

**Effects of School Aerobic Exercise Intervention
on Children's Health-Related Physical Fitness:
A Portuguese Middle School Case Study**

by

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DEFINITIONS OF TERMS

Health: A state of complete physical, mental, and social well-being and not merely the absence of disease (WHO, 1946).

Physical Health: Absence of disease and disability; energy to accomplish daily tasks and active leisure without undue fatigue (Neiman, 2002, p3).

Mental Health: Absence of mental disorders, ability to meet daily challenges and social interactions without undue mental, emotional, or behavioral problems (Neiman, 2002, p3).

Social Health: Ability to interact effectively with other people and the social environment, enjoying satisfying personal relationships (Neiman, 2002, p3).

Health behaviour: The combination of knowledge, practices, and attitudes that together contribute to motivate the actions people take regarding health and wellness (Neiman, 2002, p3).

Health promotion: The process of enabling people to increase control over, and to improve, their health (WHO, 1986).

Health-related and physical fitness: The components of physical fitness that have a relationship with good health. The components are commonly defined as body composition, cardiovascular fitness, flexibility, muscular endurance and strength (Bouchard, Shephard & Stephens 1994).

Skill-related physical fitness: The components of physical fitness that have a relationship with enhanced performance in sports and motor skills. The components are commonly defined as agility, balance, coordination, power, speed and reaction time (Bouchard, Shephard & Stephens 1994).

Healthy: Operationally defined through FITNESSGRAM. Healthy (Healthy Fitness Zone) represents those children who scored at or above the set criterion for test item. This classification is indicative of having some degree of protection against diseases which results from a sedentary lifestyle (CIAR, 1999).

Unhealthy: Operationally defined through FITNESSGRAM. Unhealthy represents those children who scored below the set criterion for test item. This classification is indicative of having an increasing risk of disease, which results from a sedentary lifestyle (CIAR, 1999).

Body Composition: A health-related component of physical fitness that relates to the relative amounts of muscle, fat, bone and other vital parts of the body (USDHHS, 1996).

Cardiovascular Fitness: A health-related component of physical fitness that relates to ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity (USDHHS, 1996).

Flexibility: A health-related component of physical fitness that relates to the range of motion available at a joint (USDHHS, 1996).

Muscular Endurance: A health-related component of physical fitness that relates to the muscle's ability to continue to perform without fatigue (USDHHS, 1996).

Strength: A health-related component of physical fitness that relates to the ability of the muscle to exert force (USDHHS, 1996).

Non-communicable diseases (NCD): Diseases such as cardiovascular diseases, hypertension, obesity, diabetes, chronic respiratory diseases, and some types of cancer-are increasingly significant causes of disability and premature death in the world.

Primary Prevention: Those provided to individuals provided to prevent the onset of a targeted condition (The U.S. Preventative Services Task Forces' Guide to Clinical Preventive Services-2nd edition, 1996).

Secondary Prevention: Identifies and treats asymptomatic persons who have already developed risk factors or preclinical disease but in whom the condition is not clinically apparent (The U.S. Preventative Services Task Force, 1996).

Physical Activity: Bodily movement produced by the contraction of striated muscle that substantially increases energy expenditure (USDHHS, 1996).

Exercise: Planned, structured, and repetitive physical activity aimed at improving and maintaining physical fitness; organized sports or games; transport; occupational physical activity; and non-organized, recreational physical activities (ACSM, 2000).

Aerobic exercise: Exercise which uses oxygen to keep large muscle groups moving continuously at an intensity that can be maintained for long time (Encarta Encyclopedia Deluxe 2003).

Anaerobic exercise: Exercise that involves heavy work by a limited number of muscles, maintained only for a short time (Encarta Encyclopedia Deluxe 2003).

Criterion-Referenced Standard: A predetermined standard of performance that indicates whether the child has attained a desired level of performance. The child's performance is compared to the standard rather than to other scores (Baumgartner & Jackson, 1995).

