

The influence of the Aerobic Conditioning and Body Mass Index on Cardiovascular Risk: a study on the military Students of the Command and General Staff Course at the Brazilian Air Force in 2011

La influencia del Condicionamiento Aeróbico y del Índice de Masa Corporal en el Riesgo Cardiovascular: un estudio en militares del Curso de Comando y Estado-Mayor de Aeronáutica de 2011

A influência do Condicionamento Aeróbico e do Índice de Massa Corporal no Risco Cardiovascular: um estudo em militares do Curso de Comando e Estado-Maior da Aeronáutica de 2011

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ABSTRACT

The research investigated the relation between the degree of Aerobic Conditioning (AC) and individual risk for the development of cardiovascular diseases – the Cardiovascular Risk (CVR) – in the group of military students of the Command and General Staff Course at the Brazilian Air Force, 2011. 88 subjects (80 men and 8 women) out of 171 students were evaluated. The stratification of the sample, according to the CVR, was based on the Framingham Risk Score. The method assigns to each individual proportional scores to the presence and magnitude of certain risk factors (hypertension, diabetes, age, smoking and changes in cholesterol), estimating his CVR in the next 10 years. According to this methodology, using data from the latest annual health inspection of the study group, 44 students presented RCV < 5%, 41 between 5 and 9% and 3% had cardiovascular risk > 10%. AC was assessed through the ergometric test performance. The AC of 55 individuals was considered excellent, good AC, 30; regular or weak AC, 3. In order to draw a parallel with a variable admittedly linked to cardiovascular diseases, it also evaluated the body mass index of the sample, relating the CVR with the parameters of the body weight found. Twenty-six students were registered within the normal weight range, 43 with overweight and 19 with parameters of obesity. No significant difference ($p > 0.05$) in the CVR was found among individuals with excellent aerobic performance and the others, (unlike the cardiovascular risk observed in individuals with overweight /obesity), significantly higher than the CVR found in the group of ideal body weight.

Keywords: Cardiovascular Risk. Aerobic Fitness. Body mass index. Military medicine.

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RESUMEN

El estudio investigó la relación entre el grado de condicionamiento aeróbico (CA) y el riesgo individual para el desarrollo de enfermedades cardiovasculares – riesgo cardiovascular (RCV) – en el grupo de alumnos del Curso de Comando y Estado Mayor de Aeronáutica de 2011. Fueron evaluados 88 individuos (80 hombres y 8 mujeres) de 171 alumnos del curso. La estratificación del RCV del muestreo fue realizada según el esquema de riesgo de Framingham. El método atribuye a cada individuo puntuaciones proporcionales a la presencia y magnitud de determinados factores de riesgo (hipertensión, diabetes, edad, tabaquismo y alteraciones en el colesterol), estimando su RCV en los próximos 10 años. Según esa metodología, utilizando los datos de la última inspección anual de salud del grupo estudiado, 44 alumnos presentaron RCV < 5%, 41 entre 5 y 9% y 3 presentaron RCV > 10%. El CA fue evaluado a través del desempeño en el test de ergometría. Obtuvieron CA excelente, 55 individuos; CA bueno, 30; CA regular o flaco, 3. Con la finalidad de trazar un paralelo con una variable relacionada a las enfermedades cardiovasculares, también fue evaluado el índice de masa corporal del muestreo, relacionando el RCV con los parámetros de peso corporal encontrados. Fueron computados 26 alumnos con peso normal, 43 con sobrepeso y 19 con obesidad. No fue encontrada diferencia significativa ($p > 0,05$) cuanto al RCV entre los individuos con desempeño aeróbico excelente y los demás, en contrapunto al RCV observado en los individuos con sobrepeso/obesidad, significativamente mayor que aquel encontrado en el grupo de peso ideal.

Palabras-clave: Riesgo Cardiovascular. Condicionamiento Aeróbico. Índice de masa corporal. Medicina militar.

