The ALPHA Health-Related Fitness Test Battery for Children and Adolescents

Test Manual

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www.thealphaproject.net

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FOREWORD

ALPHA is the first letter of the Greek alphabet. As an adjective, the term ALPHA is commonly used to designate the first in an order of precedence. In our case, ALPHA is the acronym of the first European collaborative project designed to be the first European approach to provide a set of evidence-based instruments for assessing levels of physical activity and fitness in a comparable way within the EU. The acronym ALPHA corresponds to Assessing the Levels of Physical Activity and Fitness, a project coordinated by Dr. Michael Sjöström from the Karolinska Institutet and funded by the Directorate General for Health and Consumers Affairs (DG SANCO) of the EU. A part of the result of the activity of the ALPHA Consortium, and its external advisors, is the ALPHA Fitness (ALPHA-FIT) Test Battery for Children and Adolescents which again is the first European approach to provide evidence-based recommendations and operating instructions to assess the health-related fitness status in children and adolescents on a population base in the EU. In the following pages this information is provided.

The question now is whether the ALPHA-FIT Test Battery applied to Children and Adolescents should also appear within the first positions in an order of precedence in relation to health. My answer is yes.

In fact, physical fitness refers to a physiologic state of well-being and functional capacity that allows adequately meeting the multiple demands of daily living including those coming from a physical overload, such as exercise or disease. The higher the fitness levels of a person, the higher his/her ability to meet the demands of a functional overload. This overload may come not only from exercise but also from any other physical stress. Sensu strictu, physical fitness makes reference to the full range of physical qualities, i.e., aerobic capacity, strength, endurance, speed, agility, coordination, flexibility… Nevertheless, other qualities, such as body composition or metabolism also play an important role in meeting the demands of any physical overload. Consequently, they all can also be considered as components of physical fitness. Health-related physical fitness includes those components of physical fitness that have shown to be more clearly related to health status and it could also relate to well-being and happiness although data are lacking in this regard.

I encourage not only to read the following pages but to put them into practice as a first priority in relation to health and well-being both at individual and population levels. ALPHA-FIT individuals and groups can be a healthy goal for Europe.

Granada, December 19th, 2009

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1. WHAT IS HEALTH-RELATED FITNESS?

Physical fitness is typically defined with focus on two goals: performance or health. Health-related physical fitness can be defined as the ability of a person to perform daily activities with vigour, and by traits and capacities that are associated with a low risk for the development of chronic diseases and premature death. Despite chronic diseases and cardiovascular disease events occur most frequently during or after the fifth decade of life, there is evidence indicating that the precursors of cardiovascular disease have their origin in childhood and adolescence. Therefore, the assessment of health-related fitness at childhood and adolescence is of public health and clinical interest. Health-related fitness components include cardiorespiratory fitness, musculoskeletal fitness, motor fitness and body composition.

2. THE ALPHA HEALTH-RELATED FITNESS TEST BATTERY FOR CHILDREN AND ADOLESCENTS

2.1. Development of the test battery

The ALPHA fitness test battery was developed to provide a set of valid, reliable, feasible and safe field-based fitness tests for the assessment of health-related physical fitness in children and adolescents, to be used in the public health monitoring system in a comparable way within the European Union.

2.2. Description of the test battery

ALPHA fitness test battery is time-efficient, low in cost and equipment requirements, and can be easily administered to a large number of people simultaneously.

We propose a valid, reliable, feasible and safe test battery for the assessment of health-related physical fitness in children and adolescents to be used for health monitoring purposes at population level.

3. HOW TO CONDUCT THE TESTS?

3.1. General instructions

The ALPHA health-related fitness test battery presents three slightly different versions depending on the available time to administer the tests.

a) *Evidence-based ALPHA health-related fitness test battery*. This version of the battery includes weight and height (BMI), waist circumference, skinfolds thickness (triceps and subscapular), handgrip strength, standing long jump, and 20m shuttle run tests. All these measurements have shown to be strongly related with the current and future health status of the children/adolescent.

   The time needed to administer this battery to a group of 20 individuals by one tester is around 2 hours and 30 minutes.

