



Physical fitness reference standards in Italian children

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Abstract

Physical fitness in childhood is considered a marker of current and future health. For this reason, there is a need for a simple but reliable test to assess the different components of physical fitness even at school during physical education lessons. However, standard values are required to correctly interpret the results of such tests. Hence, this study aimed to generate sex- and age-specific normative percentile values for health-related physical fitness in Italian children. To this aim, 30,472 children aged 6–11 years from the Friuli Venezia-Giulia region (Italy) were examined. The fitness test battery included the Léger test (cardiorespiratory), the shuttle test (agility), standing long jumps, frontal throws of a basketball (lower and upper limb strength), the sit-and-reach test (flexibility), and the standing balance test. Sex- and age-percentile curves were determined using the General Additive Model for Location Scale and Shape (GAMLSS).

Conclusion: The reference standards are provided as 1st, 3rd, 10th, 25th, 50th, 75th, 90th, 97th, and 99th percentiles in the form of both tables and charts and are roughly comparable with those of other European children.

What is Known:

- Physical fitness in childhood is considered a marker of current and future health;
- Several tests have been developed to assess physical fitness in children;
- There are general European reference standards for a series of tests of the main fitness components for children.

What is New:

- The present study provides specific reference standards for a series of tests that are indicative of the main fitness components and easily applied in children, particularly those in the Italian population;
- Standing balance test and basketball frontal throw test references in a wide sample of children;
- The performance of children in the present study was roughly comparable to that of other European children.

Keywords Reference values · Cardiorespiratory fitness · Muscular strength · Flexibility · Balance · Speed-agility

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Abbreviations

20-mSRT	Léger test, also called 20-m shuttle running test
P _n	<i>n</i> percentile
GAMLSS	General Additive Model for Location Scale and Shape method

Introduction

Physical fitness in childhood involves several health-related components, such as cardiorespiratory and muscular endurance, muscular strength, speed-agility, flexibility, and balance [1]. These components are considered markers of current and future health [2]. Some studies have shown that a low level of cardiorespiratory fitness is associated with cardiovascular diseases, some types of cancer, increased adiposity, and obesity [2]. Muscle strength is inversely related to cardiovascular diseases and metabolic risk factors [2] independent of cardiovascular fitness [3], and both upper and lower body muscle strength levels are considered important [4]. Additionally, muscle strength levels and speed-agility capacities are positively related to bone health and self-esteem [2]. Finally, even though there is only weak evidence indicating that flexibility and balance in childhood are correlated with health [5], the American College of Sports Medicine (ACSM) still includes exercise aimed at improving flexibility and balance in its guidelines for preventing worsening of physical fitness in adults [1] and elderly individuals. Since childhood physical fitness is important for public health [6], several tests have been developed to assess its components in a simple but reliable way. The Léger test is often used to evaluate cardiorespiratory fitness [7], and standing long jump and frontal throws of a basketball are considered reliable indices of lower [8] and upper [9] limb muscle fitness. In addition, the shuttle (10 × 5 m) [10], sit and reach [11], and standing balance [12] tests are considered reliable methods for evaluating speed-agility, flexibility, and balance, respectively. Sex- and age-specific reference values help identify children with a low level of fitness and promote healthy behaviours thereby preventing future health risks.

Although there are some reference values from different regions of the world [13], there is a scarcity of reference values for Italian children [13]. Even though reference from Europe already exist [14], there may be wide differences among countries or even within a single country [15]. Hence, this study aimed to generate sex- and age-specific normative percentile values for health-related physical fitness in Italian children aged between 6 and 11 years. Furthermore, this study aimed to provide a battery of tests by selecting the simplest tests to be performed.

Subjects and methods

A sample of 30,472 Italian schoolchildren (6–11 years old) involved in the “*MOVIMENTO in 3S: promozione della Salute nelle Scuole attraverso lo Sport*” (*MOVIMENTO in 3S* project: promoting Health in Schools through Sport) project was considered in the present study [6]. The project was a cross-sectional study; children were enrolled from different public schools in the Friuli Venezia-Giulia Region (Italy) between 2016 and 2018. One hundred thirty-seven of the 387 schools in the region joined the project and about 95% of the students of these schools participated in the measurements. The total number of primary schoolchildren in the Friuli Venezia Giulia region was about 60,000.

The experimental protocol was approved by the University of Udine Ethics Committee on Human Research for Medical Science. All the Children attending primary school were considered eligible for the study excluding those with any issues that prevented them from attending physical education classes. The procedures and purposes of the project were carefully explained to each child and his or her parents. Children gave verbal consent to participate and parents gave written informed consent. Thereafter, physical fitness tests were performed at the beginning and of each school year during school hours by a previously trained researcher to collect the data accurately and consistently.