RESUMO

Nesta pesquisa investigou-se a relação entre o grau de Condicionamento Aeróbico (CA) e o risco individual para o desenvolvimento de doenças cardiovasculares – Risco Cardiovascular (RCV) - no grupo de alunos do Curso de Comando e Estado-Maior da Aeronáutica de 2011. Foram avaliados 88 indivíduos (80 homens e 8 mulheres) de 171 alunos do curso. A estratificação do RCV da amostra foi realizada segundo o escore de risco de Framingham. O método atribui a cada indivíduo escores proporcionais à presença e magnitude de determinados fatores de risco (hipertensão, diabetes, idade, tabagismo e alterações no colesterol), estimando seu RCV nos próximos 10 anos. Segundo essa metodologia, utilizando-se os dados da última inspeção anual de saúde do grupo estudado, 44 alunos apresentaram RCV < 5%, 41 entre 5 e 9% e 3 apresentaram RCV > 10%. O CA foi avaliado através do desempenho no teste ergométrico. Obtiveram CA excelente, 55 indivíduos; CA bom, 30; CA regular ou fraco, 3. A fim de traçar um paralelo com uma variável reconhecidamente atrelada às doenças cardiovasculares, também foi avaliado o índice de massa corporal da amostragem, relacionando o RCV com os parâmetros de peso corporal encontrados. Foram computados 26 alunos na faixa de peso normal, 43 com sobrepeso e 19 com parâmetros de obesidade. Não foi encontrada diferença significativa ($p > 0,05$) quanto ao RCV entre os indivíduos com desempenho aeróbico excelente e os demais, em contraponto ao RCV observado nos indivíduos com sobrepeso/obesidade, significativamente maior daquele encontrado no grupo de peso ideal.

Palavras-chave: Risco Cardiovascular. Condicionamento Aeróbico. Índice de massa corporal. Medicina militar.

1 INTRODUCTION

Cardiovascular diseases are diseases affecting the heart and blood vessels. They are mainly represented by the cerebrovascular accidents (CVA) and coronary artery disease (CAD), involved in the genesis of the angina and acute myocardial infarction (AMI). They are responsible for almost a third of all diseases that cause absence from work and represent the leading cause of medical spending in the *Sistema Único de Saúde* (SUS - Unified Health System), with 16.2% of the total (DIAS, 2001). According to Godoy *et al.* (2007), they represent about a third of all deaths in Brazil and 65% of deaths for people between 30 and 69 years old, affecting individuals in their fully productive phase.

Accordingly, knowledge of which factors are related to a higher incidence of these diseases is fundamental, the so-called risk factors. However, more important than considering each risk factor separately is to evaluate individuals according to their overall risk, considering all the predisposing conditions in order to identify high-risk patients and motivate them to

adopt changes in their lifestyle and adhere to the therapeutic measures when so indicated (SPOSITO *et al.*, 2007).

The practice of sports is common practice in the military environment. In addition to the entertainment component and social life provided by amateur sports competition such as football, tennis, etc., much of the military engage in exercise seeking protection for their health, often surpassing their limits in pursuit of a higher aerobic conditioning. However, the degree of cardiovascular protection achieved with such a condition is not uniformly established. Trying to find the relationship between these variables in a large and homogeneous group instigated the author to perform the research.

Considering the convergence of literature affirming that individuals with weight above the ideal range have increased cardiovascular risk, data on weight and height of analyzed students were also collected in order to obtain the Body Mass Index (BMI) and check its impact on cardiovascular

risk score in our sample, in order to draw a parallel with the influence of aerobic conditioning, illustrating its magnitude.

This research presents unique relevance to the Brazilian Air Force Command (COMAER) to the extent that it studies an important fragment of its contingent of senior officers, the group of students of the CCEM. Knowing the risk profile of the group in an extremely prevalent disease, correlating with conditions that might influence such prognosis, meets the interests of COMAER, aiming to finally stimulate preventive actions to streamline costs and preserve their human resources, maintaining its full operability.

Thus, this study sought to identify the extent to which aerobic conditioning and Body Mass Index influence the cardiovascular risk profiles of the students of CCEM in 2011 in light of the scale of *Framingham*.

2 LITERATURE REVIEW

2.1 Cardiovascular disease and its risk factors

When it comes to cardiovascular risk, it is basically considered as the possibility of the occurrence of events related to coronary artery disease (CAD) or to cerebrovascular accidents (CVA). They are the most important expressions of CVD by its severity and prevalence, and risk scores based on the occurrence of these events (GODOY *et al.*, 2007).

Both the CAD as CVA have a pathophysiological genesis in chronic degenerative changes within the arteries, which results in atherosclerosis, sharing the same predisposing factors, known as risk factors (MERELE, 2007).

Risk factors for cardiovascular disease are divided between the immutable, that cannot be changed by the environment, such as age, gender and family history, and changing those that can be controlled or reversed by changes in life habits or other health actions. In the latter group, there are smoking, obesity, sedentary lifestyle, stress, hypertension, diabetes *mellitus* and dyslipidemia (clinical conditions characterized by abnormal blood plasma levels of lipids). The synergistic combination of these predisposing conditions promotes the development of atherosclerosis and consequently of CVD. The number and severity of factors involved involve varying degrees of risk, measured objectively through scores (BRAZIL, 2006).

