

Rodríguez Cabrero, M.; García Aparicio, A.; García Pastor, T.; Salinero, J.J.; Pérez González, B.; Sánchez Fernández, J.J.; Gracia, R.; Robledo, S. e Ibáñez Moreno, R. (2015). Actividad física y ocio y su relación con el índice de Ruffier en adolescentes / Physical Activity And Leisure Habits And Relation With Ruffier Index In Adolescents. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 15 (57) pp. 165-180. [Http://cdeporte.rediris.es/revista/revista57/artactividad551.htm](http://cdeporte.rediris.es/revista/revista57/artactividad551.htm)

PHYSICAL ACTIVITY AND LEISURE HABITS AND THEIR RELATION WITH THE RUFFIER INDEX IN ADOLESCENTS

ACTIVIDAD FÍSICA Y OCIO Y SU RELACIÓN CON EL ÍNDICE DE RUFFIER EN ADOLESCENTES

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Agradecimientos a la Delegación Territorial de Enseñanza y al Ayuntamiento de Leganés, así como todos los institutos implicados en el estudio.

Código UNESCO / UNESCO Code: 5899 Educación Física y Deporte Physical Education and Sport

Clasificación Consejo de Europa / Council of Europe Classification: 17 Actividad Física y Salud / Physical Activity and Health

Recibido 9 de marzo de 2012 **Received** March 9, 2012

Aceptado 18 de mayo de 2012 **Accepted** May 18, 2012

ABSTRACT

The aim of the study was to assess and correlate physical activity practice and fitness level in adolescents. A total of 884 students (age=16.4±0.8 years) answered the modified version of the "Assessment of Physical Activity Level Questionnaire (APALQ)" and aerobic capacity was assessed using the Ruffier Test. The mean Ruffier Index (RI) was 11.1±4.6 and the mean Physical Activity Index (PAI) was 13.8±4.4. The relationship between PAI and RI, and between sedentary activities in leisure time and RI, was significant but weak ($r=-0.31$; $p=0.000$). Boys showed higher physical fitness (PF) values ($t=-8.78$; $p=0.000$) than girls and spent more time doing physical activity. These differences were significant for both regulated and non regulated physical activity and for

participation in competitions ($p=0.000$). Girls spent more time in sedentary activities like reading and studying ($p=0.000$). It is necessary to promote physical activity and sport practice, especially among girls.

KEY WORDS: physical activity, adolescents, fitness level, sedentary behaviour.

RESUMEN

El objetivo del estudio fue medir y correlacionar la práctica de actividad física y con el Índice de Ruffier (IR) en adolescentes. A un total de 884 alumnos (edad= $16,4\pm 0,8$ años) se les midió la actividad física con la Versión modificada del Assessment of Physical Activity Level Questionnaire (APALQ) y se evaluó la capacidad de adaptación al esfuerzo mediante el Test Ruffier. La media del Índice de Ruffier fue $11,1\pm 4,6$ y el Índice de actividad física (IAF) $13,8\pm 4,4$. Las relaciones entre IAF y el IR, y entre horas de ocio sedentario e IR resultaron ser significativas aunque débiles ($r=-0,31$; $p=0,000$). En el IR los chicos presentaron valores superiores ($t=-8,78$; $p=0,000$) a las chicas. También destinan más tiempo a la práctica de AF y estas diferencias fueron significativas en AF reglada y no reglada y en participación en competición ($p=0,000$), mientras que las chicas destinan más tiempo a actividades sedentarias como leer y estudiar ($p=0,000$). Es necesario promover la práctica de actividades físico-deportivas, especialmente entre las chicas.

PALABRAS CLAVE: actividad física, adolescentes, condición física, actividad sedentaria.

