Cooper and Shuttle Run Test in Young Students: Results and Correlations

Young people performance is often used to define the well-being and physical activity level. Several studies were assessed in school environments where more sedentary students were recruitable. As such, over 3800 students were tested with Shuttle Run Test (5m x 10) and Cooper endurance test during Physical Education classes. Shuttle Run Test was assessed according to the instructions given by Eurofit battery while the endurance trial was run in the playing field of each school. All phases of the test were run by teachers who collected data. During growth, males and females followed different trends: females showed the highest peak between 11 and 12 years while males between 13 and 14 years. Between 11 and 14 females increased their weight by about 10 kgs, while males gained 16 kgs. During Shuttle Run Test, the mean time spent performing the trial was 19,27 sec (M) and 20,25 sec (F). In both sexes the 13 and 14 year-old students were quickest while the 12 year-old students were the slowest. Males performed the test between 3200 m and 810 m while females performed 1795 m (on average). Statistical differences were found only between Cooper test and gender in all age groups. Disinclination for active life style is widespread however school education programs could reach all young people and arrange the tendency of students towards sport and well being.

Keywords: Eurofit battery test, Cooper test, physical education

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Introduction

All young individuals over the world are affected by the complex phenomenon of growing. Indeed, all subjects during the first two decades of their life feel macroscopically the changes in their body. These modifications include performance and physical efficacy as well. Thus, physical education (PE) teachers and trainers use different field-tests to evaluate the condition of students and athletes. In particular, two widespread tests are used to evaluate physical performance (not only in the school environment): the Cooper endurance test and the Shuttle Run test (SHR). The SHR test, in particular, is applied in different assessment: fixed repetitions (5m x 10; 10m x 5) or exhaustion trials (20m, 50m).

During the 2010-11 scholastic year, a large sample of sedentary students were assessed using Cooper and SHR tests (5m x 10; Eurofit protocol, Council of Europe, 1988) to define the baseline status and to define correlation about gender, weight, and height.

These results could lead PE teachers and trainers during their own programming to support the young students during this critical growth period.

Materials and methods

Subjects. A large sample of students were recruited in Milano province (Lombardia region, Italy) during the first month of the scholastic session (Lovecchio, Bussetti & Eid, 2009; Lovecchio, Casolo, Invernizzi & Eid, 2012). In particular, 3813 healthy, sedentary students (1817 female, 1996 male) were tested at school after the collection of the informed consent from their parents. Subgroups were defined according to age (table 1). All students were considered healthy and were not affected by neurological, orthopedic or cardio-vascular diseases.

Measurements. Performance variables were selected within the Eurofit Battery Test protocol (Council of Europe, 1988) for SHR, and followed the most used aerobic-field evaluation (Cooper test). All variables were strictly defined and were not influenced by the authors of this paper. The measuring instruments were the same as those prescribed and described in the instructions for the realization of Eurofit tests or within the indication of the Cooper Institute (www.cooperaerobics.com).

In particular, the items chosen for this study were running performance trials: the first evaluated speed and rapidity, while the second evaluated the person's aerobic capacity.

The protocol happened in October 2010 in the schools that freely participated in the Motorfit project (Lovecchio et al., 2009; 2012). Data were collected by PE teachers after a specific task training. Prior to starting the study, all teachers involved in the project undertook training sessions in order to guarantee the standardization, validation, and reliability of the measurements.

All trials were performed during PE classes. Height was measured with a fixed stadiometer to the nearest 0.5 cm and weight was measured with a beam balance to the nearest 0.2 kg. All data recorded in the same format table were sent electronically to the regional office of public instruction (PE department). Once experts had collected all data, a general database was created.

Statistical analysis. Descriptive analysis (mean and standard deviation) was calculated separately for all groups.

Correlation between anthropometric characteristic and results were calculated using the Pearson index while the Analysis of Variance (Anova) was used between all parameters. The level of significance was set at 5%.

Results. The anthropometric characteristics of the subjects are shown in table 1. Both males and females had the same height (mean value) at 11 year, while in the other age clusters they followed different trends. Indeed, males (min = 120 cm; max = 187 cm) improved their own height of about 7 cm at each age class while females (min = 130 cm; max = 182 cm) showed the best peak between 11 and 12 years of age (149,52 to 155,66). Afterwards, they increased their height by approximately 3 cm, and then remained almost constant between the age of 13 and 14. Males had the best peak between 13 and 14 year.

