14 - ASSOCIATION BETWEEN AEROBIC FITNESS AND CARDIOVASCULAR RISK FACTORS IN CHILDREN

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INTRODUCTION

In the last decades, the prevalence of cardiovascular diseases (CVD) has increased all around the world. In Brazil, the CVD represent the largest percentage of the non-communicable diseases, followed by Diabetes Mellitus, both having the overweight as the main cause. (GAMA, 2011).

The emergence of the CVD is associated with risk factor as diabetes mellitus, arterial hipertension, dyslipidemia, obesity, smoking, alcohol consumption, physical inactivity and hyper caloric diet (SANTOS, 2008). The coronary atherosclerosis is one of the most diagnosed diseases among the CVD, that may appear in patients every day younger (GERBER, 1997). There are evidences that the atherosclerotic process may start in childhood and progressively increase with age and with gravity directly proportional to the number of risk factors that the person has (GAMA et. al., 2011). This can be changed through a healthy lifestyle with adequate and less caloric food, associated with the improvement of the physical fitness; determining factors to fight the obesity and cardiovascular diseases. (RIBEIRO, 2006).

The physical fitness is the capacity to practice physical activity (PA) and one of its main components is the aerobic fitness (AF), which is the total capacity of the cardiovascular and respiratory systems to practice vigorous and prolonged exercise (SHINDLER, SIEGERT and KIRCH, 2008). Scientific evidences indicate a relation between aerobic fitness and risk factors with cardiovascular disease (DUBOSE, EISENMANN and DONNELLY, 2007). In foresight studies, the AF in children and teenagers proved a good predictor of the cardiovascular risk factors when adult and it's believed to exert a protective effect in the cardiovascular system since early age (HURTIG-WENNLOF et. al., 2007; REED et. al., 2007; CARNETHON et. al., 2003; TWISK et al., 2002).

This study aimed to analyse the association between aerobic fitness and cardiovascular risk factors in children of 6 to 10 years old.

MATERIALS AND METHOD

Sample: Population under investigation: school children of 6 to 10 years old, regularly attending the 1st to 5th year in public schools of urban areas of Itaúna were eligible to this sample. These students represent a universe of 4649 school children. To calculate the minimum sample in each variable the respective value and standard deviation was used: estimated population (distribution t) and a significance level of 5%. As such, it was opted to assume the maximum sample size among the lowest obtained, which was the value of 228 people related to the insulinemia variable, which in turn, was the limiting variable to the sample for showing the largest variability. Therefore, the size of the sample was defined to 228 students as the minimum to attend the margin of error in the estimated population to all the important variables. However, estimating a loss of 50%, the final sample was defined as 456 children. A stratification of sex and age was done in each school so that the proportion of sex and age was kept. The children with physical or diseases that weren't able to practice physical activity were excluded of the sample.

Ethical aspects: The project was previously approved by the Comitê de Ética em Pesquisa da UFMG (Research Ethics Committee of UFMG, parecer No 0040.0.203.000-10 and by the Comitê de Ética da Universidade de Itaúna (Ethics Committee of Itaúna), parecer 012/10. The study was done with children who were authorized by their parents through signature of written consent forms.

PROCEDURES

Anthropometry: the body mass was gauged with children wearing light clothes, in an eletronic digital scale of “Seca” brand, with maximum capacity of 150 kilograms and precision of 0,1kilogram. The height was measured in a vertical anthropometer “Alturaexata”, with graduation in centimeters (cm) and precision of 0,001mt. Body mass and height were checked twice and the average was considered. The Body Mass Index (IMC) was calculated through the relation between total body mass in kilograms and height in meters squared.

Blood pressure: was checked with an automatic device of blood pressure of the Onrom brand, model HEM711, validated for research (GRIM & GRIM, 2008). Three measurements were taken on the right arm after, at least, 5 minutes of rest with the child sitting and with the arms in a relaxed position. An interval of two minutes between measurements was adopted and the average of the 3 was considered.

Aerobic Fitness: It was evaluated through the estimation of the maximum comsumption of oxigen using the Yo-Yo test (LEGER et. al., 1984), which consists of running back and forth in a 20 meters circuit with progressive intensity until exhaustion. The rhythm of the running was determined by a sound signal produced by a stereo device with a cd specific for the test. The distance was delineated in the sports court or in another paved area inside the school. The test starts with 8.5 km/h and increases 0.5 km/h every minute until the child is unable to keep the rhythm for two consecutive sound signals. Every child was verbally stimulated to reach the peak of effort. To calculate the VO2max, in ml/kg/min, it was used the equation described by Leger and Gadoury (LEGER & GADOURY, 1989): VO2max = 31,025 + 3,238 (final speed of the test in km/h) – 3,248 (age in years) + 0,1536 (final speed x age). This test was validated in a study with children and teenagers (VAN MECHELEN, HLOBIL & KEMPER, 1986).