INTRODUCTION

In an attempt to improve quality of life in our society, there is currently great concern about acquiring healthy life style habits and keeping them throughout the different stages of life. The high indices of obesity and the lack of physical activity prevalent nowadays make it necessary to review the life style of young people and adults (Piéron and Ruíz Juan, 2010), with special emphasis on children and adolescents as they are at a unique and crucial moment for creating healthy habits which will affect their future health (Beltrán Carrillo, Beltran Carrillo, and Valenciano Valcárcel, 2008; Serra Majem, et al., 2002). For this reason, we emphasize the importance of physical activity (PA) for health (Vállez Troyano, 2003), as it is a factor which is clearly related to the BMI at these ages (Hands, et al., 2011).

A child's state of health is indicative of its health in adulthood, and children's health is conditioned by their physical activity habits, so the physical activity which they practise during their childhood will condition their adult health (Twisk, 2001). Both national and international studies show that adolescents who practise supervised physical and sports activities out of school hours have less body fat and also less excess weight (Ara, et al., 2006; De Hoyo Lora and Sañudo Corrales, 2007). Previous studies show that screen time (television,

computer, etc.) is a predictor of BMI in adolescence (Hands, et al., 2011). In Spain the practice of physical activity has been studied in the school population and the results show that PA decreases with age, and that boys, at all ages, are more active than girls (CSD, 2010; Chillón, Tercedor, Fernández, and González-Gross, 2002; Hernández-Álvarez, et al., 2007).

Improvement in physical fitness is still one of the main determinants in the development of the adolescent (Martínez López, 2004) and the assessment of basic physical capacities also contributes to the general or integral development of the students, contributing to the dimensions of their cognitive, motor and social personality (Santiago Ruiz, 2010). Historically, recommendations of physical activity have been based on cardiorespiratory capacity, as it can be a tool to examine the link between PA and health status (Ullrich-French, Power, Daratha, Bindler, and Steele, 2010).

Tests to evaluate cardiorespiratory capacity make it possible to assess the performance level of an individual in the development of his or her abilities and to be able to predict his or her possibilities. In this sense the Ruffier Test is an endurance test (Santiago Ruiz, 2010) which assesses cardiovascular ability (Martínez de Haro, Álvarez Barrios, Cid Yagüe, and Muñoa Blas, 2005) using cardiovascular adaptation to effort (Litwin and Fernández, 1995). Recovery after effort will be quicker and more efficient in individuals with a good level of cardiovascular fitness, while a slow recovery indicates an insufficient adaptation level (Barbany, 2002).

At present the relation between cardiovascular capacity and sedentary and physical activity habits in adolescents has not been clarified (Ullrich-French, et al., 2010) and few studies have analyzed the relation among participation in organized sports, physical activity and physical fitness in adolescents (Beets and Pitetti, 2005; Kristensen, et al., 2010; Phillips and Young, 2009). The results from published research suggest that there is a weak to moderate correlation between the two variables. This has caused some debate as it has always been thought that the practice of physical activity is directly related to aerobic fitness (Kristensen, et al., 2010). From a scientific point of view it is important to clarify the relation between these two variables as they involve risk factors associated with a large variety of diseases in adulthood.

Given that regular physical activity can be a way of maintaining adolescents' fitness levels, health and body composition, the objective of this study was to measure physical activity practice, leisure habits and cardiovascular adaptation to effort in adolescents from the town of Leganés and to find the relation among these components. As a secondary objective, results were analyzed according to sex.

MATERIALS AND METHODS

SAMPLE

A total of 884 adolescents from 15 to 18, from 15 secondary schools in the town of Leganés, took part in the study. The physical characteristics of the sample are shown in Table 1.

Table 1 Physical characteristics of the sample (Mean \pm SD)

	Age	BMI(kg/m ²)	Weight (kg)	Height (cm)
Total	16.4 \pm 0.8	21.1 \pm 2.7	61.2 \pm 10.4	1.70 \pm 8.6
Boys	16.4 \pm 0.9	21.6 \pm 2.8	66.5 \pm 9.7	1.75 \pm 7.0
Girls	16.3 \pm 0.8	20.5 \pm 2.4	55.1 \pm 7.4	1.64 \pm 5.7

INSTRUMENTS

The equipment used to collect the data was as follows:

- 28 Polar Fs2c heart rate monitors
- A modified version of the Assessment of Physical Activity Level Questionnaire (APALQ) (Ledent, Cloes, and Piéron, 1997)
- Ruffier Test work sheets.