For weight there are also three different increments. Male (min = 22Kg; max = 90 Kg) increased regularly while female (min = 27 Kg; max = 86 Kg) stopped at the 13 years group.

Females increased their weight by about 10 Kgs over 3 years (11y to 14y; 42 kg to 52 kg) while males started from 42 Kgs and reached 58 Kgs.

Table 1

Anthrophometric characteristic. Data divided within age and sex

Age (years)	Sex	N	Height (cm)	Weight (Kg)	BMI (Kg/m²)
11	M	419	148,46±7,08	41,62±8,25	18,78±2,85
	F	388	149,52±7,70	41,97±8,76	18,67±3,02
12	M	514	155,35±8,59	46,85±10,86	19,00±3,30
	F	499	155,66±6,45	46,16±8,50	19,26±2,27
13	M	515	158,00±7,08	51,62±8,26	18,78±2,47
	F	486	159,49±6,50	50,11±7,73	19,69±2,82
14	M	548	168,17±8,23	58,10±10,99	20,49±2,97
	F	444	160,96±6,40	52,28±8,15	20,08±2,75

The differences between each age class is about 5 kgs and 4 kgs respectively for male and female even if during the last cluster the gap is 6,5 kgs for male and 2 kgs for female.

Males showed a greater variability than females both for height (7,75 cm) and weight (9,22).

The SHR test showed (on average) results not less than 20 sec in females and close to 19,3 for males (fig. 1). The mean time spent performing the trial was 19,27 sec (M) and 20,25 sec (F).

The worst performance in the female group was about 26 sec in all age groups, while the best females (75th percentile) took less than 19,6 sec. The 25th percentile defines a performance over 20,89 sec. The variability is close to 2,4 sec.: more than the time spent to run one shuttle.
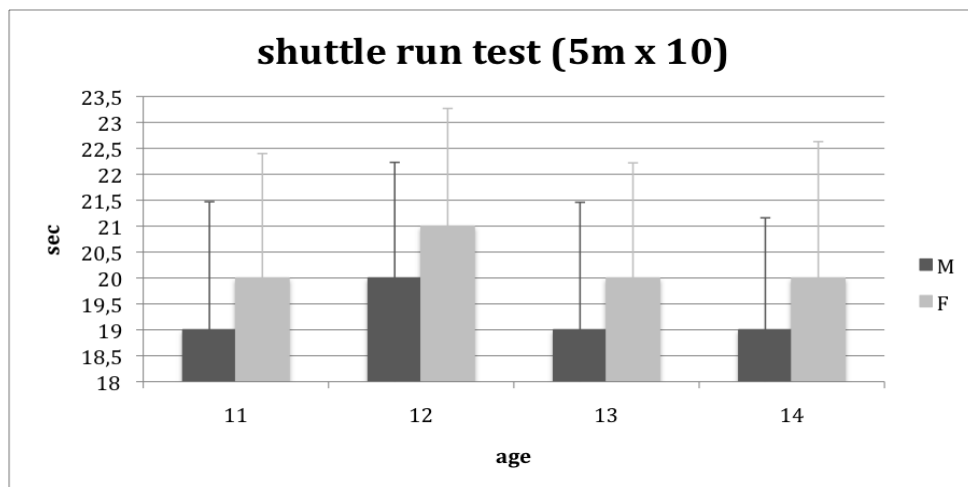
Figure 1. SHR test results (sec). Data divided by age group and gender.

Males, on the other hand, were more performing than females. The best were the 14 year-old students with 18,7sec, while the worst were the 12 year-old (20 sec on average).

The best performing males (75th percentile) ran between 17,8sec and 18,5 sec, while the worst (25th percentile) between 20 sec and 21 sec. the variability is about 2,34.

In both sexes the 13 and 14 year-old students were the most rapid while the 12 year-old were the slowest.

From the endurance point of view no groups run (on average) 2700m. (male) or 2000m. (female): the levels considered optimum by the Cooper Institute.