Normal-Referenced Standard: A standard that scores a performance in relation to the performance of other well-defined groups on the same test. In other words, children's scores are compared with other children's scores (Baumgartner & Jackson, 1995).

Reliability: The degree to which a given test measures the same score or trait over a series of trials, i.e. test-retest (Baumgartner & Jackson, 1995).

Validity: The level at which a test item measures what it is supposed to measure, i.e., push-up and upper-body strength (Baumgartner & Jackson, 1995).

LIST OF ABBREVIATIONS

AAHPER	American Association for Health, Physical Education, and Recreation
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
DALY	Disability Adjusted Life Year
HDL	High-Density Lipoprotein
HIV	Human Immunodeficiency Virus
HRM	Heart Rate Monitor
IPAQ	International Physical Activity Questionnaire
LBP	Low Back Pain
LDL	Low-Density Lipoprotein
MET	Metabolic Equivalent
MHRR	Maximal Heart Rate Reserve
MVPA	Moderate to Vigorous Physical Activity
NCDs	Non-communicable Diseases
OA	Osteoarthritis
OP	Osteoporosis
PA	Physical Activity
PE	Physical Education
UNESCO	United Nations Educational, Scientific, Cultural Organization
USDHHS	U.S. Department of Health and Human Services

VO₂ max Maximum Ventilatory Oxygen Capacity

WHO World Health Organization

**Effects of School Aerobic Exercise Intervention
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ABSTRACT

This dissertation study was primarily designed to (a) determine the current health-related physical fitness and health-enhancing physical activity of Portuguese middle school children and (b) determine the effects on Portuguese middle school children's health-related physical fitness of a one-school-year aerobic exercises intervention in school physical education.

264 middle school children; aged 10 to 15 years were selected from four public middle schools in the Minho region of Portugal. All subjects completed six health-related physical fitness tests in FITNESSGRAM, including the One mile run, curl-up, push-up, trunk left, sit-and-reach, and skinfolds test.

The body mass index (BMI) was included to measure children's body composition. The International Physical Activity Questionnaire (IPAQ) was selected and translated into Portuguese to estimate children's physical activity levels (especially for moderate to vigorous physical activity - MVPA). The heart rate monitor was also used to measure children's physical activity levels in their different school physical education classes.

141 children aged from 10 to 15 years in one middle school (Minho region, Braga), were selected from the sample 264 children to participate in a one-school-year (exclude the two-month summer vacation and holidays) aerobic exercise intervention in their school physical education classes. We randomly selected 2 classes from the 6th, 7th and 9th grade levels. We then divided them into control and experimental groups. The control groups (70 children; 31 male, 39 female) participated their normal, twice-weekly physical education classes; the experimental groups (71 children; 31 male, 40 female) participated

in a one-school-year physical education intervention that added health-enhancing physical activity (aerobic exercises), nutrition and diet information, and some cognitive-behaviour strategies to the normal physical education program. The 141 subjects took all the tests before and after the intervention so as to compare the difference in their health-related physical fitness testing between the same groups and between the two different groups, according to the different age groups and genders.