Physical fitness

A battery of 6 tests was chosen to obtain a complete report of children's physical fitness [16]. Priority was given to the use of tests that were easy to perform without the use of any special tools. The 6 tests were administered to the children on 6 different days during their class hours.

Cardiorespiratory fitness

Cardiorespiratory fitness was evaluated by a single repetition of the Léger test [16], which has been also validated in children [17, 18]. For the test, children were required to run back and forth continuously between two cones placed 20 m apart. A pre-recorded audio signal started to beep at pre-set intervals. The children had to follow the rhythm imposed by the beeps and the starting speed was selected at 8.5 km h⁻¹. The children had to be in correspondence with the cone at each beep. Every minute the speed was increased by 0.5 km h⁻¹ reducing the time between two consecutive beeps.

When the children being tested did not reach the final point in time or when the children stopped by fatigue, the last stage completed was recorded as their final score.

Speed-agility

Whole body speed-agility was evaluated by a shuttle test (10 × 5 m) [19–22], which has been validated in children [10]. Two lines have been depicted on the floor 5 m apart. At the “go!” signal, children had to run as fast as possible to the opposite line, cross it with both feet, run back across the starting line, and repeat the task for 10 shuttles (50 m), without brakes, in the shortest possible time. The best time of two trials was then taken into consideration.

Muscular power of the lower limbs

Lower limb explosive power was evaluated by means of a long jump test [12, 14, 19–26], which has been validated, by several authors, also in children [8, 16, 21]. Children were asked to jump for distance from a standing start. They were instructed to bend their knees with their arms in front of them, parallel to the ground, then to swing both arms and jump as far as possible, trying to land on their feet. The best trial between 3 tests was recorded.

Muscular power of the upper limbs

Upper limb power was evaluated by a frontal throw of a basketball (0.5 kg) [9]. The validity and reliability of this test has been previously confirmed [24]. Children were instructed to throw the basketball while sitting on the ground with their legs spread apart and with their back against the wall in order to use only upper limb’s muscles. The ball was thrown with two hands maintaining back contact with the wall. The distance of the throws was considered between the wall and the first point of contact of the ball on the ground. The best of three throws was recorded in centimetres.

Flexibility

Hip and low back flexibility was evaluated by the sit-and-reach test [12, 19–22, 24–26], which has been previously validated [11]. Children were asked to sit on the floor with legs stretched forward and knee locked and pressed against the floor. Shoes were removed and soles of the feet were placed flat against a box. Children stretched as far as possible along the measuring line and held that position for 1 to 2 s while the distance was measured. The level of the feet was considered to be 15 cm [27] in order to make all the values positive.

Static balance

The standing balance test evaluates balance capacity in children [12, 27], and it is considered valid and reliable [17, 18]. Children were asked to remove their shoes and to keep their balance on their preferred leg. The free leg had to be flexed at

the knee, and the foot had to be held by the hand against the buttock of the same side while the contralateral hand remained fixed at the level of the hip. The test started after 1 min of practice. Time in seconds was considered the score of the test. The test was considered concluded either after 30 s, when the children moved their supporting foot, or when they lost contact between the heel of the non-supporting leg and the buttocks.

Statistical analysis

Statistical analyses were performed using the GAMLSS (General Additive Model for Location Scale and Shape) package 5.1-4 [28] of the statistical software R version 3.6.3. All physical fitness results were expressed as the mean and standard deviation (SD). To perform the analysis, the collected data were first screened for incorrect inclusions. The percentile curves for the fitness variables were stratified by sex and calculated as a function of age using the GAMLSS method. The percentile curves for the 1st, 3rd, 10th, 25th, 50th, 75th, 90th, 97th, and 99th percentiles were calculated based on the model that showed the best goodness of fit.