Laboratory Analysis: After a 12-hour fasting, 10 ml of blood were collected in a disposable plastic syringe and split in two tubes with the same amount of blood in each one. One of the tubes, containing anticoagulant fluoride, was centrifuged to obtain the plasma and the realization of the blood glucose during fasting through the enzimático-automação method on the device Clinline 150 (Biomerieux – USA). Of the remaining 5ml, after centrifugation, the serum was obtained and 500 microliters were taken to the analysis of the total cholesterol and fractionated through the enzymatic colorimetric method to the analysis of

the triacylglycerol through the automation enzymatic method, all done using the device Clinline 150 (Biomerieux – USA). An amount of 1 ml of serum was used to analyse the insulemia through the electrochemiluminescence method.

Statistical Analysis: Due to the non-normal distribution of some variables, the Spearman's correlation was used to evaluate the association of aerobic fitness with each one of the risk factors of CVD. The statistical package SPSS for Windows version 17.0 and a level of probability of $p < 0,05$ was used to indicate statistical significance.

RESULTS

The descriptive characteristics of the sample are shown in Table 1. Differences between sexes were found only in the AF variables, represented by VO2max (p=0,000) and HDL cholesterol (p=0,023).

TABELA 1 – Anthropometric characteristics and cardiovascular risk factors in boys and girls (n=290).

Variable	Girls (n=132)		Boys (n=158)	
	Average	Standard deviation	Average	Standard deviation
Age (years)	8,25	1,35	8,25	1,33
Height (m)	1,32	0,09	1,33	0,10
Body Mass(kg)	29,96	8,86	31,60	8,86
BMI (kg/m ^{2})	16,91	3,56	17,46	3,27
VO_2max (ml/kg/min)	49,92*	3,08	52,04*	3,62
SBP (mmHg)	94,80	9,93	95,81	11,38
DBP (mmHg)	59,26	8,46	57,50	8,94
LDL (mg/dl)	103,69	26,95	100,30	27,95
HDL (mg/dl)	50,18*	10,62	53,09*	10,91
Triacylglycerol (mg/dl)	87,40	39,46	79,77	33,47
Insulin (µUI/ml)	5,81	5,44	4,80	3,96

BMI= Body mass index; VO_2max= maximum oxygen consumption; SBP = systolic blood pressure ; DBP = Diastolic blood pressure ; LDL= low density lipoprotein cholesterol; HDL= high density lipoprotein cholesterol.

Table 2 presents the correlations between aerobic fitness (VO2max) and CVD risk factors.

Table 2 – Spearman's correlation coefficient between VO2max and CVD risk factors DCV in girls and boys of 6 to 10 years (n=290).

	VO² Max. Girls (n=132)		VO² Max. Boys (n=158)	
	Correlation	p Value	Correlation	p Value
BMI	-0, 314	0, 000	-0, 537	0, 000
SBP	-0, 115	0, 191	-0, 309	0, 000
DBP	-0, 173	0, 048	-0, 295	0, 000
HDL	0, 001	0, 991	0, 044	0, 583
LDL	-0, 110	0, 208	-0, 208	0, 009
Triacylglycerol	-0, 342	0, 000	-0, 237	0, 003
Insulin	-0, 401	0, 000	- 0, 371	0, 000

DISCUSSION

The average values of the variables of CVD risk found in this study, except for the LDL (103,69 mg/dl) in girls, are in accordance with the ones considered “desired” by the I Diretriz de Prevenção da Aterosclerose na Infância e na Adolescência (2005) and are similar to the ones found in the “Estudo do Coração de Belo Horizonte” (RIBEIRO et. al., 2006).

There is strong scientific evidence of the association between aerobic fitness and cardiovascular risk factors in adults, but some research are still limited in children. However, negative and significant associations, varying from moderate to high, have been found in children (ANDERSEN et. al., 2006; RIZZO et. al., 2007; RUIZ et. al., 2007; RUIZ et. al., 2006; SHINDLER et. al., 2008, RESALAND et. al., 2009, DUBOSE, EISENMANN e DONNELLY, 2007).

