post-hoc test, the mean values of VLDL-C and triglycerides presented by adolescents with low $VO_{2máx}$ were significantly greater than the values found in your pairs with high and moderate $VO_{2máx}$.

Pursuing identic objectives, Andersen et al. (2003) evaluated the biological cardiovascular risk factors in 1020 children and adolescents separate $VO_{2máx}$ and observed that, for both genders, the subjects with lesser $VO_{2máx}$ levels presented elevated number of clustered risk factors.

In relation to the blood pressure, Nielsen and Andersen (2003) evaluated 5467 males and 8093 females with age between 15 to 20 years old and they reported high systolic blood pressure in the adolescents with low $VO_{2máx}$ percentiles compared with your pairs of the high $VO_{2máx}$ percentiles for both genders, however these findings weren't confirmed in our analyses.

For the total cholesterol, Twisk, Kemper and Van Mechelen (2000) followed longitudinally 307 adolescents and observed that the subjects with high $VO_{2máx}$ presented lesser TC concentrations, similar to the observed in the present study, however not statistics significant.

Armstrong and Simons-Morton (1994), Guedes and Guedes (2001) reported data suggesting a beneficial effect of the cardiorespiratory fitness in the HDL-C concentrations. However, our results not demonstrated HDL-C values elevated in the subjects with high $VO_{2máx}$ levels.

Boreham and Riddoch (2001), after extensive revision about the cardiorespiratory fitnees associated to health in children and adolescents concluded that, improvements in the cardiorespiratory fitness result in LDL-C, VLDL-C and triglycerides reduction, in part consistent with our findings.

However, physiological mechanisms about the physical exercises associated to healthy profile still aren't understood, being resulted of a complex interaction between hormones, enzymes and receivers. It is suggested that the increase in the lipase activity in the muscle and adiposity tissue during the exercise and some hours after one is associated with a possible reduction in the triglycerides synthesis in the liver, which constitute a favorable metabolic adjustment to the reduction of the lipidics concentrations (WOOD; STEFANICK, 1990 cited by GUEDES; GUEDES, 2001).

Moreover, we can't forget that, the individual $VO2_{máx}$ is 50% determined by genetic heredity (BOUCHARD et al., 1998), and the other half of the variation among the individuals can be attributed to other factors as the behavior. In this direction, the physical exercise is an important stimulation for the increase in the $VO_{2máx}$ in children and adolescents and must be recommended by the physical educators for improvement of the health in the pediatric population.

CONCLUSIONS

Our results demonstrated that adolescents with high $VO_{2máx}$ levels present lesser atherosclerotic risk compared with your pairs with low levels, with lesser mean values of VLDL-C and triglycerides. In this direction, future researches must be developed to elucidate the benefits of the physical exercise on the arterial properties in young individuals.

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ATHEROSCLEROTIC RISK IN ADOLESCENTS WITH DIFFERENT $VO_{2máx}$ LEVELS

ABSTRACT

Introduction: Prospective studies demonstrated that, in adults, high cardiorespiratory fitness takes the atherosclerotic disease reduction. In other hand, differently of the adult population, there are few and contradictory studies about the atherosclerotic risk factors associated with the cardiorespiratory fitness in children and adolescents. Objective: To compare the atherosclerotic risk factors in male adolescents with different $VO_{2máx}$ levels. Methodology: The sample was composed for 121 adolescents with age between 12 to 16 years old. The $VO_{2máx}$ was measured by 20 meters Léger test. The blood pressure was measured using a sphygmomanometer of mercury column. The total cholesterol, HDL and triglycerides were determined through the enzymatic-colorimetric method. LDL and VLDL were than calculated. In the statistical analysis were used the ANOVA's and Tukey post hoc, with $p<0.05$. Results: Significant differences were detected for the VLDL-C ($F=5.04$; $p=0.008$) and triglycerides ($F=5.17$; $p=0.007$) between the groups. In relation to the post hoc test, the VLDL-C and triglycerides presented by the males with low $VO_{2máx}$ were significantly greater than the values found in your pairs with high and moderate $VO_{2máx}$. Conclusion: Our results demonstrated that the adolescents this sample with high $VO_{2máx}$ levels present lesser atherosclerotic risk compared to your pairs with low $VO_{2máx}$, mainly for the VLDL-C and triglycerides concentrations.

KEY-WORDS: Adolescents, $VO_{2máx}$, atherosclerotic risk factors.

RISQUE ATHÉROSCLÉROTIQUE DANS LES ADOLESCENTS AVEC DIFFÉRENTS NIVEAUX de $VO_{2máx}$

RESUME

Introduction: Les études éventuelles ont démontré que, dans les adultes, la forme physique cardiorespiratoire élevée prend la réduction athérosclérotique de la maladie. Dans l'autre main, différemment de la population d'adulte, il y a de petites et contradictoires études au sujet des facteurs de risque athérosclérotiques liés à la forme physique cardiorespiratoire chez les enfants et des adolescents. Objectif: Pour comparer les facteurs de risque athérosclérotiques dans les adolescents masculins à différents niveaux de $VO_{2máx}$. Metodologie: L'échantillon s'est composé pour 121 adolescents avec l'âge entre 12 à 16 années. Le $VO_{2máx}$ a été mesuré par 20 mètres d'essai de Léger. La tension artérielle a été mesurée en utilisant un sphygmomanometer de colonne de mercure. Le tous les cholestérol, HDL et triglycérides ont été déterminés par la méthode enzymatique-colorimétrique. LDL et VLDL étaient que calculés. Dans l'analyse statistique a été employé le poteau d'ANOVA et de Tukey hoc, avec $p<0.05$. Résultats: Des différences significatives ont été détectées pour le VLDL-C ($F=5.04$; $p=0.008$) et triglycérides ($F=5.17$; $p=0.007$) entre les groupes. Par rapport à l'essai hoc de poteau, les valeurs moyennes de VLDL-C et de triglycérides présentées par les