The results revealed that 82.6% of the children failed to meet all minimum standards in FITNESSGRAM that define what it means to be physically fit. More than 20% of the children were overweight and about 7% of the children suffered from obesity (the latter measurement completed by comparing individual BMI with the standard of international Obesity Task Force. Results also show that more than half of the children are not physical active, girls are less active than boys ($r=-0.36$, $p<0.001$). 19.2% of the study's sample do not participate in any physical activity outside school and girls exercise less outside school than do boys (g: 27.6%: b: 10.3%). This study also shows that children who regularly participate in moderate-to-vigorous physical activity has a moderate correlation with children's health-related physical fitness ($r_{all}=0.30$, $p<0.01$; $r_{boy}=0.26$, $p<0.05$; $r_{girl}=0.31$, $p<0.05$) and cardiovascular fitness ($r_{all}=0.41$, $p<0.01$; $r_{boy}=0.27$, $p<0.01$; $r_{girl}=0.30$, $p<0.05$). According to the heart rate monitoring in 28 7th grade children in different indoor physical education classes, we found that children have little opportunity to exercise aerobically during their school physical education classes. On average, subjects spent 27.9 minutes (42.6% of actual class time or 31.0% of schedule class time) in moderate-to-vigorous physical activity with their heart rate above 139 bpm in the 90-minutes indoor physical education classes, subjects spent 14.4 minutes (49.8% of actual class time or 32.0% of schedule class time) in moderate to vigorous physical activity with their heart rate above 139 bpm in the 45-minutes indoor classes. Our study shows that traditional school physical education is not effective to promote children health and children in school physical education classes spend large amounts of class time being inactive and we also found that a lot of time has been spent on changing clothes and taking shower.

While the intervention did not significantly improve children's health-related physical fitness testing in all components, it did produce some improvement in their health-related physical fitness. For example, the children in the experimental groups showed greater improvement in health-related physical fitness tests and more children in experimental

groups reached the level of physically fit in FITNESSGRAM. We also found the children in experimental groups improved in some components, such as aerobic capacity abdominal and upper body strength and endurance. The elder girls in experimental groups, who had a two hours extracurricular aerobic training as a school team, significantly improved in many health-related physical fitness items.

In conclusion, the school-based aerobic exercise intervention combined by some health education was identified practicable and successfully. While a one school year intervention and only in school physical education did not result in significant improvement in all components of physical fitness. Our intervention indicates that aerobic exercise can and should be adopted as a regular component of school physical education programs. Active school physical education, active leisure, and school environments that encourage good health and active lifestyle can contribute to the development of life-long healthy lifestyle in children.

Efeitos de uma intervenção baseada em exercícios aeróbicos sobre a condição física das crianças relacionada com a saúde:

Um estudo de caso em escolas portuguesas EB 2,3

GuoYong Wang

RESUMO

Este estudo tem como principais objectivos determinar a condição física relacionada com a saúde dos estudantes portugueses do 2º e 3º ciclos do ensino básico e determinar os efeitos de uma intervenção com exercícios aeróbicos na escola, durante a aula de educação física, ao longo de um ano lectivo.

Foram seleccionadas 264 crianças de quatro escolas públicas EB 2,3 entre os 10 e os 15 anos na região do Minho. Todos os sujeitos realizaram os seis testes da bateria de FITNESSGRAM: corrida de uma milha, abdominais, extensões de braços, extensão do tronco, senta e alcança e medição das pregas adiposas. O índice de massa corporal foi incluído para medir a composição corporal das crianças. O Questionário Internacional de Actividade Física (IPAQ) foi traduzido para português e aplicado para avaliar os níveis de actividade física (principalmente de moderada a intensa - MVPA). O monitor da frequência cardíaca foi usado para medir os níveis de actividade física das crianças nas aulas de educação física.

141 crianças entre os 10 e os 15 anos foram seleccionadas numa das escolas, da amostra de 264 crianças, para participarem numa intervenção com exercícios aeróbicos durante as aulas de educação física na escola ao longo do ano lectivo. Seleccionámos aleatoriamente duas turmas de 6º, 7º e 9º anos e separámo-las em grupo de controlo e grupo experimental. Os grupos de controlo (70 crianças: 31 rapazes, 39 raparigas) participaram normalmente nas aulas de educação física duas vezes por semana; os grupos experimentais (71 crianças; 31 rapazes, 40 raparigas) participaram numa intervenção que acrescentou ao programa normal de educação física: actividade física para melhorar a saúde (exercícios aeróbicos), nutrição, informação sobre dieta e algumas estratégias cognitivas e de comportamento. Os 141 sujeitos realizaram todos os testes antes e depois da intervenção para compararmos as diferenças da sua condição física relacionada com a saúde entre os mesmos grupos (antes

e depois) e entre o grupo experimental e o de controlo, de acordo com os vários grupos de idade e géneros.