Males performed, on average, 2020 m with the best results close to 3200m. (12 year old boys) and the worst at 810m. Females, instead, performed 1795m (data pooled within age) and showed a mean performance lower than males from 180m to 440m.
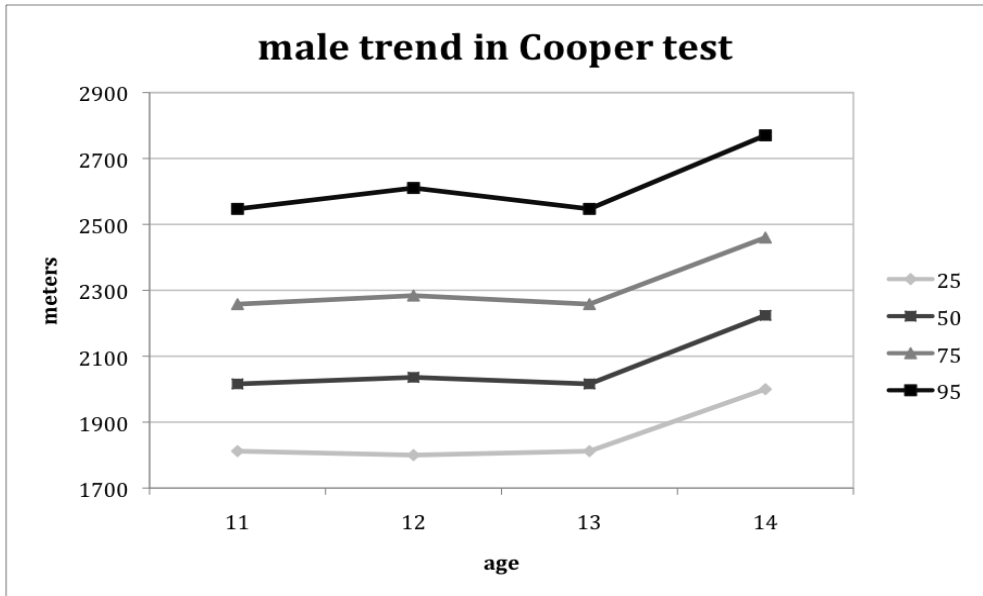
Figure 2. Cooper test: percentile line about male. Data divided according to age.

The level of performance in the male group was constant at 11, 12, and 13 years (2026m) while an important improvement was obtained during the last group: 2202m. Differently, the 14 year- old group had the greatest variability (395m) while in general it was set (on average) at 353m.

Females showed an inhomogeneous trend: 11-12 improving, 12-13 constant, 13-14 decreasing. The best trial was close to 2820m (a 12 years old girl) while the variability is lower than male: 275m

The best females (95th percentile, fig. 2) covered more than 2130m, while males covered more than 2770m (fig. 3).
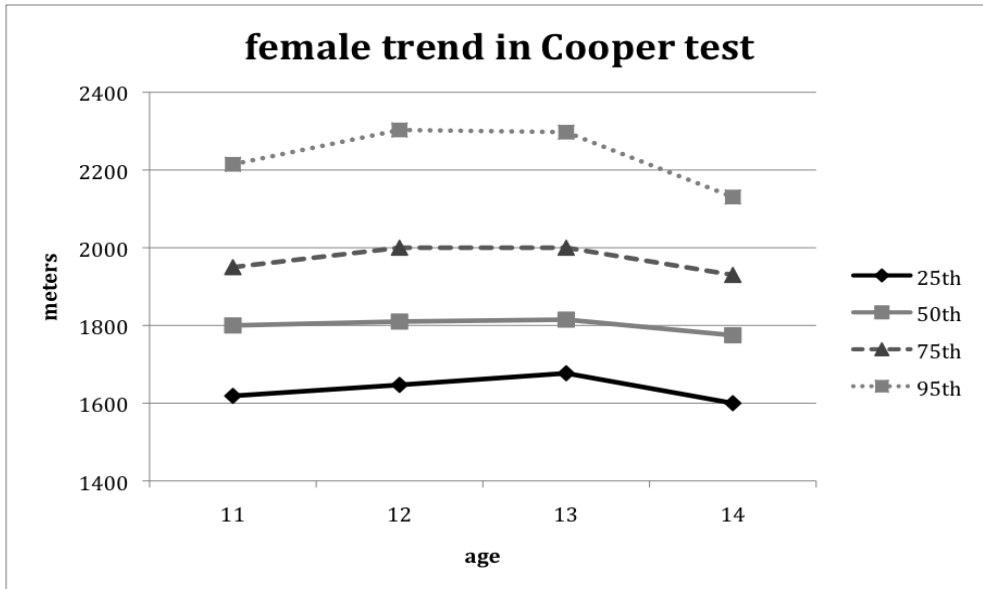
Figure 3. Cooper test: percentile line about female. Data divided according to age.

Considering the 14 year-old students, the gaps between male and female at 25, 50, 75 and 95th percentiles were 400, 550, 430 and 640m.