mâles avec bas $VO_{2máx}$ étaient sensiblement plus grandes que les valeurs trouvées dans vos paires avec haut et modéré $VO_{2máx}$. Conclusion: Nos résultats ont démontré que les adolescents de cet échantillon avec les niveaux élevés de $VO_{2máx}$ présentent peu de risque athérosclérotique comparé à vos paires à bas $VO_{2máx}$, principalement pour les concentrations de VLDL-C et de triglycérides.

MOTS CLES: Adolescents, $VO_{2máx}$, facteurs de risque athérosclérotiques.

RIESGO ATEROSCLERÓTICO EN ADOLESCENTES CON DIVERSOS NIVELES DE $VO_{2máx}$

RESUMEN

Introducción: Los estudios anticipados demostraron que, en adultos, la alta aptitud cardiorespiratoria toma la reducción de la enfermedad aterosclerótica. En la otra mano, diferentemente de la población del adulto, hay estudios pequeños y contradictorios sobre los factores de riesgo aterosclerótico asociados a la aptitud cardiorespiratoria en niños y adolescentes. Objetivo: Comparar los factores de riesgo aterosclerótico en adolescentes con diversos niveles de $VO_{2máx}$. Metodología: La muestra fue compuesta por 121 adolescentes con edad entre 12 a 16 años. El $VO_{2máx}$ fue medido de prueba 20 metros de Léger. La presión arterial fue medida usando un sphygmomanometer de la columna del mercurio. El colesterol, HDL y triglycerides totales fueron determinados con el método enzimático-colorimétrico. LDL y VLDL fueron calculados. En el análisis estadístico fue utilizado ANOVA y el post hoc de Tukey, con $p<0,05$. Resultados: Diferencias significativas fueron detectadas para el VLDL-C ($F=5,04$; $p=0,008$) y triglycerides ($F=5,17$; $p=0,007$) entre los grupos. En lo referente a la prueba del post hoc, los valores medios de VLDL-C y triglycerides presentados por los adolescentes con bajo $VO_{2máx}$ fueran perceptiblemente mayor que los valores encontrados en tus pares con alto y moderado $VO_{2máx}$. Conclusión: Nuestros resultados demostraron que los adolescentes de esta muestra con altos niveles de $VO_{2máx}$ presentan poco riesgo aterosclerótico comparado a tus pares con bajo $VO_{2máx}$, principalmente para las concentraciones de VLDL-C y triglycerides.

PALABRAS CLAVES: Adolescentes, $VO_{2máx}$, factores de riesgo aterosclerótico.

RISCO PARA ATEROSCLEROSE EM ADOLESCENTES COM DIFERENTES ÍNDICES DE $VO_{2máx}$

RESUMO

Introdução: Estudos prospectivos têm demonstrado que alta aptidão cardiorrespiratória leva a redução do risco de doença aterosclerótica em indivíduos adultos. Por outro lado, diferentemente da população adulta, estudos sobre estes fatores de risco relacionados à aptidão cardiorrespiratória em crianças e adolescentes além de escassos são contraditórios. Objetivo: Comparar os indicadores de risco para aterosclerose em adolescentes do sexo masculino de diferentes índices de $VO_{2máx}$. Metodologia: A amostra foi composta por 121 rapazes entre 12 e 16 anos de idade. O $VO_{2máx}$ foi mensurado através do teste de 20 metros proposto por Léger. A pressão arterial foi mensurada com um efigmomanômetro de coluna de mercúrio. O colesterol total, HDL e triglicérides foram determinados através do método enzimático-colorimétrico. O LDL e VLDL foram calculados. Na análise estatística foi empregada a Análise de Variância e o *post hoc* de Tukey, com $p<0,05$. Resultados: Diferenças significativas entre os grupos foram detectadas para o VLDL-C ($F=5,04$; $p=0,008$) e triglicérides ($F=5,17$; $p=0,007$). Em relação ao teste de comparação múltipla, os valores médios de VLDL-C e triglicérides apresentados pelos rapazes com baixo $VO_{2máx}$ foram significativamente superiores aos encontrados em seus pares com alto e moderado $VO_{2máx}$. Conclusão: Nossos resultados demonstraram que os adolescentes desta amostra com elevados índices de $VO_{2máx}$ apresentam menor risco aterosclerótico comparados a seus pares com menor $VO_{2máx}$, principalmente para as concentrações de VLDL-C e triglicérides.

PALAVRAS CHAVE: Adolescentes, $VO_{2máx,}$ fatores de risco para aterosclerose.