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Physical fitness percentile charts for children aged 6-10 from Portugal

M. S. RORIZ DE OLIVEIRA ¹, A. SEABRA ¹, D. FREITAS ², J. C. EISENMANN ³, J. MAIA ¹

Aim. The present study aims (1) to provide reference percentile charts for the following measures of Physical Fitness (PF): the sit-and-reach, handgrip, standing long jump, 50 yards' dash, 4x10m shuttle run and 1-mile run/walk tests in children aged 6 to 10 years, and (2) to compare the performance of the Portuguese children with their age- and sex peers.

Methods. A total of 3804 Portuguese children (1985 boys and 1819 girls) aged 6-10 years old participated in this study. The sample was stratified from 20 public elementary schools and children were randomly selected in each school. Charts were separately built for each sex using the LMS method.

Results. Boys showed better results than girls in handgrip, standing long jump, 50 yards' dash, 4x10 m shuttle run and 1-mile run/walk, while girls are better performers than boys in sit-and-reach.

Conclusion. Age- and gender- percentiles for a set of physical fitness tests for 6-10 year old (primary school) Portuguese children have been established. Boys showed greater overall PF than girls, except in the flexibility test, in which girls performed better. The reported normative values provide ample opportunities to accurately detect individual changes during childhood. These reference values are especially important in healthcare and educational settings, and can be added to the worldwide literature on physical fitness values in children.

KEY WORDS: Charts - Physical fitness - Child.

In general terms, physical fitness (PF) is the ability of an individual to efficiently match the demands of life's daily activities.¹ It is important to note that PF is not a unitary concept but rather a complex construct that combines important body functions,

namely cardiovascular and respiratory, metabolic, motor and musculoskeletal.²

There is accumulating evidence that children's PF levels are health markers of their lifestyles, comorbidities, and subsequent chronic diseases.³⁻⁵ Because clinical evidence of disease in children is generally absent, the health consequences of having a poor PF during childhood are less obvious; however cases of type 2 diabetes mellitus, hypertension and hyperlipidemia are becoming more common in children.^{6, 7}

Growth charts for height and weight are a common feature of auxology, and now the use of percentile charts has been expanded to include presenting percentiles for body mass index, waist circumference and percent body fat.⁸⁻¹¹ In addition, percentile charts for cardiorespiratory fitness have also been published.^{5, 12, 13} One problem is a lack of relevant norms for other PF components, such as muscular strength, motor coordination and agility, especially for children from 6-10 years of age.¹⁴⁻¹⁶ Furthermore, software advances, like the availability of the LMS statistical procedure, facilitate more accurate and easy interpretations of complex models and esti-

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TABLE I.—*Sample size by age and sex.*

Age [†]	Girls	Boys	Total
6	220	227	447
7	315	314	629
8	259	860	1119
9	815	462	1277
10	210	122	332
Total	1819	1985	3804

[†]6 years = 6.00 to 6.99

mation techniques.¹⁷ So, there is a need to rigorously assess and interpret children and youth's PF.

The present study aims: 1) to provide reference percentile charts for the following measures of PF: the sit-and-reach, handgrip, standing long jump, 50 yards' dash, 4x10 m shuttle run and 1-mile run/walk tests in children aged 6 to 10 years; and 2) to compare the performance of the Portuguese children with their age- and sex peers. This age range was selected because the Portuguese government is legally responsible for developing complementary activities and/or intervention projects for specific needs of each public elementary school, namely arts, foreign languages and physical education.

Materials and methods

Sample

A total of 3804 Portuguese children (1985 boys and 1819 girls) aged 6-10 years old participated in this study. The sample was stratified from 20 public elementary schools and children were randomly selected in each school. In addition, age and sex of the child was considered in the sampling. Decimal age was obtained from each child, and age groups were based on whole year (*i.e.*, 6.00 and 6.99 years, etc.). Exclusion criteria were: illnesses and motor or intellectual disabilities that could impair their performance. Sample size by age and sex is presented in Table I.

The North Educational Council and all school directors approved the project and written consent was obtained from parents or legal guardians of all children. The ethics committee of the Faculty of Sport, University of Porto approved the project.

Physical fitness assessment

PF tests were selected from the AAPHERD¹⁸ and FITNESSGRAM¹⁹ batteries, and included handgrip strength, standing long jump, 50 yard dash, 4 x 10 m shuttle run (AAPHERD); 1-mile run/walk (FITNESSGRAM). Methods and procedures for testing were the same in both years. Standardization of testing procedures was done through workshop training for all researchers and measurement teams.

Sit-and-reach (flexibility) was measured with the children seated on the floor with legs extended to front, place back and head against wall and bottom of feet against box. The children should slide the arms forward with palms down and one hand on the top of the other. The distance between fingertips to box edge is the starting point. Then the children should reach forward sliding the fingertips as far forward along the ruler as possible and holding that position momentarily. Each child is allowed two warm-up attempts and then two trials. The best of the two trials was retained for analysis.

Handgrip strength (static strength) was measured in a standing position using a digital hand dynamometer (TAKEI - T.K.K. 5401®) with an adjustable grip. The children were required to squeeze the dynamometer as vigorously as possible with either hand, holding the dynamometer away from the body with the arm extended. Two trials were recorded, and the best of the two trials was retained for analysis.

Standing long jump (coordination and explosive strength of the lower extremities) was measured as the distance from the take-off line to the heel or other part of the body that touched the floor nearest the take-off line. The children stood with feet apart behind the take-off line (feet parallel, approximately at shoulder width) and were instructed to jump as far as possible. Two trials were recorded, and the best of the two trials was retained for analysis.