Results

The initial selected sample (n : 30472) was screened for any incorrect inclusions and 41 children were deleted from the original database due to temporary physical issues preventing them from performing the tests. Then, 30,431 children were considered in the present study. Tables 1 and 2 and Figs. 1, 2, and 3 display the age- and sex-specific percentiles (P_1 , P_3 , P_{10} , P_{25} , P_{50} , P_{75} , P_{90} , P_{97} , and P_{99}) for the different fitness tests in 30,431 Italian schoolchildren (6–11 years old). In the Léger test, boys performed better ($P < 0.05$) than girls, and older children performed better ($P < 0.05$) than younger children (Fig. 1a, b); in the speed-agility shuttle test, girls and boys had similar values, and older children performed worse ($P < 0.05$) than younger children (Fig. 1c, d). In the standing long jump test (Fig. 2a, b) and frontal throw test (Fig. 2c, d), boys performed better ($P < 0.05$) than girls, and older children performed better ($P < 0.05$) than younger. In the sit-and-reach test, girls performed better ($P < 0.05$) than boys (Fig. 3a, b). In addition, girls’ performance decreased with age from P_1 to P_{50} , while it increased with age from P_{75} to P_{99} ; however, boys’ performance decreased with age from P_1 to P_{99} . Finally, in the standing balance test, boys and girls had similar values (Fig. 3c, d); moreover, in both sexes, the increment with age was maximal around P_{50} and tended to be lower when approaching both P_{99} and P_1 .

Table 1 Percentiles of the Léger test, speed-agility shuttle test, and long jump test, stratified by sex and class of age (6–11 years old)

	Age	Percentile for girls									Percentile for boys									
		1	3	10	25	50	75	90	97	99	Age	1	3	10	25	50	75	90	97	99
Léger test (<i>n</i>)	6–< 7	1.0	1.2	1.4	1.6	1.9	2.4	3.2	4.0	4.4	6–< 7	1.1	1.2	1.3	1.6	2.1	3.2	3.8	4.8	5.5
	7–< 8	1.3	1.5	1.7	1.8	2.2	2.6	3.6	4.2	5.3	7–< 8	1.1	1.3	1.4	1.8	2.3	3.6	5.2	6.1	6.7
	8–< 9	1.4	1.6	1.8	2.2	2.8	3.6	4.5	5.4	6.0	8–< 9	1.2	1.4	1.6	2.3	3.1	4.2	5.4	6.6	7.2
	9–< 10	1.5	1.8	2.0	2.8	3.4	4.3	5.1	6.6	7.3	9–< 10	1.3	1.5	1.6	2.4	3.6	4.8	5.8	7.0	8.2
	10–< 11	2.0	2.2	2.6	3.3	3.6	4.6	5.3	7.1	8.1	10–< 11	1.3	1.5	1.7	2.6	3.9	5.2	6.9	8.1	8.4
	11–< 12	2.1	2.4	2.8	3.4	3.9	4.8	5.5	7.4	8.4	11–< 12	1.4	1.6	1.9	2.8	4.2	5.6	7.3	8.4	9.2
Speed-agility shuttle test (s)	6–< 7	37.6	34.7	31.6	29.3	27.3	25.7	23.7	20.6	16.9	6–< 7	38.6	34.8	31.7	28.0	26.8	24.5	22.8	19.1	16.5
	7–< 8	37.1	34.1	31.0	28.1	26.7	24.0	22.3	18.8	16.5	7–< 8	35.8	34.5	30.7	27.4	25.3	23.1	21.3	18.8	15.9
	8–< 9	36.3	33.7	29.5	27.6	25.5	23.4	21.5	17.6	15.7	8–< 9	35.2	34.0	29.0	26.5	24.3	22.5	21.0	17.8	15.1
	9–< 10	35.0	32.6	28.7	26.5	24.4	22.3	20.8	16.9	14.9	9–< 10	34.1	32.2	28.2	25.4	23.5	21.8	19.8	16.7	14.7
	10–< 11	34.1	30.0	27.8	25.9	23.8	21.8	20.2	16.5	14.6	10–< 11	33.8	31.7	27.4	24.8	22.8	21.0	19.1	16.0	14.0
	11–< 12	33.3	29.4	27.1	25.1	23.2	21.3	19.6	16.2	14.3	11–< 12	33.0	29.6	26.5	24.2	22.1	20.4	18.2	15.5	12.9

The values correspond to the 1st, 3rd, 10th, 25th, 50th, 75th, 90th, 97th, and 99th age- and sex-specific percentiles

Discussion

The present study provides age and sex reference standards for a series of tests indicative of the main fitness components that are easily applied in schoolchildren. The values for the percentiles presented are noteworthy because they come from a fairly wide sample of 30,431 children, and they could be very useful for educators. Moreover, they can be used to compare the fitness status of Italian children to that of European children and children worldwide. Finally, these reference standards can serve as a good reference for monitoring the decline in physical fitness state that is occurring in children around the world [29–32].