Os resultados revelaram que 82.6% das crianças não conseguiram atingir os resultados mínimos no FITNESSGRAM que definem uma boa condição física. Mais de 20% das crianças são gordas e aproximadamente 7% das crianças sofrem de obesidade (comparando o índice de massa corporal individual com os padrões do Grupo de Trabalho Internacional sobre a Obesidade). Os resultados também mostram que mais de metade das crianças não são fisicamente activas, as raparigas são menos activas que os rapazes ($r=-0.36$, $p<0.001$). 19.2% da amostra não participam em qualquer actividade física fora da escola e as raparigas fazem menos exercício fora da escola do que os rapazes (raparigas: 27.6%; rapazes: 10.3%). Este estudo também mostra que existe uma correlação moderada entre a participação regular em actividade física moderada a intensa e a condição física relacionada com a saúde (r todos= 0.30 , $p<0.01$; r rapazes= 0.26 , $p<0.05$; r raparigas= 0.31 , $p<0.05$) e a condição cardiovascular (r todos= 0.41 , $p<0.01$; r rapazes= 0.27 , $p<0.01$; r raparigas= 0.30 , $p<0.05$). De acordo com a monitorização da frequência cardíaca de 28 crianças do 7º ano em diferentes aulas de educação física no ginásio verificámos que as crianças têm pouca oportunidade de realizar exercício aeróbico nas aulas de educação física escolar. Nas aulas de educação física de 90 minutos, os alunos realizaram em média 27.9 minutos (42.6% de tempo real de aula ou 31.0% de tempo de aula de acordo com o horário) de actividade física moderada a intensa, com a frequência cardíaca acima de 139 pulsações/minuto. Nas aulas de 45 minutos, os alunos realizaram 14.4 minutos (49.8% de tempo real de aula ou 32.0% de tempo de aula de acordo com o horário) de actividade física moderada a intensa com uma frequência cardíaca acima de 139 pulsações/minuto. O nosso estudo mostra que a educação física escolar tradicional têm muito tempo de reduzida actividade durante as aulas de educação física escolar e passam muito tempo nos balneários.

Apesar de a intervenção não ter melhorado significativamente a condição física das crianças relacionada com a saúde em todos os seus componentes, houve algumas melhorias. Por exemplo, as crianças dos grupos experimentais mostraram melhorias superiores nos testes de condição física relacionada com a saúde e houve mais crianças nos grupos experimentais a atingirem os níveis de boa condição física no FITNESSGRAM. Também verificámos que as crianças dos grupos experimentais

melhoraram em algumas componentes, tal como capacidade aeróbica, a força abdominal, força dos membros superiores e endurance. As raparigas dos escalões etários mais elevados dos grupos experimentais, que tiveram duas horas de treino aeróbico extra-curricular, melhoraram significativamente em muitos itens da condição física relacionada com a saúde.

Em conclusão, a intervenção com exercícios aeróbicos na escola combinados com alguma educação para a saúde, foi considerada realizável e bem sucedida, enquanto uma intervenção apenas em educação física escolar não resultou em melhoria significativa dos diversos testes de condição física. A nossa intervenção indica que o exercício aeróbico pode e deve ser adoptado como uma componente regular dos programas de educação física escolar. A educação física escolar aeróbica, o lazer activo e os ambientes escolares que potenciem a actividade física podem contribuir para o desenvolvimento de estilos de vida activos e saudáveis das crianças.