The mean speed used by female to run for 12 minute was 2,45; 2,52; 2,55 and 2,44 m/sec, respectively, at 11, 12, 13 and 14 years old. Males instead run at 2,80; 2,83; 2,80 and 3,05 m/sec.

Pearson index between BMI (Body Mass Index) and the performances did not show high correlations, while Anova found significant statistical differences about Cooper test x gender in the first three years (11, 12, 13 years old class).

Discussion

Several studies reported results on the performance of children and adolescents considering different conditions or correlations such as rural/urban living areas (Tsimeas, Tsiokanos, Koutedakis, Tsigilis & Kellis, 2005; Ozdirenc, Ozcan, Akin & Gelecek, 2005), socio-economic status (Freitas, Maia, Beunen,

Claessens, Thomis, Marques, Crespo & Lefevre, 2007), or food preferences (Hebbelinck, Clarys & De Malsche, 1999).

Thus motor tests become helpful when monitoring physical motor skills and overall performances in the school environments: the comparisons are very direct. Indeed, in longitudinal tests, comparison within sex and age can be assessed in a close system.

To support this during the 2010-11 scholastic year an Italian project collected data on the physical performance in a large sample of Italian students (Lovecchio et al., 2009, 2012). The aim was to define the physical efficacy of young people and to investigate and recognize scanty situations and then revise the school curriculum.

In this report, the baseline about two famous and widely-used field tests are presented.

The SHR (5m x10) reveals a controversial situation compared to other studies. Indeed, Freitas et al. (2007) in relation to socio-economic status found performances more slow (24, 23, 21 sec and 24, 24, 23,5 sec for male and female) in the same age group (an explanation should be the origin of the sample: Madera island) while two significant studies collected data where students were faster than our's. Greece (Tsimeas et al., 2005) and Turkey (Ozdirenc et al., 2005) showed a mean result of 2 seconds less.

In addditon, Hungarian performance (data not yet published) stopped the watch at one second less at every age class, in comparison to our data. On the other hand, two Spanish studies (Casajus, Leiva, Villarroya, Legaz & Moreno, 2007; Ortega, Ruiz, Castillo, Moreno, González-Gross, Wärnberg, Gutiérrez & Grupo AVEN., 2005) found that mean performances were slower than our Italian trials (2 or 1 second).

Vaeyes, Malina, Janssens, Van Renterghem, Bourgois, Vrijens & Philippaerts (2006), instead, with a non-elite soccer player sample (11 years old, Belgium) obtained results with an average performance of one second less, but this discrepancy could depend on the setting of execution: field surface and technical shoes for soccer.

After this brief comparison with other scientific papers and the Italian analysis we can conclude that the rapidity in this test could be considered a "good performance" when the time is 19 or 20 seconds. This is in agreement to what was described by Baquet, Berthoin, Gerbeaux, Van Praagh. (2001).

This time-reference is very important to evaluate students, but some considerations are necessary.

Indeed, males at the age of 12 years old had the worst results (on average) during the first peak of height, while during the second peak they seem to perform the trials with better results. On the other hand, females had the worst performance at 12 year when the great weight increment happened.

Moreover, we could define a trend where performance reaches the best level around 14-15 years of age while after is kept a constant trend (up to 19 years). Indeed, PE university students performed the same result: 19,1 and 20,4 sec (Van de Vliet, Rintala, Fröjd, Verellen, van Houtte, Daly & Vanlandewijck, 2006).

The Cooper test results showed two different trends between male and female. Females reach their own best results during 12-13 years, while males have their peak of performance at 14 years.

Indeed, males had constant results during 11-12-13 years when the BMI index did not show important variations. It would seem that females stop their physical improvements at the end of middle school (14 years old) while males stop having aerobic improvement during the beginning of high school (15 years old). Performance within the male sample improves each year, and the gender factor seems be the crucial factor that distinguishes the performance.

Moreover, females at each level of percentile during 13-14 years (fig. 3) had a negative peak of performance--a period of time where an increase of weight is not followed by a similar increase in height.

Of note, the Italian results are not excellent, and are recorded - on average - at the lower or weak level (following Cooper Institute criteria; www.cooperinstute.org). Therefore the Italian condition showed a wide disinclination to active sport practice: overall in young students (Lovecchio et al., 2009, 2012) and for endurance sports.

The Italian solution could be the school curriculum. In fact, the PE curriculum could play a crucial role in keeping the rapidity of speed and improving the endurance of students.

The educational School Ministry decision should be more defined and imperative because PE classes are the only mandatory physical activity for all young students and can improve the physical well-being.

Acknowledgements

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Web resources:

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