Because the relationship between cardiorespiratory fitness and health issues in children is well documented [2, 7, 33–35], the Léger test is often used to assess this important component at school [36]. The Léger test [17], also called the 20-m shuttle running test (20-mSRT), is one of the most widely used tests for evaluating cardiorespiratory fitness due to its validity and reliability and the ability to test a large number of children at the same time [37]. It can be scored by using the number of stages completed (as in the present study), the number of laps completed, or the speed reached at the last stage and allows us to estimate the maximal oxygen uptake [17, 38]. The values obtained in the present study were roughly comparable to those obtained previously in Spanish children [20, 39] and those in Tomkinson's study [22], particularly for girls. Even though the study by Tomkinson included children and adolescents aged 9–17 years old from 30 European countries, it is

not possible to compare values for the younger children. Moreover, our data from children aged >9 years were comparable to those from Australian children [40]. The review by Olds et al. [13], which included 37 countries from around the world, showed that Italian children were among the worst performers on the Léger test, whereas northern European countries were the best performers. However, the reference standards provided by the present study appear to be roughly in line with those of other European countries. Hence, the situation of the Italian children considered in the present study does not seem to be so compromised when compared with the situation of those from other European countries.

Speed-agility is strongly related to health as well, in particular to bone mineral density and bone mass accumulation later in life [2, 3, 5, 35]. There are a wide variety of tests aimed at evaluating speed-agility, often based on running patterns and changes in direction. The shuttle test is one of them [19–22], and it has been previously used several times to assess speed-agility in children and adolescents [19–22, 34]. Overall, the studies confirm that girls tend to have higher values than boys and that younger children have better performance than older children, not only in children the same age as those in our study [20] but also in adolescents until 17 years old [21, 22, 34]. Furthermore, our values appear to be in line with or slightly higher than those observed in Spanish children [20].

Muscular strength/fitness is one of the most studied fitness components in relation to health [2–5, 35]. In particular, the standing long jump is considered a general index of muscular fitness [4]. Our results were similar to those found in Spanish

Table 2 Percentiles of the frontal throw test, sit and reach test, and standing balance test, stratified by sex and class of age (6–11 years old)

	Age	Percentile for girls										Percentile for boys									
		1	3	10	25	50	75	90	97	99	Age	1	3	10	25	50	75	90	97	99	
Frontal throw test (cm)	6<7	90.5	124.0	158.7	190.6	220.0	251.4	285.7	320.2	370.2	6<7	110.5	135.2	170.8	200.7	240.0	280.3	310.1	350.6	380.6	
	7<8	110.8	130.2	165.0	200.3	235.2	270.1	305.8	340.4	363.5	7<8	120.3	142.2	180.8	212.6	252.1	294.3	333.3	374.8	407.5	
	8<9	145.4	170.7	210.7	240.4	280.5	321.2	360.5	392.5	425.0	8<9	155.1	180.0	225.5	266.6	310.0	354.4	392.4	440.2	465.5	
	9<10	150.7	190.3	244.8	285.4	328.7	370.6	410.8	450.6	481.8	9<10	165.4	205.3	265.4	315.1	360.5	410.8	450.8	500.8	535.1	
	10<11	160.4	221.2	285.3	325.8	365.2	410.6	454.3	500.8	540.1	10<11	180.6	250.4	315.1	360.2	410.1	455.1	500.4	545.4	580.2	
	11<12	191.0	270.3	326.0	362.7	400.8	449.6	500.4	540.7	580.0	11<12	227.8	304.1	352.0	400.1	450.2	500.3	545.8	590.3	640.8	
Sit and reach test (cm)	6<7	4.8	6.8	11.0	14.8	18.8	22.8	26.3	29.6	32.5	6<7	1.6	4.0	7.5	11.5	16.4	19.5	23.0	27.1	30.5	
	7<8	2.4	4.8	9.8	14.5	18.6	22.6	26.4	30.7	33.5	7<8	1.4	2.8	6.0	10.8	16.1	18.6	22.8	25.9	29.6	
	8<9	1.8	4.5	8.9	14.1	18.5	22.5	27.4	31.1	33.6	8<9	1.1	2.5	5.5	9.7	15.7	18.5	22.1	25.3	28.5	
	9<10	1.6	4.0	8.5	13.6	17.5	23.1	27.5	32.5	34.5	9<10	0.8	2.1	4.6	9.2	14.8	18.2	21.8	25.0	28.1	
	10<11	1.2	3.5	8.1	13.5	17.4	22.7	28.6	32.8	34.9	10<11	0.7	1.5	4.2	8.9	14.4	17.7	21.5	24.8	27.9	
	11<12	1.1	3.2	7.8	13.1	17.0	23.1	29.5	33.2	35.4	11<12	0.4	1.3	3.9	8.1	14.3	17.5	21.1	24.3	27.4	
Standing balance test (s)	6<7	0.8	2.1	3.7	7.7	13.8	25.3	26.5	27.1	27.9	6<7	0.9	1.4	3.8	5.5	11.2	19.0	23.5	26.7	29.4	
	7<8	1.6	3.3	6.2	12.7	15.4	25.8	26.8	27.4	28.1	7<8	1.7	2.5	4.0	8.5	13.6	21.7	25.6	27.4	29.5	
	8<9	3.6	6.1	10.5	14.1	21.7	27.6	27.9	28.3	28.7	8<9	2.3	3.4	6.2	12.1	17.4	23.4	26.1	27.8	29.7	
	9<10	4.3	8.6	12.3	17.3	24.6	27.8	28.2	28.6	29.0	9<10	2.7	4.8	9.5	13.8	22.8	26.7	26.9	28.5	29.8	
	10<11	4.8	9.6	14.4	21.4	26.3	28.4	28.6	29.1	29.6	10<11	3.0	5.7	12.1	17.5	25.1	26.3	27.6	28.8	29.8	
	11<12	5.5	11.3	15.9	23.2	28.2	28.8	29.1	29.6	29.9	11<12	3.4	6.4	12.8	18.7	25.7	27.9	28.4	29.3	29.9	