The 50-yard (45.7 m) dash (running speed) was measured as the time elapsed in covering the distance while running at full speed. Children were instructed to run as fast as possible through the finish line. The starter used the commands "Are you ready?" and "Go!" The starter made a downward sweep of the arm at the

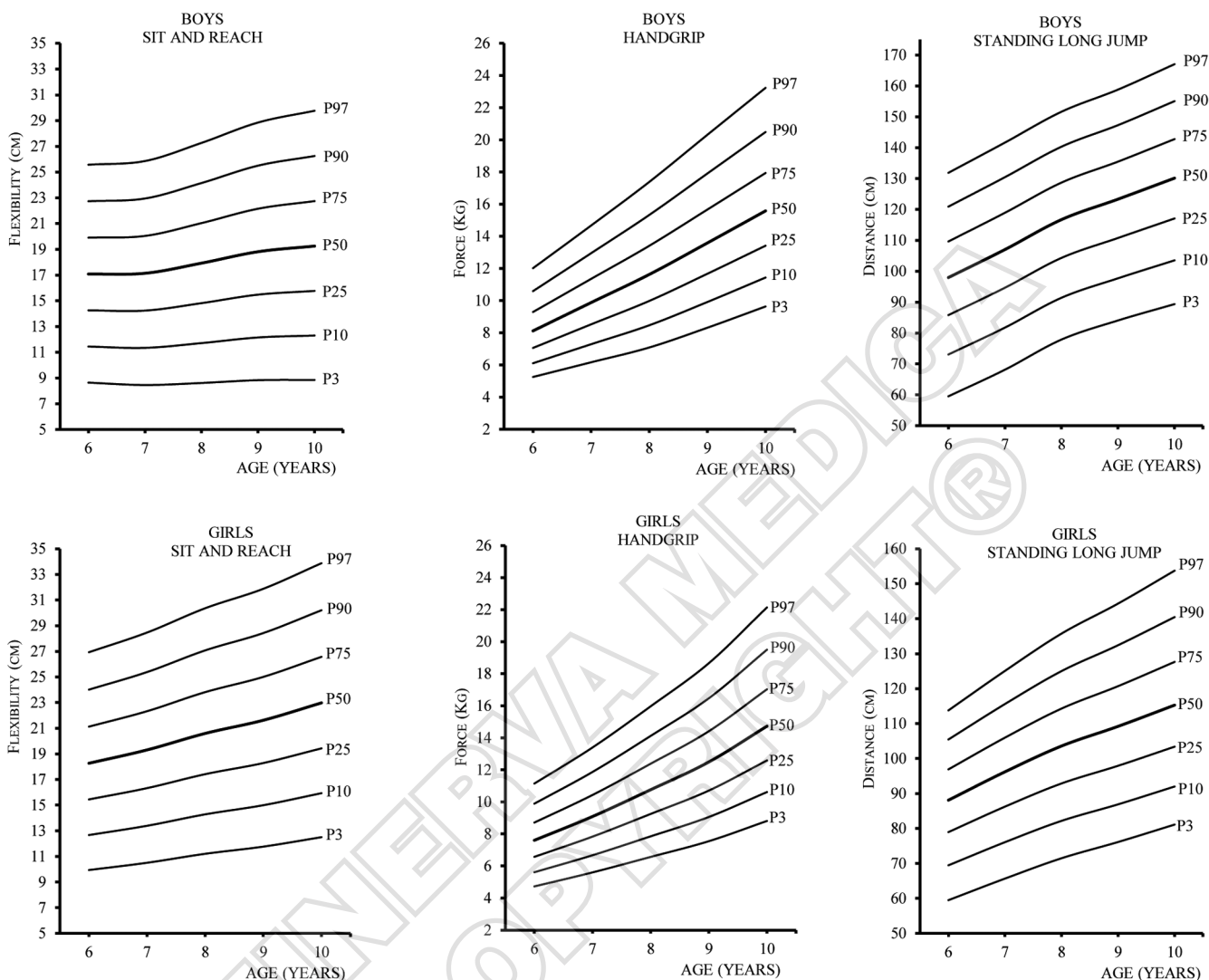


Figure 1.—Reference charts for the motor tests: sit-and-reach, handgrip and standing long jump (boys and girls).

Results

Table II gives the proportions of data in the channels round the seven fitted centiles of 3rd, 10th, 25th, 50th, 75th, 90th and 97th for the PF measures showing the quality of the fitting models to the data.

The percentile charts are shown in Figures 1 and 2. Table III displays the respective percentile values (P₃, P₁₀, P₂₅, P₅₀, P₇₅, P₉₀ and P₉₇) for sit-and-reach, handgrip, standing long jump, 50 yards’ dash, 4x10m shuttle run and 1-mile run/walk. Appendix

1 provides L, M and S values and their respective standard errors.

Boys showed better results than girls in handgrip, standing long jump, 50 yards’ dash, 4x10m shuttle run and 1-mile run/walk (Figures 1 and 2). The sit-and-reach test shows different trends in both gender - boys have very small variations at P₃, P₁₀ and P₂₅, for all ages but girls exhibit higher values than boys, varying from 1.1 cm to 4.1 cm. Handgrip shows increases in both sexes across age. P₃ and P₉₇ show divergent trajectories from 6 and 10 year old children