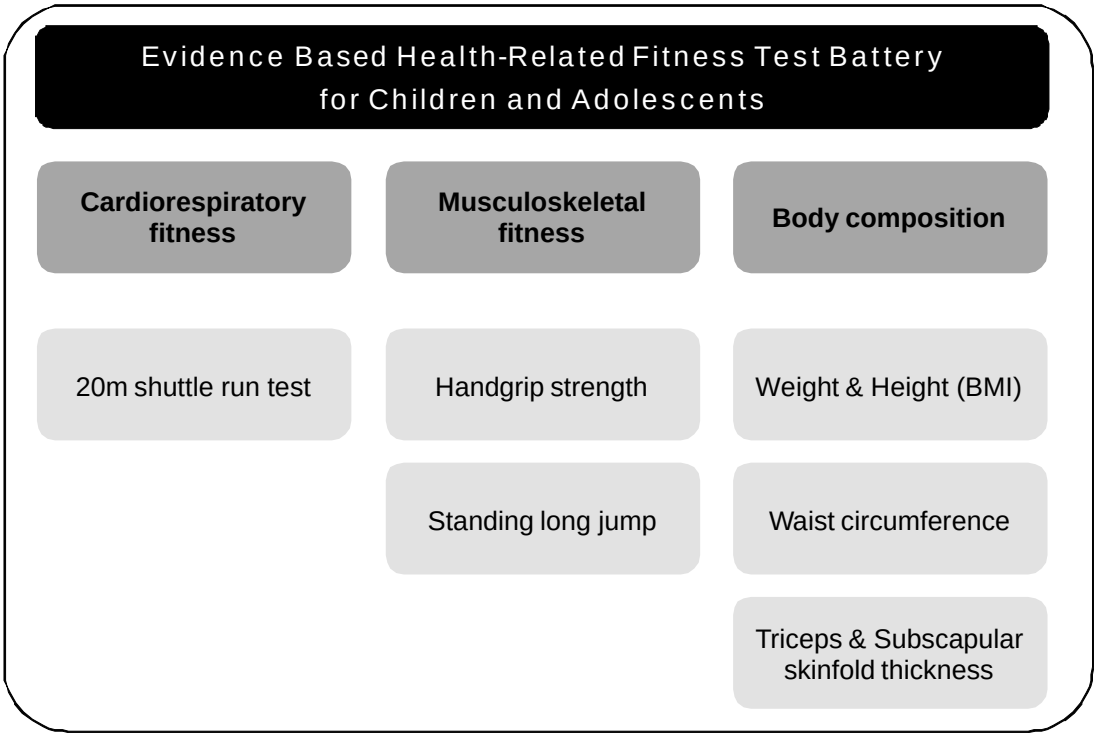


Figure 1. Evidence based Health-Related Fitness Test Battery for Children and Adolescents. BMI indicates body mass index (weight in kg divided by height in meters squared, kg/m^2).

b) *High priority ALPHA health-related fitness test battery* (Figure 2). When there are time constraints, as it can be the case in the school setting, we recommend omitting the assessment of the skinfold thickness. This measurement is the most skill demanding, so in these cases BMI and waist circumference can be enough to assess body composition.

   The time required to administer this battery to a group of 20 children by one trained physical education (PE) teacher or a health-professional is less than 2 hours (i.e. 2 PE sessions of ~55 minutes).