2.2 Framingham risk score

The global risk assessment is performed using scores based on large and long population studies. The most used assessment is the Framingham score, centered in the Framingham Heart Study, a work that began in 1948 (and is still going on) in a small town near Boston, in the United States, and is on its third generation of researchers. He estimates the individual cardiovascular risk (CR) in 10 years, based on predisposing factors determined in the study. Markers and

newer diagnostic techniques have been included in the study over the years, to the extent that they arise and are relevant. Much of the scientific knowledge regarding CVD comes from this work (LOTUFO, 2002; POLANCZYK, 2005).

Wilson *et al.* (1998) developed the Framingham Risk Score (ERF) through a 12-year follow-up of 5345 patients, with ages from 30 to 74 years old, and of these, 2489 men and 2856 women. During the study period, 383 men and 227 women had cardiovascular events with statistically significant association related to the variables used for preparation of the risk score. This methodology has been widely used to quantify the percentage of individual risk for developing CVD and guides the intensity of the therapeutic and/or preventive measures (SPOSITO, 2007).

2.3 Physical activity and cardiovascular risk

Physical inactivity is a major risk factor involved in the increased incidence of various diseases, in particular those from cardiovascular origin. Physical exercise has beneficial effects over mortality rates, positively influencing the quality and life expectancy of individuals (COOPER, 1990; YUSUF *et al.*, 2004).

Physical activity need not be vigorous in order to obtain these benefits. In primary prevention programs, the recommendation is the accumulation of thirty minutes of moderate exercise on most days of the week. It is important to emphasize that the activity that does not allow for maintenance of a normal level of conversation is considered intense (BRAZIL, 2006).

It is not established that a more intense level of training or a more established aerobic capacity has protective character against CVD in the general population. Demetra *et al.* (2008), in a prospective study, examined the relationship between physical conditioning and obesity on cardiovascular risk scores. The analysis concluded that aerobic conditioning has a weak relation to cardiovascular risk protection, while body fat exerted significant influence on risk prediction of events, regardless the cardiopulmonary capacity presented by the individuals of the sample analyzed.

Blair *et al.* (2001), in a review of 67 papers, concluded that there was not sufficient evidence to establish that a more developed aerobic conditioning outweighs the habit of regular practice of moderate physical activity with no highlights for cardiopulmonary conditioning in reducing mortality from any cause in the general population. They, in fact, observed a strong relationship between body fat and the increase of deaths from any cause.

2.4 The impact of obesity on cardiovascular risk

Obesity is currently considered a worldwide epidemic. Its causes are partly explained by issues related to heredity, but

environmental factors are the main factors responsible for its prevalence. The inadequate nutrition of Western daily life, combining increasingly calorie components with increasingly generous portions, the epidemic of obesity is a fact that seems irreversible. Associated with this, technological innovations, for all the benefits they can offer to society, bring in their wake a growing economy of body calorie expenditure in tasks that used to be routine, and absorb the free time of modern man in entertainment, and irresistible as devoid energy consumption. Such a disproportionate balance between intake and calorie consumption promotes the storage of energy as fat, resulting in obesity (PEREIRA *et al.*, 2003).

Excess weight is directly related to the so-called metabolic syndrome, in which the association of increased blood glucose, abnormal blood lipids and hypertension risks potentiate the cardiovascular (BRANDÃO, 2005).

The reduction in body weight is associated with improved lipid profile, increasing HDL-cholesterol (with protective effect against atherosclerosis) and reducing the triglycerides rate (harmful action of the arteries), and reduces

the hypertension rates. Thus, treatment of obesity is seen in the context of any comprehensive program of prevention of CVD (GIGANTE *et al.*, 1997; PITANGA; LESSA, 2007).