The values correspond to the 1st, 3rd, 10th, 25th, 50th, 75th, 90th, 97th, and 99th age- and sex-specific percentiles

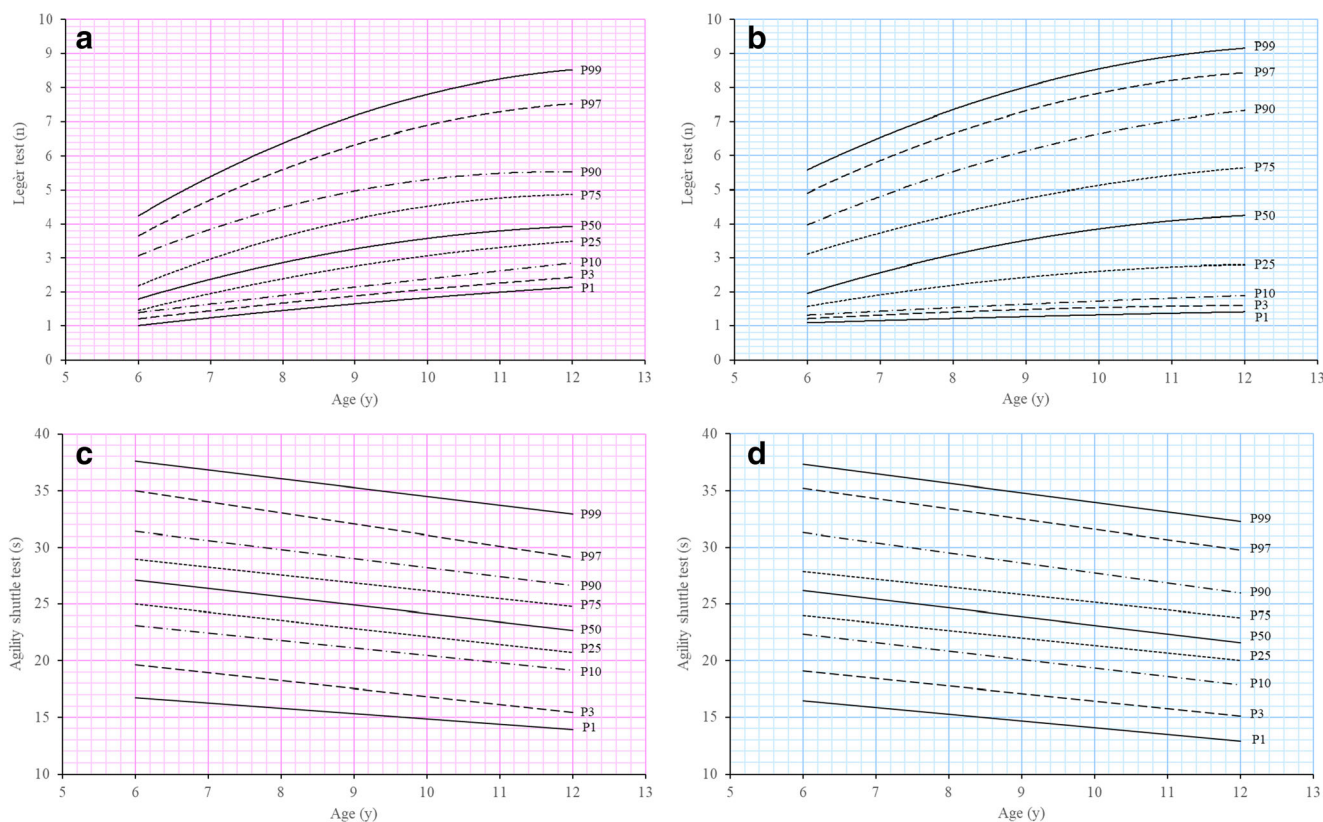


Fig. 1 Percentile curves of the physical fitness (Léger test: **a**, **b**; speed-agility shuttle test: **c**, **d**), stratified by sex (girls: **a**, **c**; boys: **b**, **d**) and class of age (6–11 years old)