PROCEDURE

The APALQ was used to assess physical activity. This questionnaire permits the definition of three parameters: activity frequency, activity intensity and activities of daily living. It does not include hours of sleep. A double control procedure (Sperber, Devellis, and Boehlecke, 1994) was used to ensure the precision of the translation.

The questionnaire has five questions with four possible answers on a four point scale:

1. Participation in organized out of school sports activities.
2. Participation in informal out of school sports activities.
3. Days of the week in which the subject participates in physical and sports activities for at least 20 minutes.
4. Hours per week in which the subject participates in any high intensity physical activity (which makes you breathe rapidly or with difficulty and sweat).
5. Participation in sports competitions.

The answers were codified on a 1 to 4 Likert scale, where 1 was the lowest and 4 the highest. The maximum score on the questionnaire was 20. A physical activity index (PAI) was obtained to see the PA level of the participants. A procedure which has previously been validated (Zaragoza, et al., 2011).

The Ruffier Test which assesses cardiovascular adaptation to effort was also administered (Litwin and Fernández, 1995). This test was used to assess athletes in numerous studies in France in the 80s (Martínez López, 2004). However, the Ruffier test is still being used at present to assess physical fitness in adolescents and athletes as can be seen in several recent publications (Bruneau, et al., 2009; Hernández-Álvarez, et al., 2007; Hernández-Álvarez, Velázquez-Buendía, Martínez-Gorroño, Garoz-Puerta, and Tejero, 2011; Martínez López, 2004; Piquet, et al., 2000; Vállez Troyano, 2003).

The test protocol was a follows:

- Each subject put on a heart rate monitor and rested for five minutes. Once this time period was finished they noted down the heart rate which showed on the monitor (p0).
- They then performed 30 complete squats in 45 seconds.
- Once the exercise was over they noted down their heart rate (p1).
- They again noted down the heart rate shown on the monitor after one minute (p2).

The Ruffier Index is obtained with these three values by applying the following formula:

$$RI = \frac{p0 + p1 + p2 - 200}{10}$$

The test is evaluated using the following scale:

0	Excellent
1-5	Very good
6-10	Good
11-15	Medium
16-20	Weak

DATA ANALYSIS

The data were processed using the Statistical Package for Social Sciences (SPSS) version 18.0[®] and the confidence level was set at 95%. Descriptive statistics were calculated and t tests were applied to contrast the means between the sexes in the quantitative variables. Frequencies and chi square were calculated for the qualitative variables. Pearson's correlation coefficient was used to analyze the relation among the variables.

RESULTS

Table 2 shows the results obtained for the different variables in the total sample and the comparison by sex.

Table 2 Ruffier Index and Physical Activity Index

	Total		Boys		Girls		Diff. by sex	
	Mean	SD	Mean	SD	Mean	SD	<i>t</i>	<i>p</i>
Ruffier Index	11.1	4.6	9.9	4.2	12.5	4.6	-8.78	0.000
PA Index	13.8	4.4	15.8	3.8	11.8	4.0	16.4	0.000
Hours spent sitting (studying/reading)	1.88	1.25	1.49	0.99	2.3	1.36	-10.0	0.000
Hours spent watching TV	2.07	1.19	2.08	1.15	2.07	1.23	0.14	0.890

As can be observed the young people scored a value of about 11 on the Ruffier test, although there were significant differences between the sexes ($t = -8.78$; $p = 0.000$), with the boys showing a considerably better score. Similarly, in the PAI the value registered by the boys was significantly higher than the one for the girls ($t = 16.4$; $p = 0.000$). If we consider the number of hours spent in sedentary activities, there are also significant differences between the sexes with regard to time spent studying or reading ($t = -10.0$; $p = 0.000$), in this case the girls are the ones who devote more time to these activities. However, there are no sex differences with regard to the hours spent watching television. Both sexes devote approximately two hours a day to this type of activity.