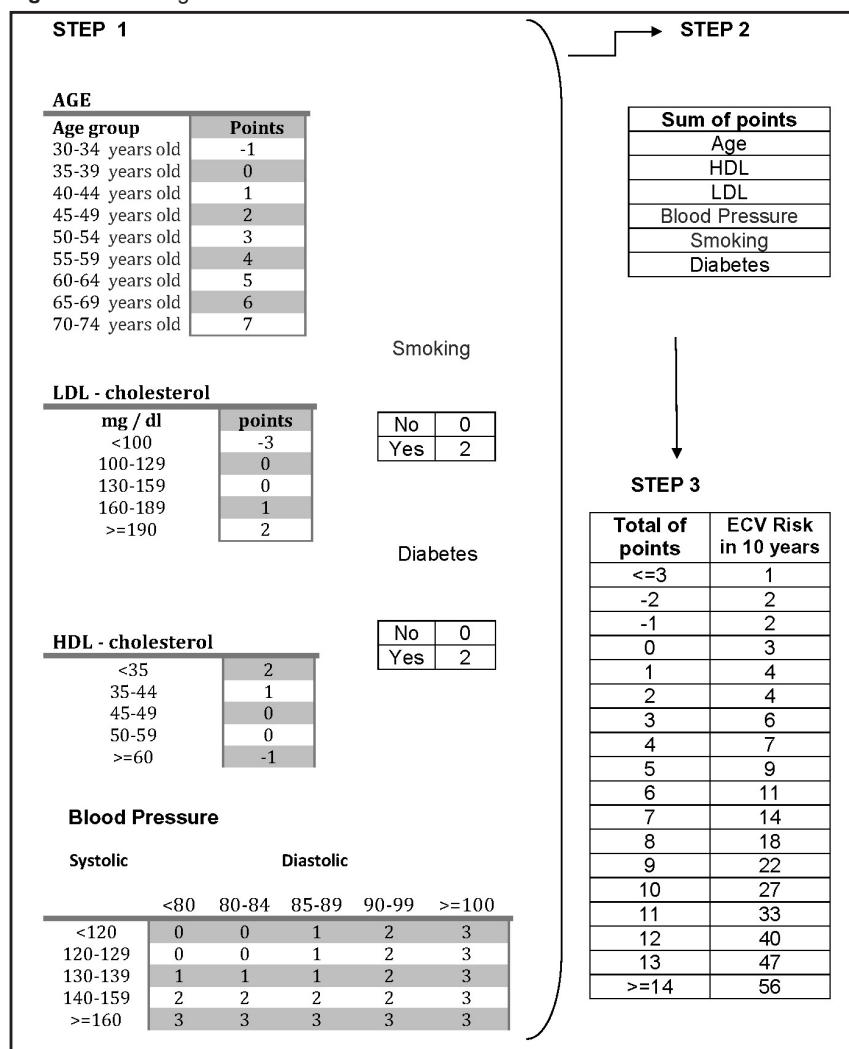
3 MATERIALS AND METHODS

The universe studied was the group of students of CCEM/2011 of COMAER, totaling 171 senior officers, the Lieutenant Colonel and Major, being 162 male and 9 female.

The sample was represented by all students of CCEM/2011 who agreed to participate and for which it was possible to retrieve the laboratory data for the last regular health inspection. This amount corresponded to 88 individuals, 80 men and 8 women.

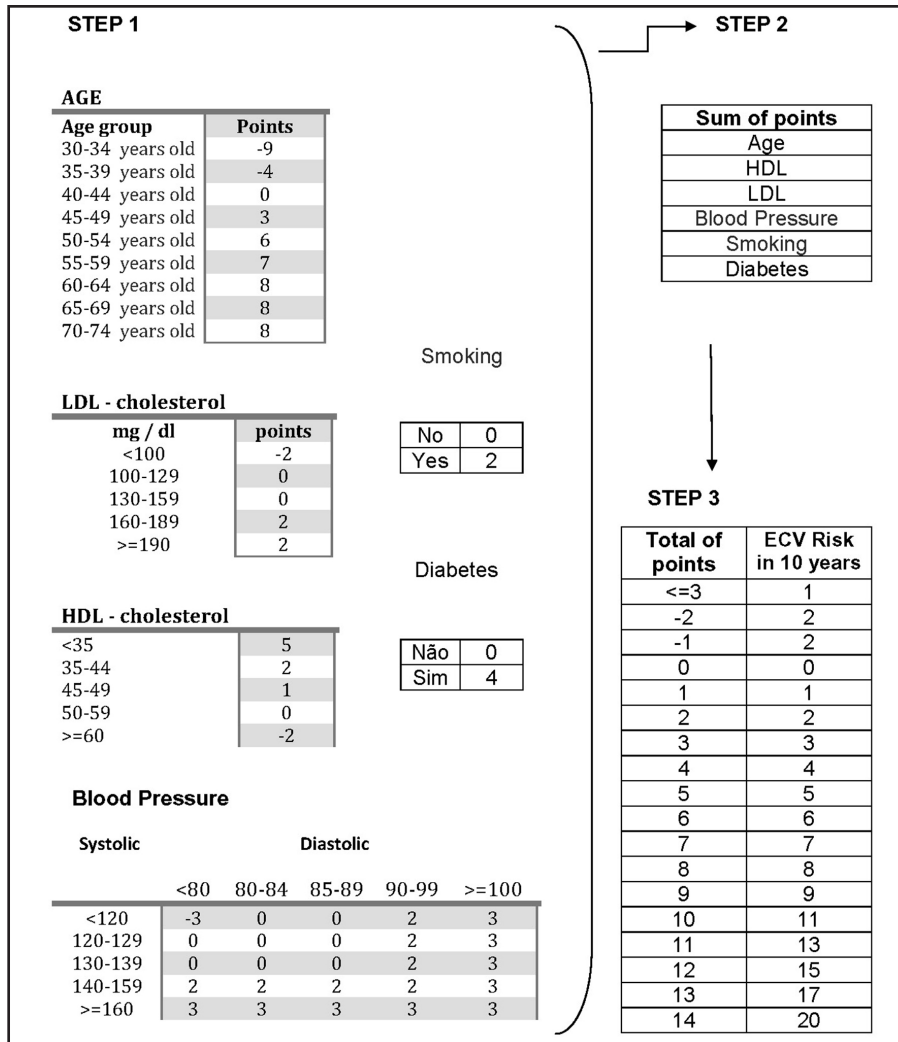
The cardiovascular risk stratification was based on the application of the Framingham score, which estimates the percentage probability of the person experiencing a cardiovascular event in the next ten years. The method classifies the risk profiles at various levels, assigning degrees according to parameters detailed in Figures 1 and 2, corresponding to the calculations in male and female, respectively.