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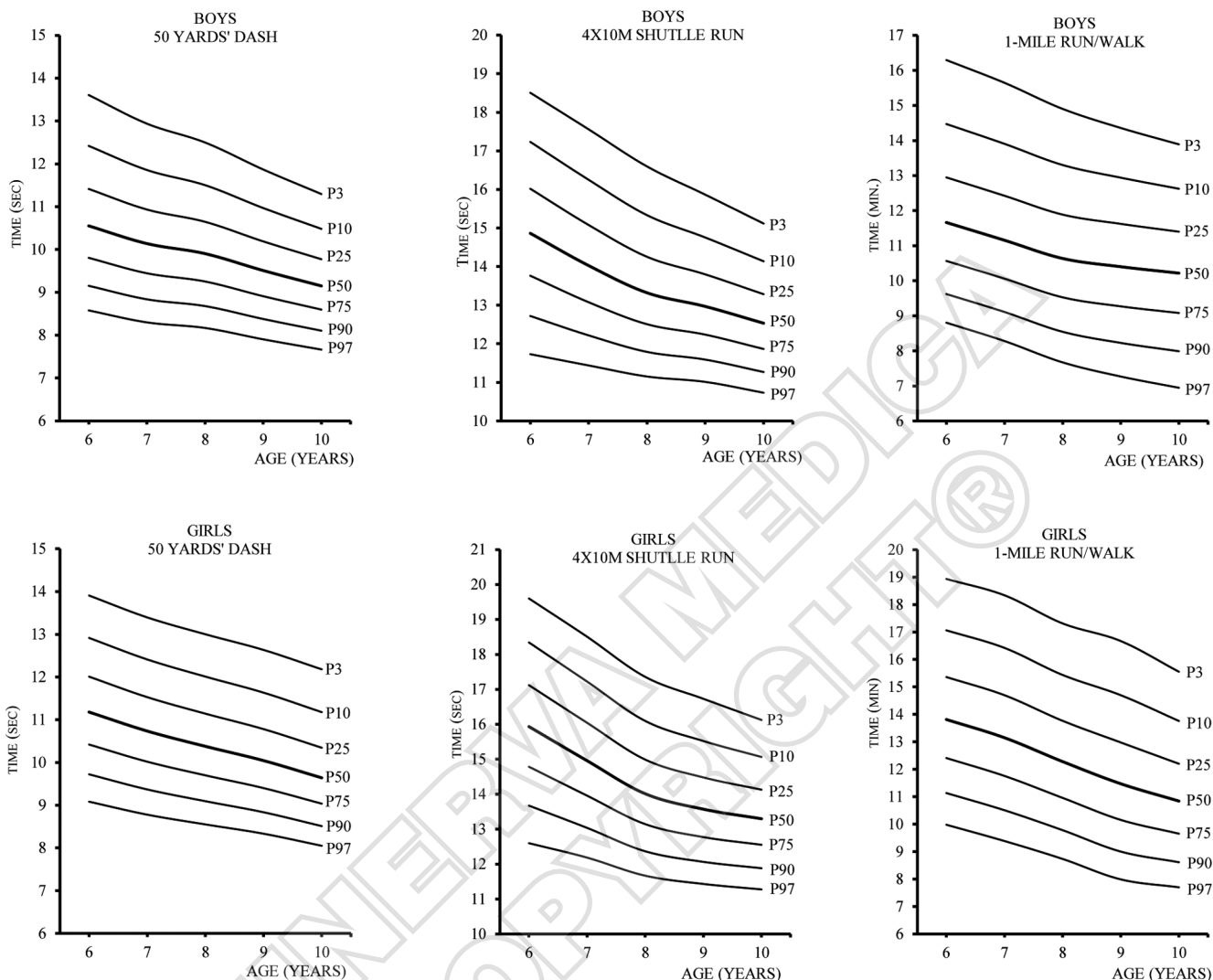


Figure 2.—Reference charts for the motor tests: 50 yards' dash, 4x10m shuttle run and 1-mile run/walk (boys and girls).

with differences from +4.3 kg to +11.2 kg in boys, and +4.1 kg to +11.0 kg in girls. A similar trend was observed for standing long jump. In both 50 yards' dash and 4x10 m shuttle run, a predictable trend is observed, *i.e.*, time decreases from 6 to 10 years. In the 1-mile run/walk there are larger differences between boys and girls at 6 than at 10 years. When aged 6 and 10, the median (P_{50}) value is respectively 11.7 min and 10.2 min for boys; and 13.8 min and 10.8 min for girls.

Median (P_{50}) trajectories for sit-and-reach, hand-grip, standing long jump, 50 yards' run, 4x10 m

shuttle run and 1-mile run/walk (boys and girls) of Portuguese children compared with their age- and sex peers are shown in Table IV, Figures 3, 4. Portuguese children results present a similar trend to other studies.^{14-16, 24-26}

Portuguese children from the present study show a higher level of flexibility across all ages in both sexes. In handgrip, Portuguese girls show very similar results to Azorean girls, but lower values compared to the Madeira and the Spanish, and higher values than those of Latvia. Portuguese boys from the mainland show less grip strength than those of Madeira,

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TABLE III.—Percentiles scores (P3, P10, P25, P50, P75, P90 and P97) for sit-and-reach, handgrip, standing long jump, 50 yards' dash, 4x10m shuttle run and 1-mile run/walk, by age and sex.