children of the same age [20] and European children aged 6 to 9 years old [14] but lower than those found in Polish [21] and Australian children older than 9 years old. However, in all these studies, as in ours, boys and older children had higher outcomes than girls and younger children, respectively [14, 20, 21, 40]. In terms of muscle fitness, upper body muscle fitness is considered an important predictor of health in children [4]. One of the most commonly used tests to assess this component was the handgrip test [4, 14, 20, 21, 41]. However, in our opinion, it is very important to provide an easy-to-perform test that does not require special tools to evaluate upper body muscle fitness. In light of this, the basketball frontal throw test was developed [42]. Our results were slightly higher than those observed in Australian children and adolescents older than 9 years old [40]. In addition, to the best of our knowledge, this is the first study that has provided reference values for the basketball frontal throw test in a wide sample of children.

The flexibility standard reference values provided by the present study are in line with those for Spanish children [20]; moreover, older boys and girls showed less flexibility levels than younger boys, while girls were more flexible than boys. The reference values from Dobosz [21] showed that Polish boys performed better than Italian boys. Finally, the review

by Catley and Tomkinson [40] shows higher values in Australian children than in the children in our study, but it is not clear if the differences were due to different methods of assessment.

To our knowledge, the present study was the first to provide a standing balance test reference in children. This may help promote the use of this test in assessing balance, since it has been proven to be reliable to evaluate balance capacity in children [12, 18]. Nevertheless, although our results on balance were not directly comparable with others, the trends whereby older individuals performed better than younger individuals [14, 21, 34] and girls performed better than boys [14, 34] were confirmed by other studies.

For a practical application of these data, educators, coaches, and all other people involved in children physical activity may consider these reference values of fitness status: very poor ($X < P10$); poor ($P10 \leq X < P25$); medium ($P25 \leq X < P75$); good ($P75 \leq X < P90$); and very good ($X < P90$). The lowest percentiles, for example, 10th percentile, can represent a “warning signal” for further tests and investigations. Miguel-Etayo and colleagues [14] suggest that a fitness level below P5 is potentially pathological and cardiorespiratory and muscular fitness is particularly associated with health status [2]. Moreover, children with values below P25 may be introduced