Figure 1: Framingham score for men.



Reference: Brazil (2006).

Figure 2: Framingham score for women.



Reference: Brazil (2006).

As mentioned earlier, one of the Framingham score's biggest criticisms is the excessive weight that it attributes to the age in sum, which may overestimate the risk in age ranges and underestimate it in younger individuals. In order to define the convenience of adopting preventive or therapeutic measures that interfere favorably on predisposing factors, Mafra and Oliveira (2008) describe the calculation of the relative risk of each individual by projecting their future risk, at the age of 60 years old. This method was used in this study in order to properly compare the variables, based only on factors that are influenced by the environment, since the age factor (with great weight in the score), is unchangeable. Thus, for the specific purpose of correlating cardiovascular risk with the aerobic performance presented in the treadmill test, the relative Framingham score was calculated projecting the age of 60 years old for all individuals in the sample, leveled with the same score in this regard.

All participants were volunteers and received information about their goal, on the data collected and the methods used, filling out an individual questionnaire

and consenting to terms of the study approved by the Institutional Ethics Committee. They assigned a number to each individual in the sample, which was linked to the data collected, guaranteeing the confidentiality thereof. The results and conclusions of the research were published in audiovisual presentation at the end of the study for the group of students of CCEM/2011.

The blood dosage of the HDL-cholesterol, LDL-cholesterol and glucose levels were obtained through recovery of the data of the last regular Health Department, all in the period between December 2010 and February 2011, is the same methodology used to obtain the blood pressure levels of the participants of the research.

A diagnosis of diabetes was considered if a fasting glucose was equal to or less than 126 mg/dl, or if their was a prior diagnosis of the disease. To this end, as well as to inquire about the presence or absence of smoking, the participants of the study were requested to fill out a questionnaire.

The aerobic conditioning was assessed through cardiopulmonary capacity observed during a treadmill test

(Bruce protocol), compulsory for all students for admission on the CCEM. The test is performed on electric treadmill with progressive stages of speed/slope and concomitant electrocardiographic monitoring. Its primary goal is the eventual detection of ischemic myocardial response to physical stress. Moreover, it classifies individuals into four different degrees of aerobic or cardiopulmonary physical conditioning: excellent, good, average and poor, according to the estimated maximum volume of oxygen consumption (VO^2 max).

The degree of aerobic conditioning was assessed by the VO^2 max attained during the treadmill test performed by each participant in the study. In a progressive exercise test (treadmill test ergometry), oxygen consumption gradually increases with the increase of work (increase during acceleration and incline of the treadmill). The VO^2 max is identified when the increment of effort no longer causes an elevation of oxygen consumption by the lungs. At this level, the increase of energy production is through anaerobic metabolism. This limit, also called the aerobic threshold, is used to determine the cardiopulmonary capacity of the individual (AMERICAN COLLEGE SPORTS MEDICINE, 2000). According to Brito *et al.* (2002), the ideal verification of VO^2 max is that which is performed by direct measurement of exhaled gases through ergospirometry. The value of the VO^2 max in the simple treadmill test is obtained indirectly, taking into account parameters of performance on the test, therefore subject to some variations and being one of the limitations of the study.

The parameters of nutritional status were assessed using the Body Mass Index (BMI), obtained through the result of dividing the amount of the individual's weight in kilograms by height in meters raised to the second power. The data for this variable were collected during the suitability and physical conditioning test (TACF) applied to the students of CCEM in the first half of 2011. The sample was divided among individuals with normal weight (BMI between 19.5 and 24.9 kg/m^2), overweight (BMI between 25 and below 30 kg/m^2) and obesity (BMI 30 kg/m^2 or higher).