Boys								Girls						
Handgrip (kg)														
AGE	P3	P10	P25	P50	P75	P90	P97	P3	P10	P25	P50	P75	P90	P97
6	5.3	6.1	7.1	8.1	9.3	10.6	12.0	4.7	5.6	6.6	7.6	8.7	9.9	11.1
7	6.2	7.3	8.5	9.9	11.4	13.0	14.7	5.6	6.7	7.8	9.1	10.4	11.9	13.4
8	7.1	8.5	10.0	11.6	13.4	15.3	17.4	6.6	7.9	9.2	10.8	12.4	14.1	16.0
9	8.3	9.9	11.7	13.6	15.7	17.9	20.3	7.5	9.1	10.7	12.5	14.4	16.5	18.7
10	9.6	11.4	13.4	15.6	17.9	20.5	23.2	8.8	10.6	12.6	14.7	17.0	19.5	22.1
Sit and Reach (cm)														
AGE	P3	P10	P25	P50	P75	P90	P97	P3	P10	P25	P50	P75	P90	P97
6	8.6	11.4	14.3	17.1	19.9	22.7	25.6	9.9	12.7	15.4	18.3	21.1	24.0	26.9
7	8.5	11.3	14.2	17.1	20.0	23.0	25.9	10.5	13.4	16.3	19.3	22.3	25.4	28.5
8	8.6	11.7	14.8	17.9	21.0	24.2	27.3	11.2	14.3	17.4	20.6	23.8	27.1	30.4
9	8.8	12.2	15.5	18.8	22.2	25.5	28.9	11.8	15.0	18.3	21.6	25.0	28.4	31.9
10	8.9	12.3	15.8	19.3	22.7	26.3	29.8	12.5	15.9	19.4	23.0	26.6	30.2	33.9
Standing Long Jump (cm)														
AGE	P3	P10	P25	P50	P75	P90	P97	P3	P10	P25	P50	P75	P90	P97
6	59.5	73.0	85.8	98.0	109.6	120.9	131.9	59.5	69.5	79.0	88.1	96.9	105.5	113.8
7	68.1	81.8	94.7	107.0	118.9	130.5	141.7	65.7	76.1	86.2	96.2	106.0	115.6	125.1
8	77.9	91.4	104.3	116.7	128.7	140.3	151.7	71.5	82.2	92.9	103.6	114.3	125.0	135.7
9	84.1	97.7	110.8	123.4	135.5	147.3	158.8	76.1	86.9	97.9	109.2	120.7	132.4	144.3
10	89.4	103.5	117.1	130.2	142.8	155.1	167.1	81.1	92.0	103.4	115.3	127.6	140.5	153.8
4x10m Shuttle Run (sec)														
AGE	P3	P10	P25	P50	P75	P90	P97	P3	P10	P25	P50	P75	P90	P97
6	18.5	17.2	16.0	14.9	13.8	12.7	11.7	19.6	18.3	17.1	15.9	14.8	13.7	12.6
7	17.6	16.3	15.1	14.0	13.1	12.2	11.4	18.5	17.2	16.0	15.0	14.0	13.0	12.2
8	16.6	15.3	14.3	13.3	12.5	11.8	11.1	17.4	16.1	15.0	14.0	13.1	12.4	11.7
9	15.9	14.8	13.8	13.0	12.2	11.6	11.0	16.7	15.5	14.5	13.6	12.8	12.1	11.4
10	15.1	14.1	13.3	12.5	11.9	11.3	10.7	16.1	15.1	14.1	13.3	12.6	11.9	11.3
50 Yard's Dash (sec)														
AGE	P3	P10	P25	P50	P75	P90	P97	P3	P10	P25	P50	P75	P90	P97
6	13.6	12.4	11.4	10.6	9.8	9.2	8.6	13.9	12.9	12.0	11.2	10.4	9.7	9.1
7	12.9	11.9	10.9	10.1	9.4	8.8	8.3	13.4	12.4	11.5	10.7	10.0	9.4	8.8
8	12.5	11.5	10.6	9.9	9.3	8.7	8.2	13.0	12.0	11.1	10.4	9.7	9.1	8.5
9	11.9	11.0	10.2	9.5	8.9	8.4	7.9	12.6	11.6	10.8	10.0	9.4	8.8	8.3
10	11.3	10.5	9.8	9.1	8.6	8.1	7.7	12.2	11.2	10.3	9.6	9.0	8.5	8.0
1-Mile Run/Walk (min.)														
AGE	P3	P10	P25	P50	P75	P90	P97	P3	P10	P25	P50	P75	P90	P97
6	16.3	14.5	13.0	11.7	10.6	9.6	8.8	18.9	17.1	15.4	13.8	12.4	11.1	10.0
7	15.7	13.9	12.4	11.2	10.1	9.1	8.3	18.3	16.4	14.7	13.2	11.8	10.5	9.4
8	14.9	13.3	11.9	10.6	9.5	8.5	7.7	17.3	15.4	13.8	12.3	11.0	9.8	8.7
9	14.4	12.9	11.6	10.4	9.3	8.2	7.3	16.7	14.7	13.0	11.5	10.2	9.0	8.0
10	13.9	12.6	11.4	10.2	9.1	8.0	7.0	15.6	13.8	12.2	10.8	9.7	8.6	7.7

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TABLE IV.—Values of the P50 motor tests from different countries: handgrip, sit and reach, standing long jump, 4X10 m shuttle run, 50 yards' dash and 1-mile run/walk (boys and girls).