The results of the Ruffier test can be classified in levels of cardiovascular capacity (Fig. 1).

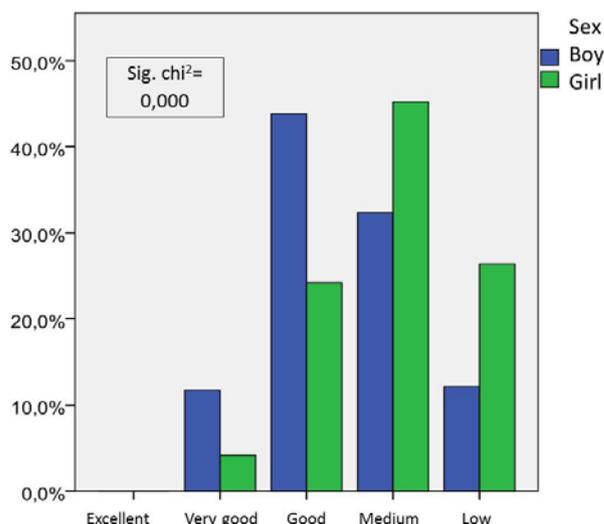


Fig. 1 Percentage of boys and girls in each category according to the Ruffier test results

The scores show how the majority of the boys obtained good or medium results, while in the girls the results were of a lower level (χ^2 : 72.71; $p=0.000$).

Table 3 shows the relation between the Ruffier Index and the rest of the variables studied.

Table 3 Relation between the Ruffier Index, the PAI and the hours spent in sedentary leisure activities

			PAI	Hours watching TV	Hours sitting studying/reading
Ruffier Index	Total	Pearson Correlation	-0.310	-0.009	0.152
		Two tailed sig.	0.000	0.788	0.000
	Boys	Pearson Correlation	-0.330	0.052	0.130
		Two tailed sig.	0.000	0.278	0.008
	Girls	Pearson Correlation	-0.129	-0.074	0.018
		Two tailed sig.	0.009	0.153	0.734

There is a significant correlation between the Ruffier Index score and the PAI. This correlation is negative, which indicates that the subjects who obtained a higher PAI score registered a lower RI score, so that they have a better result in this test. The RI has a positive but weak correlation ($r= 0.15$; $p=0.000$) with the hours spend sitting, being lower in those who have a better result in the Ruffier test. If we compare the sexes, we can see a stronger correlation between the PAI and the RI in the case of the boys, although in both it is significant. In the case of the hours spent sitting this relation is only apparent in the boys ($r=0.13$; $p=0.008$).

Tables 4 and 8 show relative frequencies for each of the items included in the PAI.

Table 4 Practice of organized sports activities

Organized sports activities	All (%)	Boys (%)	Girls (%)
Never	34.9	21.7	48.5
Less than once a week	2.9	2.3	3.6
At least once a week	22.2	19.8	24.9
Almost every day	40.0	56.2	23.0

Table 5 Recreational sports practice

Recreational sports activity	All (%)	Boys (%)	Girls (%)
Never	21.1	7.3	36.1
Less than once a week	13.9	11.9	1.2
At least once a week	42.9	49.1	36.3
Almost every day	22.1	31.6	11.4

Table 6 Twenty minutes of continuous practice during Physical Education classes

20 minutes of continuous practice during Physical Education classes	All (%)	Boys (%)	Girls (%)
Never	5.1	2.6	7.8
Once a month	9.1	6.7	11.9
Between once a month and once a week	26	23.4	29.1
Two or three times a week	53.5	57.9	48.7
Four times a week or more	6.3	9.4	2.6

Table 7 Intense extracurricular physical activity

Intense extracurricular physical activity	All (%)	Boys (%)	Girls (%)
Never	23.6	10.3	38
Between half an hour and 1 hour	27.6	25.6	29.9
From 2 to 3 hours	21.1	24.8	17.1
From 4 to 6 hours	16.2	21.5	10.4
7 or more hours	11.4	17.8	4.6