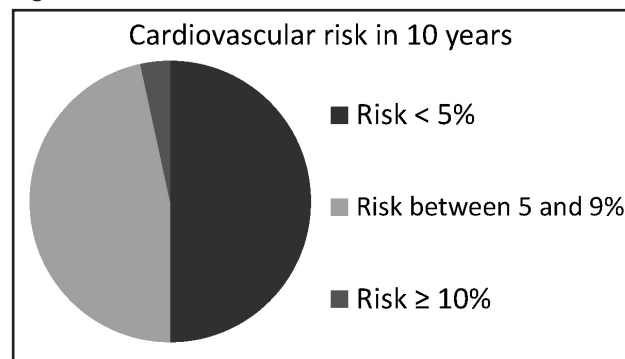
4 PRESENTATION AND ANALYSIS OF RESULTS

Regarding aerobic conditioning, the sample analyzed was divided into two groups, the first of which were characterized as excellent performance and the second of which failed to achieve the minimum indexes for the same concept; that is, individuals who reached the poor, average and good performances. According to the assessment made by the treadmill test, 55 individuals achieved an excellent aerobic conditioning degree, 30 individuals achieved a good degree, 3 of them achieved an average degree and only 1 achieved a poor conditioning assessment.

Regarding the absolute risk of developing a cardiovascular event in the next 10 years, according to the criteria of the Framingham score, 44 students were at a risk

below 5%, 41% between 5 and 9% and 3 students had a risk higher than 10%. Figure 3 illustrates the observed values.

Figure 3: Absolute cardiovascular risk in students of CCEM/2011.



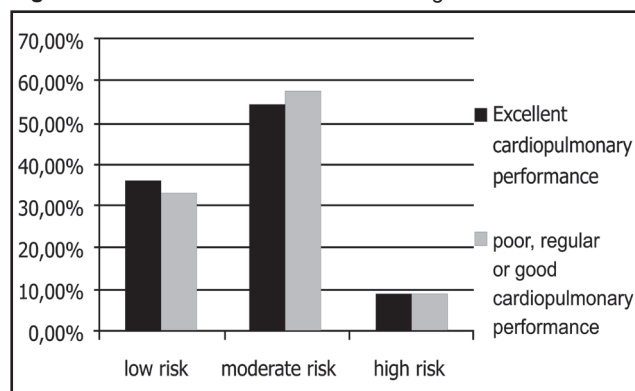
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Cardiovascular risk stratification of the sampling was conducted on three levels, assigning degrees of risk according to the Framingham score: low (less than 10%); moderate (between 10 and 19%); and high (above 20%, inclusive), intended for people over 60, who achieved the same score on the age factor.

The sample was divided into two levels of aerobic conditioning, assessed by VO^2 max attained during the treadmill test: one group, defined as excellent conditioning, and a second group, which included the conditioning levels considered as good, average and poor (grouped by low frequency observed in average and poor levels).

Figure 4 illustrates the percentage of occurrence of the degrees of cardiovascular risk in each group according to the Framingham score. It was observed that 20 of 55 individuals with physical conditioning considered as excellent (36.36%) and 11 of 33 from the group with poor conditioning degrees, moderate or good conditioning (33.33%) had low cardiovascular risk. Moderate risk was presented by 30 individuals with excellent aerobic performance (54.54%) and 19 from the second group (57.57%). In the range of high risk, 5 individuals from the excellent cardiovascular performance group and 3 from the second group. Both groups were observed with 9.09% of their samples in this risk range.

Figure 4: RCV related to aerobic conditioning.

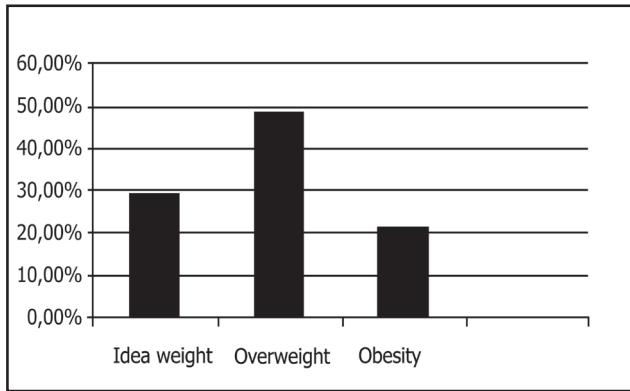


Reference: The author.

According to the above findings, there was no statistically significant difference ($p > 0.05$) between groups with excellent aerobic conditioning and those with lower performance with respect to the risk of developing cardiovascular disease events in 10 years, according to the Framingham score in our sample analyzed.

In relation to body mass index (Figure 5), only 26 students studied (29.5%) were in the normal weight range, 43 (48.9%) stood in the overweight range and 19 (21.6%) have reached obesity parameters.

Figure 5: Distribution of students of CCEM/2011 according to BMI.