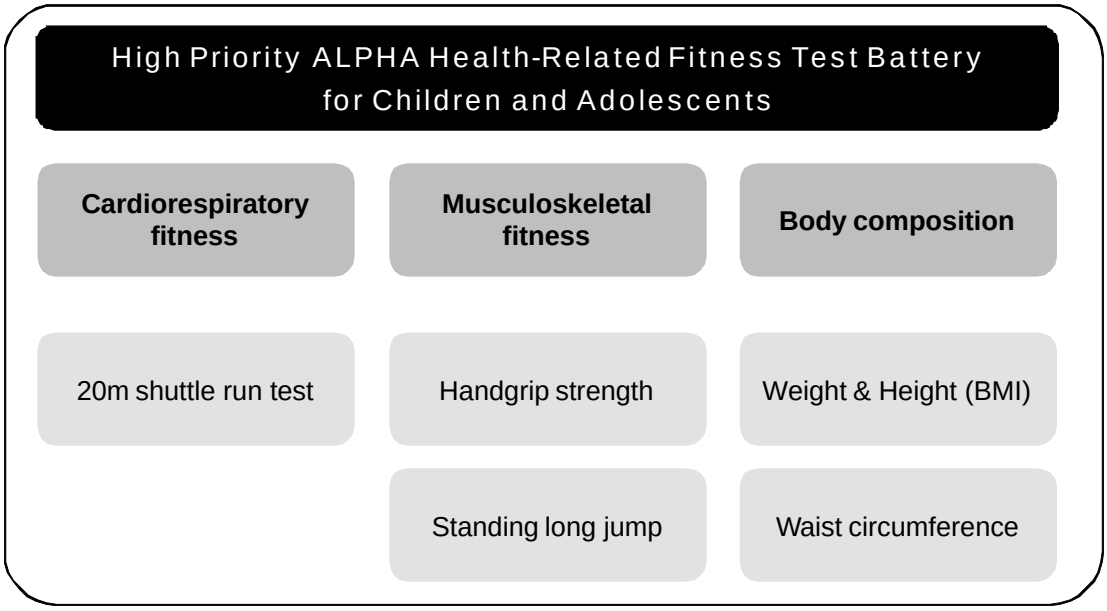


Figure 2. High priority ALPHA Health-Related Fitness Test Battery for Children and Adolescents. BMI indicates body mass index (weight in kg divided by height in meters squared, kg/m^2).

c) *Extended ALPHA health-related fitness test battery* (Figure 3). In those cases where there are no time limitations, we recommend using all the tests included in the evidence-based battery together with one additional test (4x10m shuttle run) to assess motor fitness. This test has shown a poorer health- and criterion-related validity, but only because of a low number of studies.

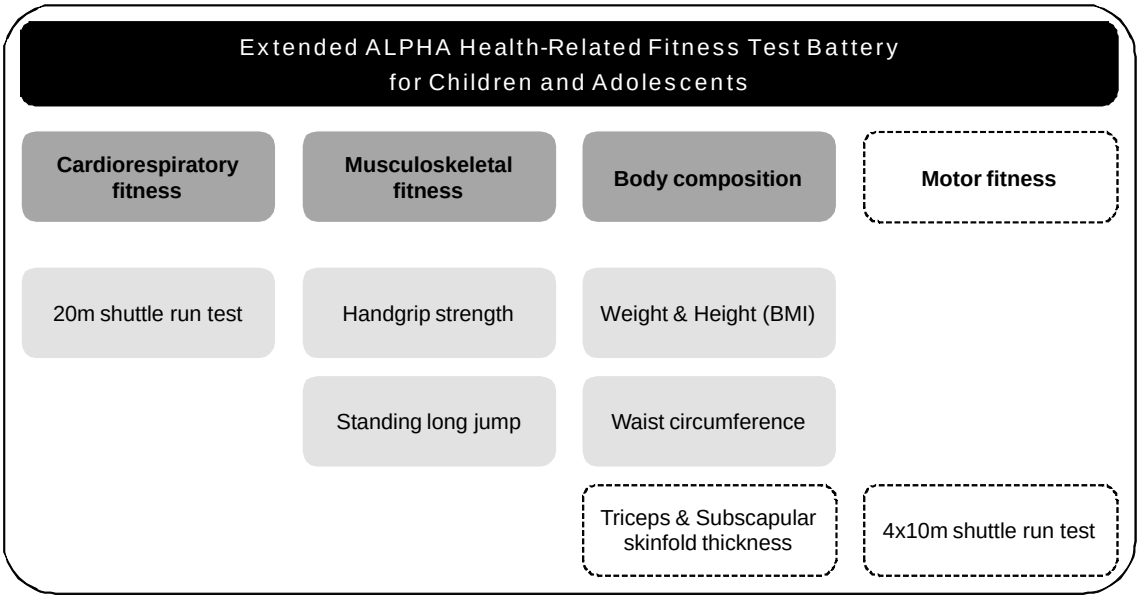


Figure 3. Extended ALPHA Health-Related Fitness Test Battery for Children and Adolescents. BMI indicates body mass index (weight in kg divided by height in meters squared, kg/m^2).