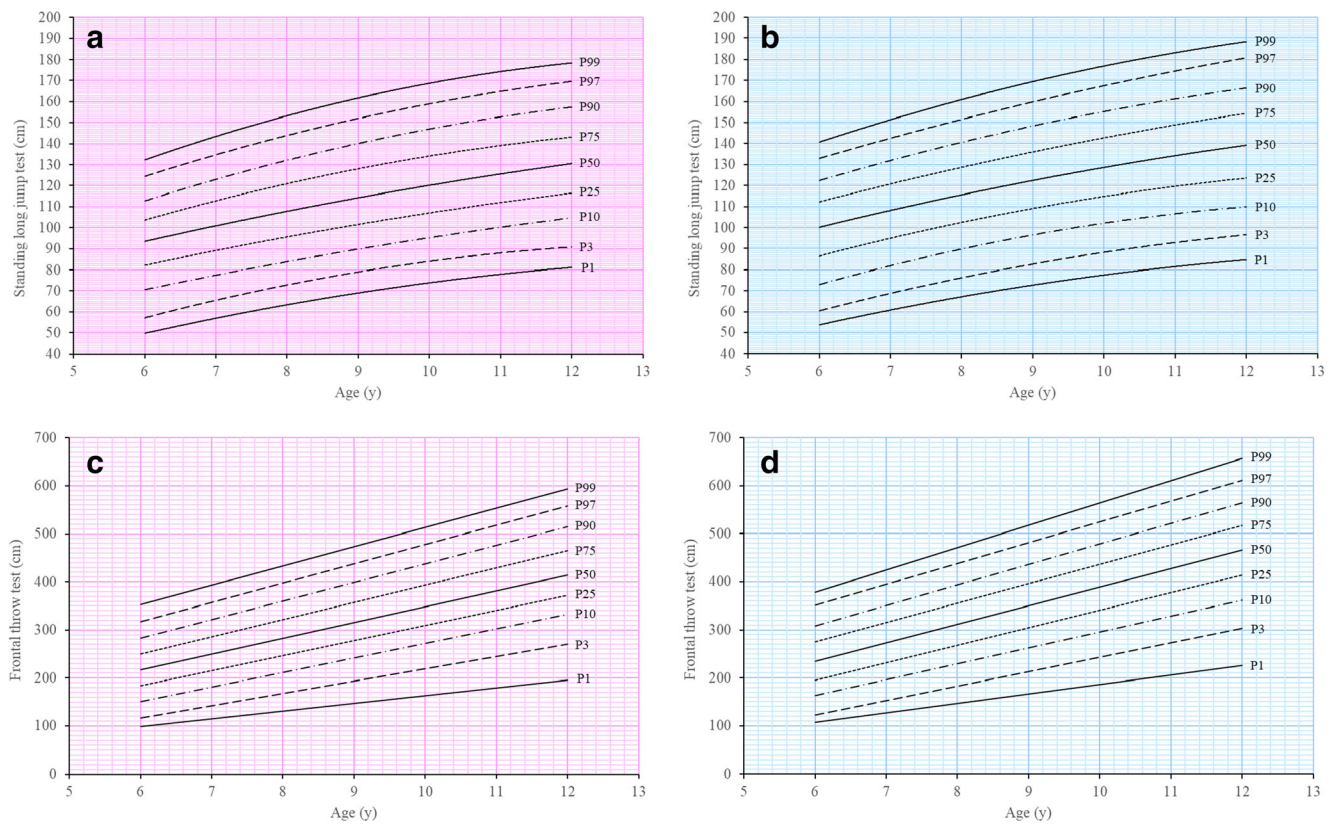


Fig. 2 Percentile curves of the physical fitness (standing long jump test: **a, b**; frontal throw test: **c, d**), stratified by sex (girls: **a, c**; boys: **b, d**) and class of age (6–11 years old)

to training programmes to improve their fitness. On the other hand, children with values above the highest percentiles may be advised for further athletic developments.

A further aspect to be considered is the secular trend in children's physical fitness; it seems that in many countries around the world, physical fitness has been worsening over the years [29–32, 38]. The study by Tomkinson et al. [38], which used the Léger test to assess cardiorespiratory fitness in 11 mainly developed countries around the world between 1980 and 2000, showed a marked decline in performance in both sexes, especially in older compared to younger individuals. In this light, the data provided by the present study may be useful for monitoring this phenomenon. Many factors can influence physical fitness, such as sex, age, children's body mass index, and the amount of physical activity, and these factors are independently related to each other [43]. Indeed, the study by Zaqout et al. [33], in accordance with our data, showed that boys had better cardiorespiratory fitness and upper- and lower-limb strength than girls, while girls had better balance and flexibility. Furthermore, increased body mass index (BMI) was related to lower cardiorespiratory fitness, flexibility and lower limb strength, balance, and increased upper limb strength as previously reported [6], while higher physical activity was connected to the improvement of all components of physical fitness except balance [43].

Children's BMI is also positively associated with their mother's obesity, but, luckily, CRF and muscular strength mitigate this relationship [44]. Therefore, physical fitness and physical activity are important, and the role of the school may be crucial, on the one hand, to identify children with low physical fitness levels and, on the other hand, to encourage children to be active. However, physical activity programmes should aim to improve not only cardiorespiratory fitness but also muscular fitness and speed-agility [2]. For this reason, physical activity is recommended in the form of both structured and unstructured activity in children; in particular, aerobic exercise is recommended daily, while activity focused on muscle and bone strengthening should be prescribed at least 3 days per week [45]. Recent findings [46] suggest that also active videogaming may be beneficial.

Two of the main strengths of the present study are the large number of children involved and the fact that all tests are easy to perform at school without specific tools. Furthermore, to the best of our knowledge, this is the first study to provide reference values of the standing balance test in children. On the other hand, the two main limitations are (1) the design of the study is cross-sectional while it would be preferable to obtain data from a longitudinal study on growing children and (2) the children included in the sample come from a single region of Italy.