BOYS (P50)						GIRLS (P50)				
Handgrip (kg)										
AGE	6	7	8	9	10	6	7	8	9	10
Mainland Portugal	8.1	9.9	11.6	13.6	15.6	7.6	9.1	10.8	12.5	14.7
Madeira			14.5	16.5	18.5			11.5	14.0	16.5
Azorean	9.1	11.0	12.7	14.5	16.4	7.6	9.1	10.7	12.4	14.4
Latvia	8.6	10.8	12.7	14.4	16.4	8.0	9.4	11.4	12.8	14.8
Sit and reach (cm)										
AGE	6	7	8	9	10	6	7	8	9	10
Mainland Portugal	17.1	17.1	17.9	18.8	19.3	18.3	19.3	20.6	21.6	23.0
Madeira			18.8	18.0	17.5			20.0	19.5	19.8
PPF	26.0	25.0	25.0	25.0	25.0	27.0	27.0	28.0	28.0	28.0
Latvia	16.5	15.6	15.8	14.6	14.5	18.3	17.8	17.4	16.5	16.3
Standing long jump (cm)										
AGE	6	7	8	9	10	6	7	8	9	10
Mainland Portugal	98.0	107.0	116.7	123.4	130.2	88.1	96.2	103.6	109.2	115.3
Madeira			126.0	133.5	141.0			117.0	125.0	133.0
Azorean	90.0	100.0	110.0	120.0	130.0	80.0	90.0	100.0	110.0	120.0
Australian		120.5	127.0	136.0	146.0		106.0	120.0	126.5	135.5
4X10 m shuttle run (s)										
AGE	6	7	8	9	10	6	7	8	9	10
Mainland Portugal	14.9	14.0	13.3	13.0	12.5	15.9	15.0	14.0	13.6	13.3
Azorean	14.4	14.0	13.4	12.7	12.0	15.2	14.5	13.9	13.2	12.6
PPF	13.3	12.8	12.2	11.9	11.5	13.8	13.2	12.9	12.5	12.1
50 yards' dash (s)										
AGE	6	7	8	9	10	6	7	8	9	10
Mainland Portugal	10.6	10.1	9.9	9.5	9.1	11.2	10.7	10.4	10.0	9.6
Azorean	11.8	11.1	10.5	9.9	9.3	12.6	11.9	11.2	10.6	9.9
1-mile run/walk (min)										
AGE	6	7	8	9	10	6	7	8	9	10
Mainland Portugal	11.7	11.2	10.6	10.4	10.2	13.8	13.1	12.3	11.5	10.8
Azorean	12.7	12.1	11.6	11.0	10.5	13.7	13.3	12.9	12.5	12.0
PPF	12.4	11.4	11.1	10.3	9.5	13.1	12.6	12.3	11.5	11.2

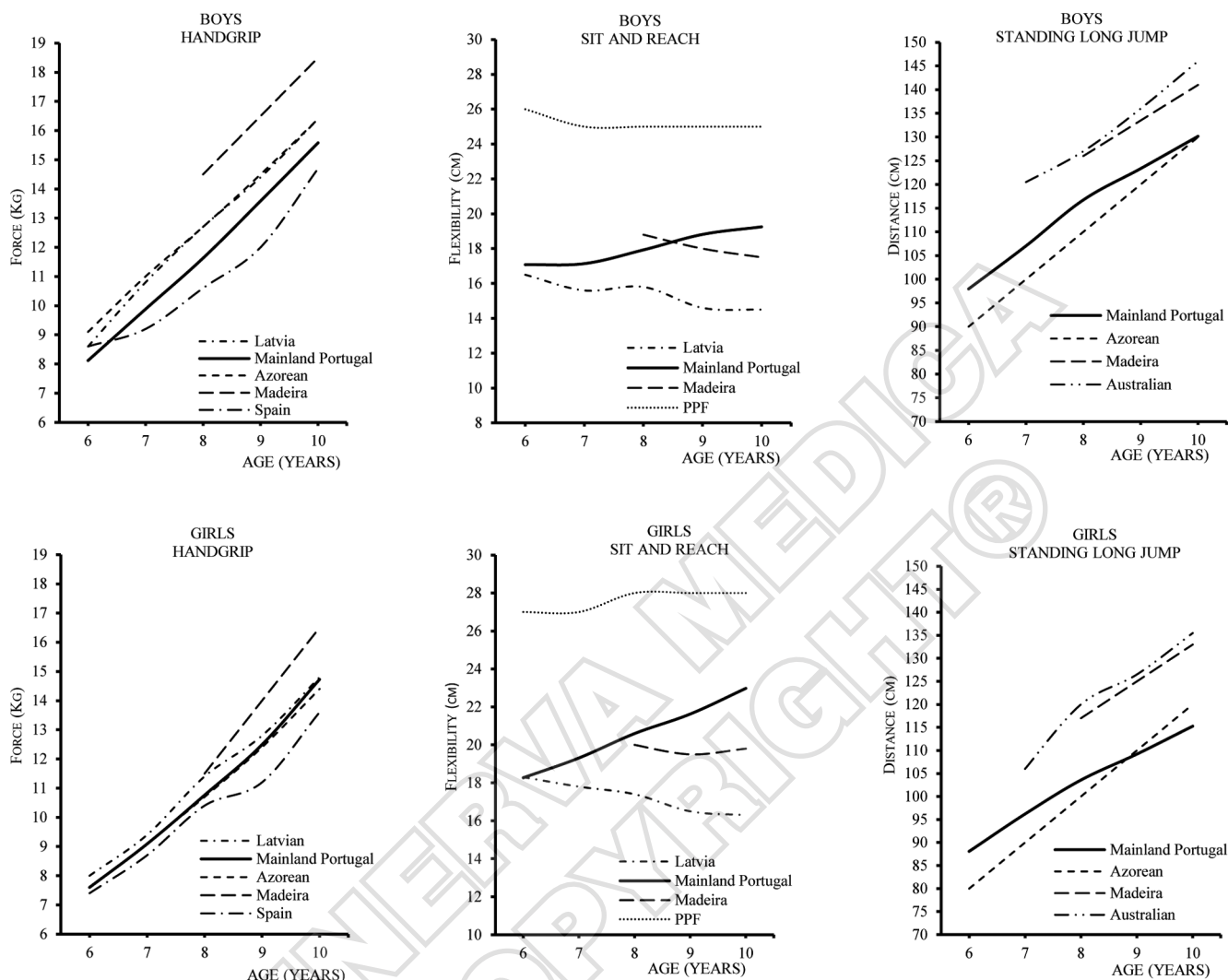


Figure 3.—Comparison of the P50 motor tests: sit-and-reach, handgrip and standing long jump (boys and girls).

