Low Level of Physical Fitness in Spanish Adolescents. Relevance for Future Cardiovascular Health (AVENA Study)

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Introduction and objectives. Several studies have demonstrated that physical fitness in childhood and adolescence is related to cardiovascular risk in adulthood. Current data on the physical fitness of Spanish adolescents are not available. Therefore, the aims of this study were: *a*) to assess the physical fitness of Spanish adolescents and establish reference values for use in health and educational settings as indicators of cardiovascular health, and *b*) to determine the percentage of Spanish adolescents below the minimum level of aerobic fitness needed to guarantee future cardiovascular health.

Subjects and method. The modified EUROFIT battery of tests was used to assess physical fitness in a representative sample of Spanish adolescents (n=2859; 1357 boys and 1502 girls) taking part in the AVENA *(Alimentación y Valoración del Estado Nutricional de los Adolescentes)* study.

Results. Standard parameters for the physical condition of Spanish adolescents are reported in this study. The 5th percentile for maximum aerobic capacity (Course Navette test) ranged from 2.0-3.3 palier in boys and from 1.4-1.9 palier in girls. The findings indicate that, on the basis of aerobic fitness, approximately 20% of Spanish adolescents have an increased risk of future cardiovascular disease. This subgroup also performed poorly in all other tests of physical fitness used.

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Conclusions. The results reported in this study enable the level of physical fitness in adolescents to be interpreted as an indicator of future cardiovascular health. They also indicate that the physical fitness of Spanish adolescents must be improved to help protect against cardiovascular disease in adulthood.

Key words: *Fitness. Adolescents. Cardiovascular risk.*

Bajo nivel de forma física en los adolescentes españoles. Importancia para la salud cardiovascular futura (Estudio AVENA)

Introducción y objetivos. En diversos estudios se ha mostrado la relación entre el nivel de forma física durante la infancia-adolescencia y el riesgo cardiovascular en la edad adulta. Dado que no se dispone de datos relativos al nivel de condición física de los adolescentes españoles, los objetivos de este estudio son: *a*) determinar el nivel de condición física de los adolescentes españoles y establecer valores de referencia que puedan ser utilizados en el medio sanitario y educativo como indicadores de salud cardiovascular, y *b*) conocer la proporción de adolescentes españoles que no alcanza valores de capacidad aeróbica indicativos de salud cardiovascular futura.

Sujetos y método. Se ha utilizado la batería EUROFIT modificada para evaluar la condición física de una muestra representativa de adolescentes españoles (n = 2.859; 1.357 varones y 1.502 mujeres) procedente del estudio AVENA (Alimentación y Valoración del Estado Nutricional de los Adolescentes).

Resultados. Se han obtenido los valores normativos de condición física de la población adolescente española. El rango del percentil 5 respecto a la capacidad aeróbica máxima (test de Course Navette) es de 2,0-3,3 y 1,4-1,9 *paliers* para varones y mujeres, respectivamente. Casi 1 de cada 5 adolescentes presenta riesgo cardiovascular futuro sobre la base de su capacidad aeróbica. Este subgrupo de adolescentes mostró también una peor forma física que el resto de adolescentes en todas las pruebas físicas realizadas.

Conclusiones. Los resultados obtenidos en el presente estudio permiten evaluar e interpretar correctamente el

ABBREVIATIONS

VO_{2max}: maximal oxygen consumption.

nivel de forma física de cualquier adolescente. Los resultados obtenidos indican la necesidad de mejorar el nivel de condición física de los adolescentes españoles.

Palabras clave: *Forma física. Adolescentes. Riesgo cardiovascular.*

INTRODUCTION

Recent studies have shown that aerobic capacity and muscle strength are powerful predictors of cardiovascular and all-cause death and disease, both in men[1-3] and in women.[2-5] The role of poor physical fitness as a cardiovascular risk factor is even greater than other well established factors, such as dyslipidemia, hypertension, or obesity.[6]

Although the clinical manifestations of atherosclerotic cardiovascular disease usually appear in adulthood, the pathogenic commencement of the disease occurs in childhood or adolescence,[7,8] and cardiovascular risk factors have even been identified at these ages.[9-12] Some of these factors may be able to predict future death and disease, as is the case for overweight children.[13] The study of these factors during the crucial stage of adolescence is, therefore, relevant for the diagnosis and prevention of conditions associated with cardiovascular disease in adults. Several cross-sectional studies have demonstrated an association between the level of physical fitness during childhood and adolescence and cardiovascular risk factors.[14-16] Likewise, important longitudinal studies have shown that the level of physical fitness in an adult, as well as the presence of other conventional cardiovascular risk factors, such as hypercholesterolemia or hypertension, is conditioned by the level of physical fitness in childhood or adolescence.[17-21] In order, therefore, to evaluate future cardiovascular risk as early as possible, this evaluation should start in childhood or adolescence. However, a correct clinical evaluation of the level of physical fitness requires up-to-date reference values for the study population. Thus, the aim of this study was to establish the normative values for physical fitness in Spanish adolescents.

SUBJECTS AND METHOD

Subjects and Experimental Design

This study formed part of the AVENA (*Alimentación y Valoración del Estado Nutricional en Adolescentes*) Study, whose full methodology has been reported previously.[22] This multicenter study was undertaken in Spanish adolescents from 13-18.5 years of age. In order to account for the heterogeneity of the population, the study was undertaken in both, public and private high schools, or apprentice training schools.

The study was multistage, randomized, and stratified according to origin (Granada, Madrid, Santander, Zaragoza, and Murcia), social and economic condition (according to the site of the educational establishment; data provided by the various regional educational authorities), sex, and age. Exclusion factors included a clinical diagnosis of diabetes, pregnancy, the use of alcohol or drugs, and, in general, the presence of any disease not directly associated with nutrition. Exclusion from the study was made effective *a posteriori*, without the students being aware of it, in order to avoid any undesired situation.

To determine the overall sample size, we used the parameter of greatest variance in the population, obtained from published data at the time the study was planned,[23] that is, the body mass index (BMI). The sampling was determined by this dispersion. The confidence level was 95%, with an error of ±0.25. The number of subjects for the complete study was calculated to be 2100. The total number was distributed equally among the different cities, and proportionally by sex and age group (13, 14, 15, 16, and 17-18.5 years). The sample was overestimated to prevent loss of information. Finally, a weighting factor was applied to balance the sample according to the distribution of the Spanish population and guarantee the true representation of each of the groups defined by the abovementioned factors (Source: National Statistics Institute). After eliminating from the study all those subjects who failed to meet the inclusion criteria, the final number of participants was 2859 (1357 boys and 1502 girls).

The study was undertaken in accordance with the deontological norms laid down in the Helsinki Declaration (Hong Kong revision, September 1989) and the European Union recommendations for Good Clinical Practice (document 111/3976/88, July 1990), and the current Spanish laws governing clinical research in human subjects (Royal Decree 561/1993 concerning clinical trials). The study was submitted for evaluation and approved by the Ethics Committees of the Spanish National Research Council and the Marqués de Valdecilla University Hospital (Santander, Spain).

Evaluation of Physical Fitness

Prior to starting the study, the researchers involved in the project undertook training sessions in order to guarantee the standardization, validation, and reliabili-