3.2. Standardization

A strict standardization of the field work precludes to a great extent the confounding bias that often interferes when comparing results from isolated studies. This manual, which includes not only the description of the tests but also the most appropriate sequence, and the instructions for the tester and participants, will enable a higher accuracy in the assessment of physical fitness and its relationship with health in young people.

3.3. The recommended sequence

The recommended sequence to administer this battery would be:

1. Pubertal status.
2. Weight and height (BMI).
3. Waist circumference.
4. Skinfold thickness (triceps and subscapular).
5. Handgrip strength, standing long jump and 4x10m shuttle run test. These could be carried out alternatively or simultaneity when there are two or more testers.
6. 20m shuttle run test.

3.4. Instructions for the participants

Child must be instructed to abstain from strenuous exercise in the 48 h preceding the testing. To wear comfortable sport clothes and shoes is vital for the appropriate administration of the battery. A notable and constant level of encouragement is recommended to guarantee the maximum performance from the participants throughout the tests.

4. SAFETY MODEL

4.1. Pre-testing health screening

Knowledge of the current and former health status of the children and adolescents is important in order to enhance safe testing. A pre-testing screening should identify young people at high risk, and should be similar to the one typically used to allow the children and adolescents to take active part in the PE lessons. For this purpose, in most/many European countries, children have annual physical examinations by the school-doctors who provide detailed information regarding the skeletomuscular, cardiorespiratory, haematocirculatory, psychoneurological and endocrine-metabolic systems. When this service is not available, it is recommendable that the parents or guardians complete at least a pre-testing/pre-participation screening questionnaire before the child starts with the PE lessons and/or the fitness testing. A good example of such questionnaire is the Exercise and Physical Activity Readiness Assessment questionnaire. In any case, it is important to be alert to the subjective symptoms such as skin pallor, dizziness, syncope and dyspnea. The tests should be immediately interrupted if there is any sign of problem or risk (see the standard operating procedure for specification). Any child able to take part in physical education classes can perform the ALPHA health-related fitness test battery.

4.2. Recommendation for safe testing

A small and comfortable chamber, but warm and ventilated at the same time, is highly recommended for the body composition measurements. Ideally, nobody else apart from the tester, an assistant, and a maximum of 2 participants should be present in the chamber at the same time. A non-slippery surface is necessary for the standing long jump and 4x10m shuttle run tests. Finally, a space of at least 25 m length is required for a safe administration of the 20m shuttle run test.

Immediately after the body composition measurements (BMI, waist circumference and skinfold thickness), and before continuing with the rest of the tests (handgrip strength, standing long jump, 4x10m shuttle run, and 20m shuttle run), it is necessary to carry out a 5-10 minutes warm up composed of jogging and stretching exercises.

5. TESTS

5.1. Pubertal status (Tanner stage)

An evaluation of the pubertal status of children and adolescents is of importance due to the fact that childhood and adolescence is a period of life where many changes occur. Though pubertal development should be ideally evaluated by a paediatrician or trained physician through direct observation, this is not feasible in most settings. Instead, trained interviewers can ask the children and adolescents to classify themselves in one of the five stages of pubertal maturity defined by Tanner and Whitehouse.