Table 8 Participation in sports competitions

Sports competitions	All (%)	Boys (%)	Girls (%)
I have never participated	15.6	7.3	24.3
No, but I have participated in the past	38.6	27.6	50.3
Yes, at school	8	6.8	9.1
Yes, in a club	37.9	58.3	16.2

There are differences between the sexes in the five variables which constitute the PAI, and in all cases the boys are the ones who participate more. With regard to organized physical activity ($\chi^2=122.9$; $p=0.000$), more than half the boys perform physical activity of this type almost every day (56.2%) while 48.5% of the girls never do. Physical activities in a recreational setting also attract the boys more than the girls ($\chi^2=156.2$; $p=0.000$). There are also differences in the frequencies with which they report doing intense physical activities continuously for more than 20 minutes in the Physical Education classes ($\chi^2=45.3$; $p=0.000$), in intense extracurricular activities ($\chi^2=146.2$; $p=0.000$), as well as in sports competitions ($\chi^2=197.7$; $p=0.000$).

DISCUSSION

Our results place the students from Leganés at a higher level of physical fitness than 13 year old secondary education students in Madrid, although we should emphasize the age difference in the samples. Forty-two point eight percent of the 13 year old secondary education students from a Madrid municipality (Tres Cantos) recorded a physical fitness level between good (2.8%) and very good (40%) while 57.2% had between a medium (28.6%) and low (28.6%) level (Vállez Troyano, 2003). However, if we compare this study with the results published by Hernández Álvarez et al. (2007) they are lower than the mean for students from the Community of Madrid in the RI with the boys scoring 12.71 ± 4.17 compared to 9.9 ± 4.2 in our study and the girls 16.57 ± 4.34 compared to 12.5 ± 4.6 .

In all the published studies we can see how adaptation to effort is worse in the girls than in the boys. Significant differences were found in the RI between both sexes. Greater physical aptitudes have been described in adolescent boys as compared with girls, with the exception of flexibility, using different assessment tests (Serra Majem, et al., 2002).

With regard to organized physical activity (in a club or sports school) our subjects showed a higher frequency of practice than those recorded in the enKID study with a national population of between 2 and 24 years of age, in which 60% of the males and 75% of the girls did no exercise or exercised less than twice a week (Serra Majem, et al., 2002). Similar results were found by Hernández Álvarez et al. (2007) studying a population like the one in the

present study. Fewer boys from Leganés never participated in organized physical activities (21.7% compared to 26.8%) while the girls from Leganés had a higher level of sedentariness (48.5% compared to 42.7%). This tendency to participate in organized activities is higher than that recorded in the national survey of Spanish sports habits of young people between 15 and 24 years in 2010 who tended more to practise informal sports activities and in second place organized ones (Centro de Investigaciones Sociológicas, 2010) and higher than the results for Spanish students of between 16 and 18 years of age published by the High Council for Sport (CSD) (2010).

In both sexes the percentage of students who practice almost every day is higher when it is a question of organized activities which is why we support the proposal to encourage participation in and creation of organized physical and sports activities (Garrido Pastor, García Aparicio, and Alonso Ojembarrena, 2008; Román Viñas, Serra Majem, Aranceta Bartrina, Ribas Barba, and Pérez Rodrigo, 2006).

Sports competition again revealed differences between both sexes. Our total results are higher than the level of participation in competitions recorded in the survey of Spanish habits, where 75% tended not to compete or be concerned about competing (Centro de Investigaciones Sociológicas, 2010), in our case 37.9% of the students competed in a club and 8% in school competitions with the boys registering a higher level of participation. The age range studied in both cases should be taken into account (the national survey was carried out with adolescents of both sexes of over 15). If we compare with the studies published by the High Council for Sport (CSD, 2010) we can see that in Leganés, both the boys and girls of 16 to 18 years of age reveal a lower percentage of participation in competitive sports (boys 65.1% v 70%, girls 25.3% v 64%), with a much greater difference in the girls.