《学校有氧运动对中学生健康身体素质影响的研究》

---有关葡萄牙中学案例的调查研究

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摘要

本博士课题旨在研究（1）一学年学校体育课有氧运动的干预对中学生健康身体素质的影响；（2）中学生的健康身体素质和身体运动水平的情况和关系等。

我们从葡萄牙的北部地区选取了 264 名 10 至 15 岁的中学生，对他们进行了健康身体素质-FITNESSGRAM 的综合测试，测试项目包括：一英里跑、有韵律的仰卧起坐、有韵律的俯卧撑、俯卧抬体、坐体前屈、和皮脂测定。同时我们选用了 IOTF 的儿童青少年身体质量指数（BMI）的标准、国际性身体活动问卷（IPAQ）和最新的心率测试仪(Polar S810 HRM)来测定和评估学生的身体成份、身体锻炼情况和不同的学校体育课的运动强度。

141 名从 264 名学生中选出的 10 至 15 岁中学生参加了为期一学年（不包括 2 个月的暑假和 20 天左右的圣诞和新年假期）的学校体育课的有氧运动的干预实验。我们随机从 6、7 和 9 年级中选出各两个班级，把他们随机地分成实验班和对照班。对照班的学生（70 名；31 名男生，39 名女生）参加他们每周二次正常的体育课；实验班的学生（71 名；31 名男生，40 名女生）参加每周二次的干预性体育课，包括：强化健康为主的有氧运动、健康知识和认知行为的干预（运动和健康方面的知识、技术、技能和实践）。实验对象都参加了干预前后的健康身体素质-FITNESSGRAM 的综合测试。

针对 264 名学生的研究调查显示：82.6% 的学生没有通过 FITNESSGRAM 的所有六项测试的最低标准因而没有达到身体健康的标准；超过 1/5 的学生超重，近

1/10 学生患有肥胖症；一半以上的学生不经常运动，女学比男生身体运动水平明显的低($r=-0.36, p<0.001$)；19.2% 的学生(女生: 27.6%: 男生: 10.3%)。体育课后从不参加任何锻炼；研究也显示：经常参加中等以上运动锻炼与学生的健康身体素质有近中等的显著性相关 ($r_{全部}=0.30, p<0.01$; $r_{男}=0.26, p<0.05$; $r_{女}=0.31, p<0.05$) 与心肺功能也有近中等的显著性相关($r_{全部}=0.41, p<0.01$; $r_{男}=0.27, p<0.01$; $r_{女}=0.30, p<0.05$)。

根据对 14 节不同室内体育课的 28 名男女学生心率的测试，我们发现学生在传统的体育课中学生在课内很少能以有氧运动的模式锻炼，在 90 分钟的体育课上，学生平均只有 27.9 分钟 (42.6% 的实际体育课时间或 31.0% 体育课时间) 达到中等和激烈强度（心率达到 139 搏/分以上）；在 45 分钟的体育课上，学生平均只有 14.4 分钟 (49.8% 的实际体育课时间或 32.0% 体育课时间) 达到中等和激烈强度（心率达到 139 搏/分以上）；我们发现传统的体育课教学模式注重过多的运动技术的掌握，并不十分有效地提高学生的身体素质，同时学校体育课的许多时间也被发现大量地用在换服装和运动后的淋浴上。

一年的结合健康知识的体育课为主的有氧运动干预虽然没有全面、显著性地提高所有学生的健康相关身体素质，但我们的干预也显著性地提高了健康相关身体素质一些项目。通过一学年的干预后，实验组比对照组明显地有更多学生地通过健康相关身体素质综合 FITNESSGRAM 所有项目的测试而达到健康的水平；实验组的学生在有些健康相关身体素质的项目如心肺功能、腹部力量、上肢力量和有氧耐力进步也非常明显；而参加每周 2 小时的课外有氧运动锻炼的高年级女生，她们的与健康相关身体素质提高更为显著。

总之，学校体育课结合健康知识的有氧运动的干预实验是卓有成效和成功的。我们的研究表明有氧运动教学模式是可以也应该被学校体育课所采纳。充满活力的学校体育课、积极的休闲和健康的学校环境能够对学生的健康以及培养终身的健康生活方式会有很好的促进作用。