Azores and Latvia. In the standing long jump, and in both sexes, mainland Portuguese children jumped a lesser distance when compared to Madeira and Australia children, in girls between -9.80 cm and -20.22 cm and in boys between -9.27 cm and -20.50 cm. In the 50 yards' dash, Mainland Portuguese children are the fastest when compared to children from Azores, but are less agile (4x10 m shuttle run). In the 1-mile run/walk Portuguese girls show lower aerobic performance at 6 years of age in relation to the Azorean and American, but present a greater aerobic performance at 10 years. Portuguese boys need less time to

cover the 1-mile when compared to their Azorean peers but require more time than the Americans at 9 (+0.10 s) and 10 (+1.14 min) years.

Discussion

This study presents age- and gender- percentiles for a set of PF tests on Portuguese children aged 6-10 years. In general, boys perform better than girls in cardiorespiratory endurance, strength, agility and running speed, while girls are better performers than

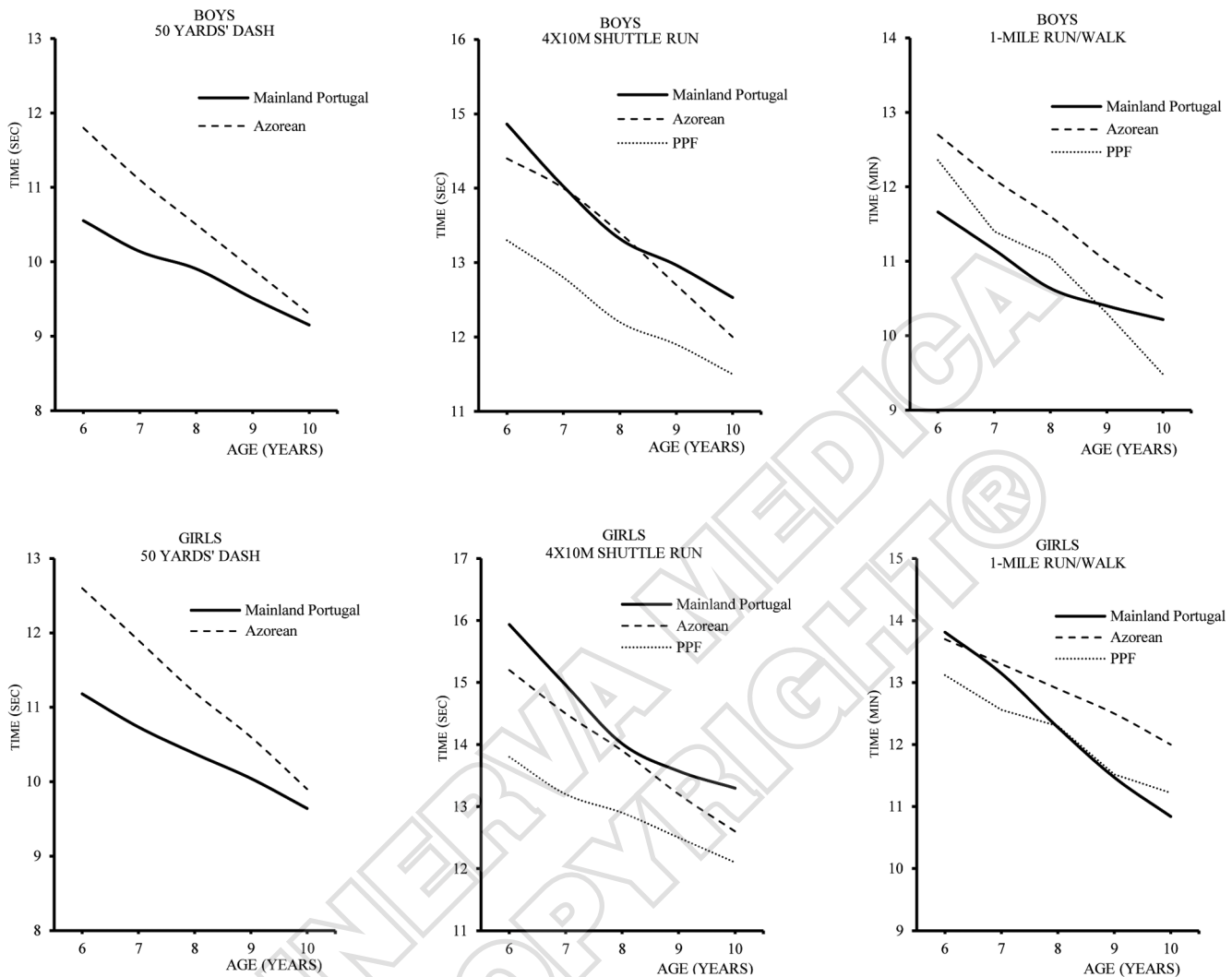


Figure 4.—Comparison of the P50 motor tests: 50 yards dash, 4x10m shuttle run and 1-mile run/walk (boys and girls).

boys in flexibility¹. On the other hand, there is a wide inter-individual variation in each measure accounted for by genetic factors and normal growth and maturation sensitivity to the physical and built environment, cultural, social and economic conditions that affects the development of motor performance and physical fitness (but see Malina *et al.* 2004). Portuguese girls from the present study are more flexible than boys, a pattern consistent with Madeira island²⁴ Latvia²⁶ and US.¹⁵ However, observed increments in the present study in both genders across age also occur in American girls, whereas in Latvia and Madeira

island flexibility levels decrease. Nevertheless, Portuguese children, in both sexes, exhibit a lower performance than those from America, with a difference that ranges between -5.02 cm and of -8.92 cm. In this comparison it is important to remember the time lag among studies (15 years). There is increasing evidence that children and adolescents' PF has declined over the last few decades which seems to be associated to the current problems of sedentary lifestyle, overweight and obesity.^{27, 28} Also, the use of different statistical methods for centile estimation and differences in measurement protocols may explain the dif-