The AF in this study resulted in significant and negative correlation with BMI, PAD, triacylglycerol and insulinemia in girls. In the boys the correlations were stronger ($p<0,01$) and were also significant with the PAS and with the LDL. Maybe the significant difference between the sexes in AF may be the reason why we didn't find significant associations of AF with PAS and LDL in girls. The results of this study are in accordance with other studies that evaluated the association between AF and CVD risk factors in the pediatric population (HURTIG-WENNLOF et. al., 2007; RUIZ et. al., 2007; RUIZ et. al., 2006; RIZZO et. al., 2007). A study of Kriemler et. al. (2008) found an inverse significant association between AF and the sum of four skin folds, insulin resistance and metabolic risk. They also noticed a reduction of 6% to insulin resistance to each increase of a stage in the AF test, the same test used in the current study.

The importance of the AF was emphasized by Kelly et. al. (2004), who found a concomitant improvement in VO2max, in the HDL cholesterol and in the endothelial function after 8 weeks of aerobic training with a group of children and teenagers, when compared to the controlled group without training. A study conducted with children and teenagers who are overweight or obese, submitted to 12 weeks of aerobic training of moderate intensity, 3 times a week, found a significant reduction in the proportion total cholesterol to HDL, in the C-reactive protein and in the body fat, concomitant to a raise in the AF (ROSSETTI, 2008). A study with 9 year-old children showed them to be 13 times more prone to have a grouping of CVD risk factors for those who were in the first quartile in comparison to those who were in the fourth quartile of AF (ANDERSSEN et. al., 2007). Another study with 1140 european children of 9 to 10 years old, found chances 3,09 times bigger of grouping of metabolic risk for girls and

2,42 times bigger for boys when comparing those below the percentile 75 with those above the percentile 75 of AF (RUIZ et. al., 2007). Ruiz et. al.(2006) found significant differences between the first and fourth quartiles of AF in resistance to insulin (HOMA index) for both sexes, as well as between the first and fourth quartiles for triacylglycerol and proportion of total cholesterol total to HDL in girls.

Even in overweight children, a better AF attenuates the metabolic risk and of CVD. Although the mechanisms to explain this effect haven't been explored, it possibly involves the genetic aspects, adipocytokine and oxidative capacity of the skeletal muscles (DUBOSE, EISENMANN e DONNELLY, 2007). Different possible mechanisms could explain the association between AF, PF and CVD risk factors. The reduction of blood pressure in more physically active children could be explained by direct mechanisms, including neuro-humoral, vascular and structural adaptations. The physical activity increases the consumption of glucose by the active muscles, process regulated by the translocation of GLUT4 to the plasma membrane and transversal tubules. The increasing of GLUT4 in the muscles of trained people contributes to an increase in the sensitivity of the muscle membrane to insulin (SHINDLER et. al., 2008). In a study by Kriemler et. al. (2008), AF was significantly associated with obesity, increase in the resistance to insulin and raising of the score of metabolic risk, particularly worsening of the lipid profile. The association between AF and CVD risk factors is weak and is only statistically significant in large samples, being even weaker in children, because there are fewer completely sedentary children than adults (FROBERG et. al., 2005). These authors highlight that the PF is more difficult to measure and demonstrates greater variation than the AF in children, maybe that's why the relation between AF and risk factors is greater. Moreover, the AF is closely linked to the body weight and obesity, what may partially explain the greater relation between AF and grouping of CVD risk factors. Although the current study has found some differences in the associations between AF and risk factors in both sexes, these associations, confirmed in recent literature, leads us to believe the importance of the evaluation and interpretation of AF by the physical education professional in the school environment.

CONCLUSION

The aerobic fitness was negatively and significantly associated, in both sexes, with BMI, diastolic blood pressure, triacylglycerol and insulin. Negative and significant correlation was also noticed with systolic blood pressure and LDL only for boys. It is recommended that the aerobic fitness should be part of the monitoring of the health of the pediatric population.

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ASSOCIATION OF AEROBIC FITNESS WITH CARDIOVASCULAR RISK FACTORS IN CHILDREN

ABSTRACT

Objective: to identify the association of aerobic fitness with cardiovascular disease risk factors in children. Methods: cross-sectional study with 290 school children of 6 to 10 years old of both sexes, randomly selected. The aerobic fitness was assessed by the 20 meters shuttlle run test (Yo-Yo test).Blood was collected after a 12-hour fasting period. Blood pressure, stature and weight were evaluated in accordance with international standards. As cardiovascular risk factors, it was considered: body mass index (BMI), systolic and diastolic blood pressure (SBP or DBP), HDL and LDL cholesterol, triglycerides and insulin levels. Spearman's coefficient was used to identify the association between the variables. Results: significant inverse correlations were found, in both sexes, among aerobic fitness and BMI, DBP, triglycerides and insulin levels. Significant inverse correlations were found, only in boys, among aerobic fitness and PAS and LDL cholesterol. Conclusion: the significant associations among aerobic fitness and cardiovascular risk factors in children justify the use of these variables in monitoring the health in pediatrics.