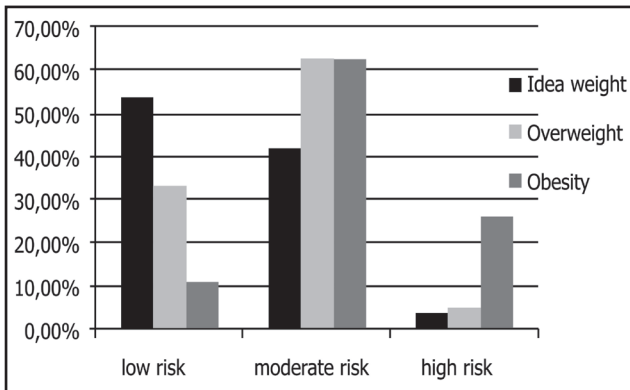


Reference: The author.

One concern is the large percentage of students in obesity and overweight ranges, particularly when we consider the relationship between these conditions and the occurrence of CVD (PITANGA; LANE, 2007).

As shown in Figure 6, distribution in the low cardiovascular risk range included 14 out of 26 individuals with normal weight (53.85%), 14 out of 43 were included in the overweight range (32.56%) and only 2 (10.53%) out of 19 students were considered obese. Eleven normal-weight individuals stood in the moderate risk (42.31%), 27 overweight (62.79%) and 12 obese (62.90%). In the high-risk range, there was only 1 individual with a normal weight (3.85%), 2 (4.65%) in the overweight range and 5 (26.32%) individuals considered obese.

Figure 6: Degrees of CR related to BMI in students of CCEM/2011.



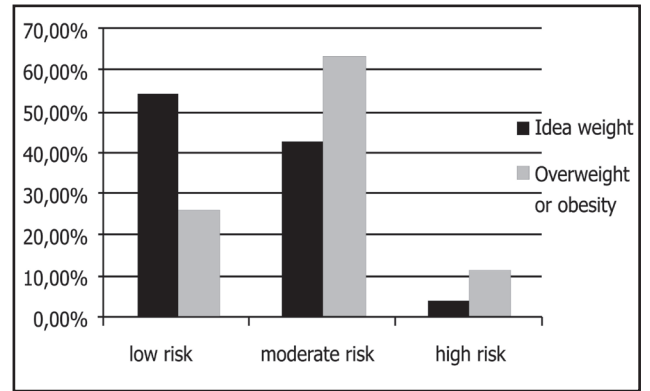
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It can be observed that more than half of individuals with normal weight were within the low CR condition,

where only about 10% of the obese were framed. Also evident was the higher prevalence of obese individuals in the range of vascular high risk. In relation to the moderate CR, the variable BMI resulted in decreased risk only in individuals with ideal weight.

Figure 7 tries to scale the isolated impact of the ideal weight variable in relation to other body mass indices, comparing individuals framed in ideal weight parameters to the rest of the sample, which showed overweight and obesity indices in different ranges of cardiovascular risk.

Figure 7: Impact of the condition of ideal weight in the students' CR of CCEM/2011.



Reference: The author.

According to the results of Figure 7, we observed a statistically significant difference ($p < 0.05$) between the group of normal weight and the one represented by overweight/obese individuals, according to the Framingham score. The results underscore the importance of maintaining body weight within the ideal range in order to minimize cardiovascular risk.

The findings are consistent with those described by Demetra *et al.* (2008) and Blair *et al.* (2001), discussed in the literature review, since the degree of aerobic conditioning as an isolated factor did not affect the CR, in contrast to the presence of the obesity and overweight conditions, which found a close relationship with this risk in the studied group.

5 CONCLUSION

Avoid a sedentary lifestyle is clear in the literature a protective factor against a variety of diseases, especially cardiovascular diseases. However, the question remains as to whether a more refined level of aerobic conditioning implies a greater protection.

This research intended to study the cardiovascular risk profile of official students of CCEM/2011, stratifying the sample studied on severity levels of this risk, verifying its relation to the degree of aerobic conditioning and, in parallel, with the nutritional status.

In this sample, the data analysis showed that the level of aerobic conditioning did not influence the probability of occurrence of any cardiovascular disease event in 10 years. However, significant influence in this

risk was assessed by Body Mass Index; the individuals who performed in the normal range in this parameter obtained scores statistically lower risk compared to those who scored in levels of overweight and obesity.

The results are in accordance with those reported in the literature. Under the COMAER, they refer their focus on the bases of prevention and health promotion impose over their effective, in order to warn about the importance of prioritization of actions on the variables of greatest impact in reducing morbidity and mortality,

avoiding misunderstandings and the most relevant conditions non-reversible for predicting diseases.

This study intends to instigate a discussion on the topic, encouraging the realization of new research and the expansion of knowledge about this group of diseases ever so prevalent. It intends, in the broader sense, to provide a simple share of contribution to the broad scientific knowledge already built around the area, inspiring prevention and health promotion actions that provide an effective impact on longevity and quality of life of individuals.