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ferences found. At the P50, girls perform better than boys in the trunk flexibility, which increases from age 6 to 10 years, respectively +1.19 cm ($\approx 7\%$) and +3.73 cm ($\approx 19\%$). There is some evidence of the absence of mean flexibility changes from 6 to 10 years of age,²⁹ or that a decline is present.^{26, 30} In spite of not observing a decrease of flexibility in Portuguese children, boys' values are more stable from 6 to 8 years when considering P3, P10 and P25 trajectories. Malina *et al.*¹ reported that from 5 to 11 years the mean values for flexibility in girls are stable, but on the other hand in boys the lower trunk flexibility decreases linearly with age from 5 years and reaches its lowest point at age 12. In addition, Guedes *et al.*³⁰ suggested that girls preferences for games and/or daily physical activities where flexibility is emphasized in detriment of more vigorous activities strength and endurance related may have favored their better performance flexibility compared with boys.

It is well-established that muscular strength increases during childhood and is negatively associated with gains in fat mass.^{1, 31} In the present study, static and explosive strength assessed by the hand-grip and standing long jump tests, respectively, presented a linear increase from 6 years onwards. Boys show better average static strength values than girls (difference ranges between 6% and 8%), which is close to previous suggestions given by Shepard³² that before puberty boys have, on average, 10% higher strength values than girls. When compared to children from Latvia, Azores and Madeira, Mainland Portuguese boys are weaker, whereas girls have similar values to their peers. It was suggested that static strength was independent of learning effects and that the differences found may be associated with biological maturation.³³ Serrano *et al.*¹⁶ also indicate that static strength seemed to be more strongly correlated with lean body mass and arm muscle area, than with direct variables of size (weight and height) and BMI.

For the standing long jump, the mainland Portuguese children showed a lower performance than Madeira and Australia peers. According to Safrit³⁴ the technique of the standing long jump can influence the results and make comparisons difficult. On the other hand, several studies confirm a lower proficiency of children and adolescents with overweight and obesity in tests that require projection of body mass.^{1, 35, 36} These variables were not controlled in the present study. In the 50 yard dash and 4x10 m

shuttle run tests, the results are similar in both genders. Although boys were faster than girls across age, the time trajectory of P50 in boys is 5% to 7% lower than girls. These results are similar to those found in Azores and American children. Malina *et al.*¹ reported that in the 50 yard dash test, gender differences were small during childhood. Dash times from the mainland Portuguese children were lower than peers from Azores and from US in the 4x10 m shuttle run test. Several reasons, such as motivation, test protocols and size can explain these differences.^{24, 37}

Considering all tests previously reported, in which boys appear more proficient than girls, it is in the 1 mile run/walk test that differences are more pronounced differences between gender, *i.e.*, boys are 6% to 19% faster, which is a similar finding to Azorean and American children. It has been suggested that the gender difference is due to not only on biological factors, which are more pronounced during adolescence, but also in motivational and environmental factors.^{1, 3, 38} However, the gender differences are lower across age groups. Considering differences at P50, boys require less time to complete the 1 mile run/walk test compared to girls (*i.e.*, -18% [-2.1 min] at 6 year old and -6% [-0.6 min] at 10 year old). In the Azorean and American studies, different results between sexes were found. Although boys are systematically faster than the girls, this difference increases from 6 to 10 years: Azorean go from -1.0 min to -1.5 min, and the Americans go from -0.8 min to -1.7 min. Several authors suggest that throughout childhood the variable more related to the aerobic fitness test performance is total body fat, *i.e.*, increasing fat is associated with a decreasing aerobic fitness test performance in children.²⁷

A few caveats related to the creation of reference values should be noted. First, the value and the meaning of the results obtained with the LMS method depend, to a certain extent, on the quality of the available data resulting in high reliability of children's performance. In this study, intraclass correlation coefficients ranged from 0.80 (50 yards' dash) to 0.97 (sit-and-reach) showing the high consistency of assessments. In addition as with all percentile references requiring cross-sectional data no inferences are allowed about intra-individual changes, inter-individual differences in intra-individual changes and predictors of these changes, which could only be provided by a longitudinal study. To date, no longitudi-

nal physical fitness references have been published. Besides the lack of longitudinal physical fitness data, another reason is that no statistical models have been provided, to solve the many problems involved with such an enterprise. However, some strengths are to be considered in the present study: 1) the magnitude of the sample size; 2) the preciseness of estimated centile values; 3) the use of LMS_chartmaker Pro software version 2.45 which provided high graphical representation due to the well fitted models.

Conclusions

Age- and gender- percentiles for a set of physical fitness tests for 6-10 year old (primary school) Portuguese children have been established. Boys showed greater overall PF than girls, except in the flexibility test, in which girls performed better. The reported normative values provide ample opportunities to accurately detect individual changes during childhood. These reference values are especially important in healthcare and educational settings, and can be added to the worldwide literature on physical fitness values in children.

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Acknowledgments.—The authors would like to thank all the children and schools who participated in the study. Additionally, we would like to extend our appreciation not only to the Municipality of Maia, but also to all researchers who assisted data collection.

Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Received on January 7, 2014.

Accepted for publication on January 7, 2014.

Appendix 1.

Models for each test with L, M and S values and their respective standard errors.