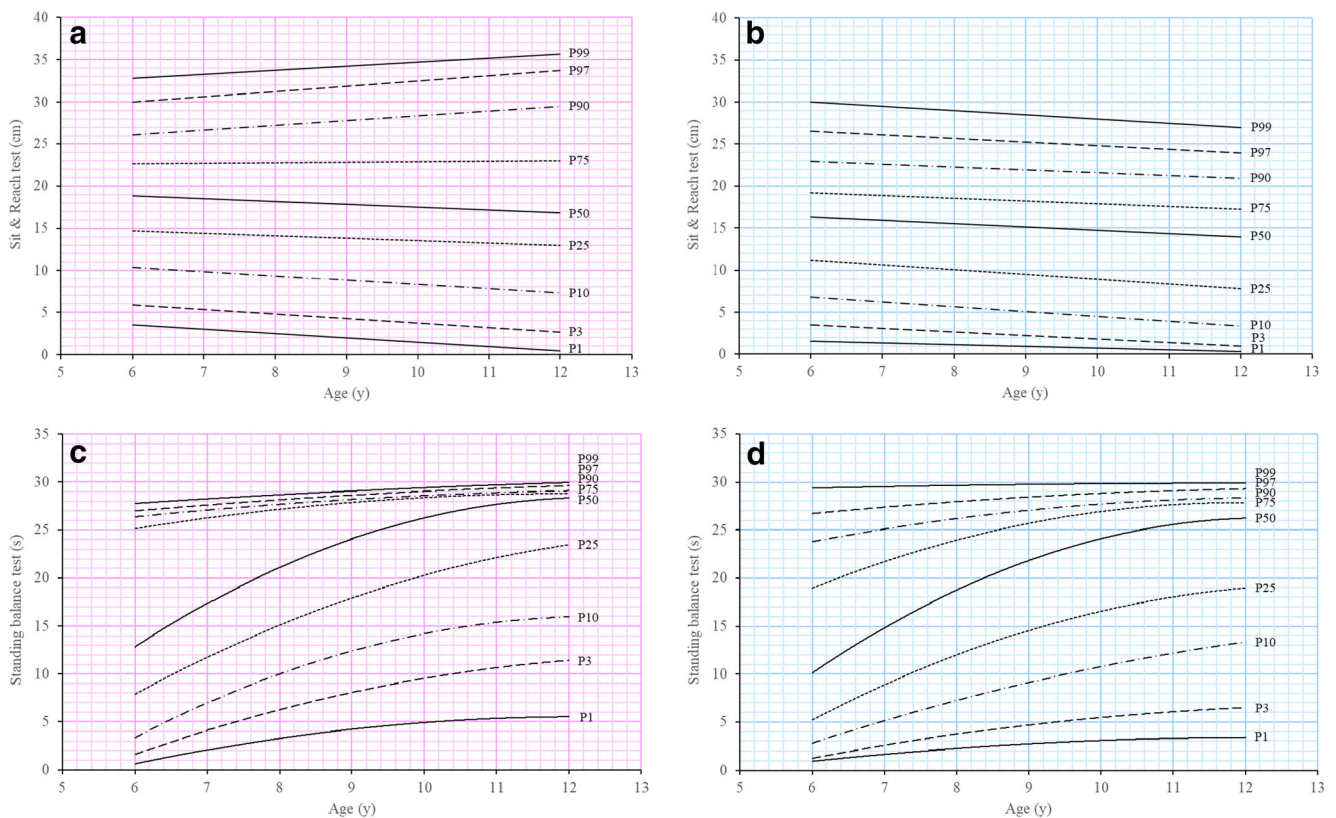


Fig. 3 Percentile curves of the physical fitness (sit and reach test: **a**, **b**; standing balance test: **c**, **d**), stratified by sex (girls: **a**, **c**; boys: **b**, **d**) and class of age (6–11 years old)

In conclusion, our results provide reference standards for a complete series of tests that are indicative of the main components of physical fitness and applicable to children aged between 6 and 11 years. It is important to note that the tests included in this work are easy to perform without any specific tools.

Furthermore, the performance of children in the present study was roughly comparable to that of other European children, and our data could be useful for monitoring the secular trend of physical fitness in children, which has been decreasing over the years.

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Authors' contributions SL conceived the overall study, all the authors contributed to design the research and to make the measurements. GB analysed the data. FV wrote the manuscript with the help of FF and GB. SL, MP, GM, RM revised the manuscript. All the authors read and approved the manuscript.

Data availability N/A

Declarations

Ethics approval and consent to participate This article does not contain any studies with human participants or animals performed by any of the authors. The experimental protocol was approved by the University of Udine Ethics Committee on Human Research for Medical Science. Before the study began, the purpose and objectives were carefully explained to each child and his or her parents. Children gave their verbal consent, and written informed consent was obtained from their parents.

Consent for publication Patients signed informed consent regarding publishing their data

Conflict of interest The authors declare no conflict of interest.

Code availability N/A

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