REFERENCES

AMERICAN COLLEGE SPORTS MEDICINE

Guidelines for Exercise Testing and Prescription. 6. ed. Philadelphia: Lippincott Williams & Wilkins, 2000.

AZAMBUJA, M. I. et al. Impacto econômico dos casos de doença cardiovascular grave no Brasil: uma estimativa baseada em dados secundários. **Arquivos Brasileiros de Cardiologia**, v. 88, n. 91, n. 3, set. 2008.

BLAIR, S. N., et al. Is physical activity or physical fitness more important in defining health benefits? **Medicine Science Sports Exercise**, v. 33, n. 6, p. 379-399, 2001.

BRANDÃO, A. P. I Diretriz brasileira de diagnóstico e tratamento da síndrome metabólica. **Arquivos Brasileiros de Cardiologia**, v. 84, Suplemento I, abr. 2005.

BRASIL. Ministério da Saúde. **Cadernos de prevenção básica**, v. 14, 2006. Disponível em: <<http://bvsm.sau.gov.br/bvs/publicacoes/abcad14.pdf>>. Acesso em: 02 mai 2011.

BRAUNWALD, E. **A textbook of cardiovascular medicine**. 8. ed. Philadelphia: Saunders Elsevier, 2008.

BRITO, F. B. et al. II diretrizes brasileiras sobre teste ergométrico. **Arquivos Brasileiros de Cardiologia**, v. 78, Suplemento I, abr. 2002.

COOPER, Kenneth H. **Programa aeróbico para o bem estar total**. 3. ed. Rio de Janeiro: Melory, 1990.

DEMETRA, D. C. et al. Fitness is a better predictor of cardiovascular disease risk factor profile than aerobic fitness in healthy men. **Circulation**, 2005. Disponível em: <<http://circ.ahajournals.org/content/111/15/1904.abstract>>. Acesso em: 02 jul. 2011.

DIAS, Elizabeth C. **Doenças relacionadas ao trabalho: Manual de Procedimentos para os Serviços de Saúde**. Brasília: Editora MS, 2001.

GIGANTE, D. P. et al. Prevalência de obesidade em adultos e seus fatores de risco. **Revista de Saúde Pública**, v. 31, n. 3, p. 236-46, 1997.

GODOY, M. F. et al. Mortalidade por doenças cardiovasculares e níveis socioeconômicos na população de São José de Rio Preto, São Paulo.

Arquivos Brasileiros de Cardiologia, São Paulo, v. 88, n. 2, fev. 2007.

LOTUFO, Paulo A. O escore de risco de Framingham para doenças cardiovasculares. **Revista da Associação Médica de São Paulo**, v. 87, p. 232-237, dez. 2002.

MAFRA, F.; OLIVEIRA, H. Avaliação do risco cardiovascular – metodologias e suas implicações na prática clínica. **Revista Port. Clínica Geral**, v. 24, p. 391-400, 2008.

MERLE, C. J. **Manual de Fisiopatologia**. 2. ed. São Paulo: Roca, 2007.

PEREIRA, et al. Obesidade: hábitos nutricionais, sedentarismo e resistência à insulina. **Arquivo Brasileiro de Endocrinologia Metab**, v. 47, p. 111-27, 2003.

PITANGA, F. J. G; LESSA, I. Associação entre indicadores antropométricos de obesidade e risco coronariano em adultos na cidade de Salvador, Bahia, Brasil. **Revista Brasileira de Epidemiologia**, v.10, n. 2, p. 239-248, 2007. Disponível em: <<http://www.scielo.org>>. Acesso em: 15 mai. 2011.

POLANCZYK, CARÍSI ANNE. Fatores de risco cardiovascular no Brasil: os próximos 50 anos. **Arquivos Brasileiros de Cardiologia**, v. 84, n. 3, mar. 2005.

SANTOS, R. D. et al. Diretrizes para cardiologistas sobre excesso de peso e doença cardiovascular dos Departamentos de Aterosclerose, Cardiologia Clínica e FUNCOR da Sociedade Brasileira de Cardiologia. **Arquivos Brasileiros de Cardiologia**, v. 78, Suplemento I, p.1-14, 2002.

SPOSITO, Andrei C. et al. IV Diretriz brasileira sobre dislipidemias e prevenção da aterosclerose. **Arquivos Brasileiros de Cardiologia**, São Paulo, v. 88, n. 1, abr. 2007.

WILSON, PETER W. F. et al. Prediction of coronary heart disease using risk factor categories. **Circulation**, v. 12, p. 1837-74, 1998.

YUSUF, SALIM et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. **Lancet**, v. 364, p. 937-52, 2004.