		Boys			Girls		
MODELS		L2M04S2o		Sit-and-reach	L2M03S2o		
AGE	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se	
6	0.99 ± 0.19	17.08 ± 0.52	0.25 ± 0.011	0.92 ± 0.037	18.27 ± 0.52	0.23 ± 0.003	
7	0.99 ± 0.13	17.14 ± 0.21	0.25 ± 0.008	0.92 ± 0.037	19.31 ± 0.22	0.23 ± 0.003	
8	0.99 ± 0.09	17.93 ± 0.22	0.26 ± 0.006	0.92 ± 0.037	20.60 ± 0.24	0.23 ± 0.003	
9	0.99 ± 0.10	18.81 ± 0.23	0.27 ± 0.006	0.92 ± 0.037	21.63 ± 0.25	0.23 ± 0.003	
10	0.98 ± 0.14	19.25 ± 0.29	0.27 ± 0.010	0.92 ± 0.037	22.98 ± 0.32	0.23 ± 0.003	
MODELS		L3M05S3o		Handgrip	L2M04S2o		
AGE	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se	
6	0.25 ± 0.34	8.12 ± 0.32	0.21 ± 0.014	0.51 ± 0.21	7.60 ± 0.23	0.21 ± 0.009	
7	0.41 ± 0.16	9.88 ± 0.13	0.21 ± 0.007	0.51 ± 0.15	9.09 ± 0.10	0.21 ± 0.007	
8	0.47 ± 0.14	11.63 ± 0.14	0.22 ± 0.006	0.51 ± 0.10	10.76 ± 0.12	0.22 ± 0.005	
9	0.45 ± 0.14	13.59 ± 0.16	0.22 ± 0.006	0.51 ± 0.12	12.49 ± 0.14	0.22 ± 0.005	
10	0.42 ± 0.19	15.58 ± 0.21	0.22 ± 0.009	0.50 ± 0.17	14.73 ± 0.20	0.23 ± 0.008	
MODELS		L1M04S3o		Standing Long Jump	L3M05S3o		
AGE	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se	
6	1.33 ± 0.09	97.96 ± 2.29	0.18 ± 0.013	1.34 ± 0.37	88.09 ± 1.59	0.15 ± 0.013	
7	1.33 ± 0.09	107.03 ± 1.08	0.17 ± 0.007	1.18 ± 0.26	96.20 ± 0.81	0.15 ± 0.006	
8	1.33 ± 0.09	116.73 ± 1.08	0.16 ± 0.006	0.99 ± 0.18	103.58 ± 0.82	0.16 ± 0.006	
9	1.33 ± 0.09	123.35 ± 1.10	0.15 ± 0.006	0.81 ± 0.21	109.21 ± 0.89	0.16 ± 0.006	
10	1.33 ± 0.09	130.16 ± 1.39	0.15 ± 0.007	0.63 ± 0.31	115.28 ± 1.32	0.16 ± 0.009	

MODELS	L1M05S2o			50 Yards' Dash			L2M04S2o		
AGE	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se
6	-0.89 ± 0.16	10.55 ± 0.21	0.11 ± 0.006	-0.23 ± 0.55	11.18 ± 0.15	0.11 ± 0.006			
7	-0.89 ± 0.16	10.14 ± 0.08	0.11 ± 0.004	-0.45 ± 0.40	10.73 ± 0.07	0.11 ± 0.004			
8	-0.89 ± 0.16	9.90 ± 0.07	0.11 ± 0.003	-0.72 ± 0.28	10.38 ± 0.07	0.10 ± 0.003			
9	-0.89 ± 0.16	9.51 ± 0.07	0.10 ± 0.003	-0.99 ± 0.33	10.04 ± 0.07	0.10 ± 0.003			
10	-0.89 ± 0.16	9.15 ± 0.07	0.10 ± 0.004	-1.26 ± 0.50	9.64 ± 0.08	0.10 ± 0.005			

MODELS	L3M05S3o			4x10m Shuttle Run			L3M04S3o		
AGE	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se
6	0.34 ± 0.83	14.86 ± 0.27	0.11 ± 0.009	0.57 ± 0.76	15.93 ± 0.21	0.11 ± 0.008			
7	-0.45 ± 0.40	14.03 ± 0.10	0.11 ± 0.004	-0.18 ± 0.41	14.96 ± 0.10	0.10 ± 0.006			
8	-1.07 ± 0.40	13.32 ± 0.09	0.10 ± 0.004	-0.79 ± 0.40	14.01 ± 0.08	0.10 ± 0.004			
9	-1.15 ± 0.43	12.97 ± 0.08	0.09 ± 0.003	-1.05 ± 0.43	13.57 ± 0.08	0.09 ± 0.005			
10	-1.10 ± 0.62	12.53 ± 0.09	0.08 ± 0.004	-0.87 ± 0.63	13.30 ± 0.09	0.09 ± 0.007			

MODELS	L3M04S3o			1-Mile Run/Walk			L2M04S4o		
AGE	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se	L ± se	M ± se	S ± se
6	-0.57 ± 0.50	11.66 ± 0.23	0.15 ± 0.012	0.10 ± 0.34	13.81 ± 0.30	0.16 ± 0.016			
7	-0.40 ± 0.27	11.15 ± 0.11	0.16 ± 0.006	0.04 ± 0.25	13.15 ± 0.14	0.17 ± 0.008			
8	-0.10 ± 0.18	10.64 ± 0.09	0.17 ± 0.005	-0.02 ± 0.16	12.28 ± 0.13	0.17 ± 0.008			
9	0.31 ± 0.16	10.40 ± 0.07	0.17 ± 0.004	-0.09 ± 0.13	11.47 ± 0.11	0.18 ± 0.007			
10	0.66 ± 0.32	10.22 ± 0.14	0.17 ± 0.009	-0.15 ± 0.19	10.84 ± 0.11	0.18 ± 0.007			