In general the tendency to participate in physical and/or sports activities tends to decrease as the surveyed subject's age increases (Rodríguez Romo, Mayorga García, Merino Jiménez, Garrido Muñoz, and Fernández del Valle, 2005), and it is also necessary to bear in mind the adolescent years involved, especially in the girls, due to the changes in motivation, interests and type of practice (Garrido Pastor, et al., 2008; Rodríguez Romo, et al., 2005; Román Viñas, et al., 2006) as participation in PA programmes during adolescence seems to have an impact on continuing practice as an adult (Alfano, Klesges, Murray, Beech, and McClanahan, 2002; Kuh and Cooper, 1992; Telama, Yang, Laakso, and Viikari, 1997).

It was found that the time that the girls spend sitting and reading or studying both during the week and at the weekends is greater than that of the boys by more than 30 minutes. In both sexes the average time devoted to watching television is 2.1 hours a day, to which other types of sedentary activities like playing video games, etc, should be added. At present strategies are being designed to try to decrease the time populations spend doing sedentary

activities (Canadian Society for Exercise Physiology, 2010) fundamentally by controlling screen time (Garrido Pastor, et al., 2008).

A significant though weak correlation has been found between the regular practice of PA and the RI. This coincides with the conclusions of the authors of a study of 13 year old students who report that the students who regularly practised sports activities showed better cardiovascular adaptation (Vállez Troyano, 2003). If we assess other studies carried out with other fitness assessments we can see the same correlation with the youngsters of 11, 12 and 14 years of age (Thomas, Nelson, and Church, 1991), while other authors have found a weak to moderate correlation (Boreham, Twisk, Savage, Cran, and Strain, 1997; Dencker, et al., 2006; Ekelund, et al., 2001; Hands, Larkin, Parker, Straker, and Perry, 2009; Katzmarzyk, Malina, Song, and Bouchard, 1998; Kristensen, et al., 2010; Morrow and Freedson, 1994; Pate, Dowda, and Ross, 1990; Rowlands, Eston, and Ingledew, 1999; Sallis, McKenzie, and Alcaraz, 1993). Different explanations are suggested for these results: a) the levels of physical activity in the youngsters do not reach an intense level during a prolonged period of time, b) aerobic fitness is genetically determined, c) there is really little or no relation between PA and aerobic capacity in children (Klissouras, 1971, 1997; Malina and Katzmarzyk, 2006; Martinez-Vizcaino and Sanchez-Lopez, 2008; Morrow and Freedson, 1994).

It should be underlined that our study had a considerably large sample, but its size made it impossible to make an objective evaluation of PA using techniques like accelerometry. At present, questionnaires are recommended for evaluating physical activity in large samples, provided that they are reliable and validated with the target population; in our case the APALQ was used which complies with the above mentioned requirements with adolescents.

With regard to the evaluation of physical fitness with the Ruffier test, we know that some authors consider it an arbitrary index as it studies heart rate at an unstable period (Guillet and Genéty, 1984) but the objective is not functional but rather to evaluate the cardiovascular response to effort in short intense situations which commonly and naturally occur during play. It would be interesting in future studies to extend the tests to evaluate not only cardiovascular capacity but also muscular capacity in adolescents based on specific batteries of tests for this age group like the Fitnessgram created by the Cooper Institute (Welk and Meredith, 2008).

CONCLUSIONS

A positive though weak significant relation was found between the Index of Physical Activity and the Ruffier Index.

The level of cardiovascular adaptation of the adolescents of Leganés to effort is “medium” according to the assessment carried out with the Ruffier test. The RI results of the boys were significantly better than those of the girls.

The time spent doing activities in front of some type of screen is similar in both sexes, however, PA practice in the girls, both out of school hours and in sports competitions is significantly lower to that of the boys.

The time devoted to practising physical activities in the Physical Education classes is insufficient to fulfil current recommendations of physical activity for adolescents.

It is necessary to complement and encourage physical and sports activities, especially among girls.

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