KEYWORDS: children, cardiovascular risk, aerobic fitness.

ASSOCIATION DES CAPACITÉ AÉROBIC AVEC FACTEURS DE RISQUE CARDIOVASCULAIRE CHEZ LES ENFANTS

RÉSUMÉ

Objectif: Identifier l'association de capacité aérobique (CA) avec facteurs de risque de maladie cardiovasculaire chez les enfants. Méthodes: Une étude transversale de 290 écoliers âgés de 6 à 10 ans des deux sexes, choisis au hasard. La CA a été évaluée par le test allez-retour 20 mètres. Données recueillies dans le sang après un jeûne de 12 heures. La pression artérielle, la taille et le poids ont été évalués conformément aux normes internationales. Ont été considérés comme des facteurs de risque cardiovasculaire: l'indice de masse corporelle (IMC), tension artérielle systolique ou diastolique (TAS et la TAD), HDL et LDL cholestérol, de triglycérides et d'insuline. Nous avons utilisé de corrélation de Spearman pour identifier l'association entre les variables. Résultats: corrélations significatives et négatives ont été trouvés dans les deux sexes, entre aérobique et de l'IMC, le TAD, de triglycérides et d'insuline. Chez les garçons il y avait aussi une corrélation négative significative avec la TAS et de LDL cholestérol. Conclusion: Les associations significatives entre la capacité aérobique et des facteurs de risque cardiovasculaires chez les enfants de cette étude justifient l'utilisation de ces variables sur la surveillance de la santé en pédiatrie.

MOTS-CLÉS: enfants, risque cardiovasculaire, condition physique aérobic.

ASOCIACIÓN DE CONDICÍON FÍSICA AERÓBICA CON FACTORES DE RIESGO CARDIOVASCULAR EN NIÑOS

RESUMEN

Objetivo: Determinar la asociación de condicíon física aeróbica (CFA) con factores de riesgo de enfermedad cardiovascular en los niños. Métodos: Estudio transversal con 290 niños de 6 a 10 años de ambos sexos, seleccionados al azar. La CFA fue evaluada por el test de carrera de ida y vuleta en 20 metros. La sangre fue recogida después de un ayuno de 12 horas. La presión arterial, la altura y el peso se evaluarán de acuerdo con los estándares internacionales. Se consideran factores de riesgo cardiovascular: el índice de masa corporal (IMC), presión arterial sistólica o diastólica (PAS y PAD), HDL y LDL colesterol, triglicéridos e insulina. Se utilizó la correlación de Spearman para determinar la asociación entre las variables. Resultados: La correlación significativa y negativa fueron encontrados en ambos sexos, entre aptitud aeróbica y el IMC, la PAD, triglicéridos e insulina. En los niños también hubo una correlación negativa significativa con la PAS y LDL. Conclusión: Las asociaciones significativas entre la condición física aeróbica y los factores de riesgo cardiovascular en los niños de este estudio justifican el uso de estas variables sobre vigilancia de la salud en pediatría.

PALABRAS CLAVE: niños, riesgo cardiovascular, condicíon física aeróbica.

ASSOCIAÇÃO DA APTIDÃO FÍSICA AERÓBICA COM FATORES DE RISCO CARDIOVASCULAR EM CRIANÇAS

RESUMO

Objetivo: identificar a associação da aptidão física aeróbica (AFA) com fatores de risco de doenças cardiovasculares em crianças. Métodos: estudo transversal com 290 escolares de 6 a 10 anos de ambos os sexos, aleatoriamente selecionados. A AFA foi avaliada pelo teste de corrida de vai-e-vem de 20 metros (Yo-Yo teste).Coletou-se o sangue após jejum de 12 horas. A pressão arterial, a estatura e peso foram avaliados segundo padrões internacionais. Foram considerados fatores de risco cardiovascular: índice de massa corporal (IMC), pressão arterial sistólica ou diastólica (PAS ou PAD), colesterol HDL e LDL, triacilgliceróis e insulinemia. Utilizou-se a Correlação de Spearman para identificar a associação entre as variáveis. Resultados: correlações negativas e significativas foram encontradas, nos dois sexos, entre aptidão física aeróbica e IMC, PAD, triacilgliceróis e insulinemia. Nos meninos houve correlação negativa e significativa também com PAS e LDL. Conclusão: as associações significativas entre aptidão física aeróbica e fatores de risco cardiovascular nas crianças desse estudo justificam o uso dessas variáveis no monitoramento da saúde em pediatria.

PALAVRAS-CHAVE: crianças, risco cardiovascular, aptidão física aeróbica.