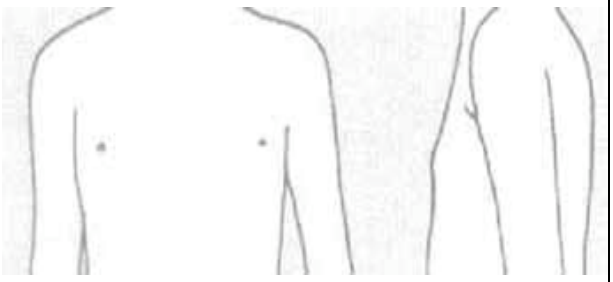
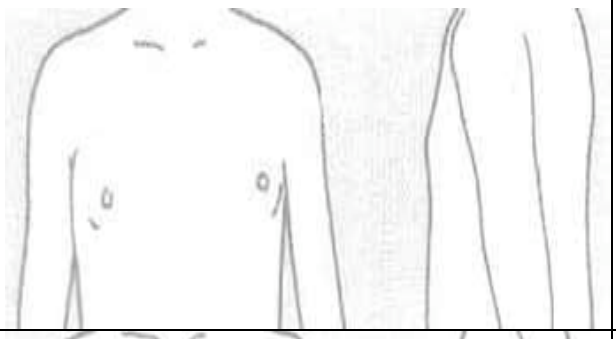
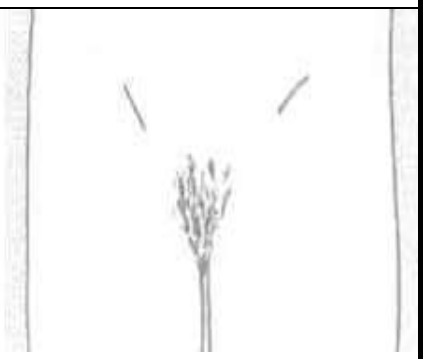
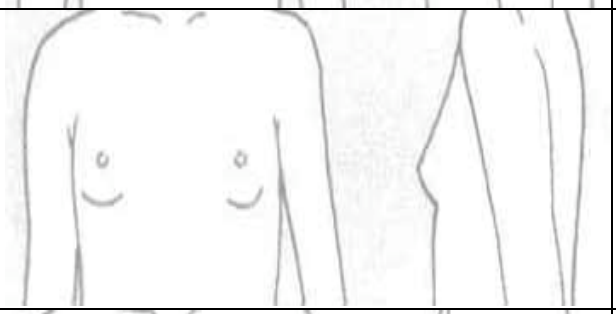
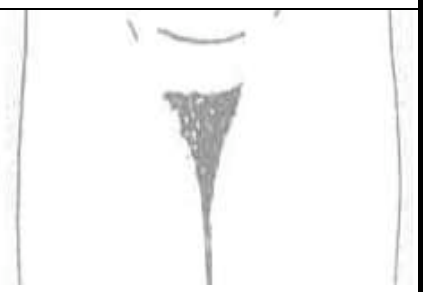
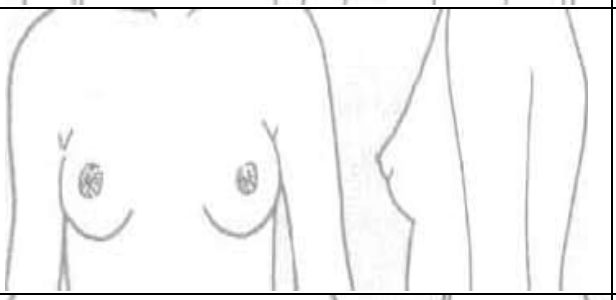
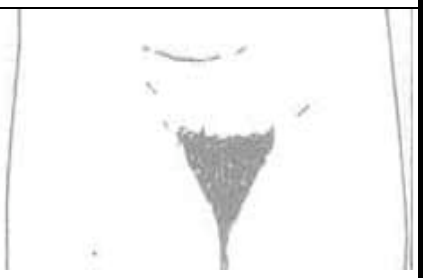
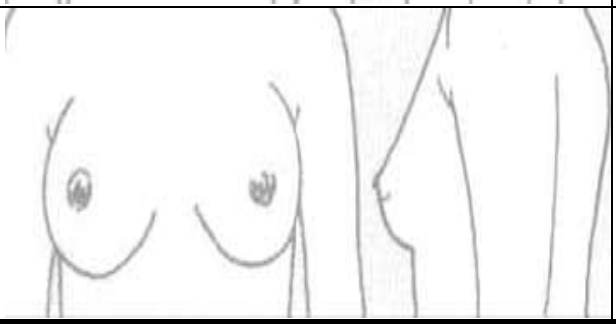
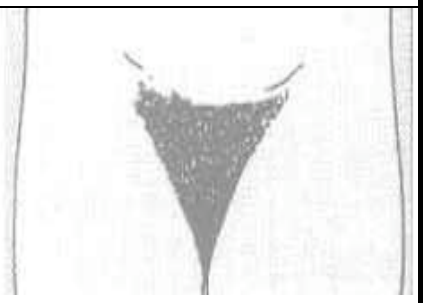
5.1.1. Girls

In girls, Tanner Stage should be assessed by the stage of breast development and public hair distribution as denoted in **table 1**.

Table 1. Girls Tanner Stages by breast development, and by hair distribution.

Stage	Breast Development	Hair distribution
1	The infantile stage persists from the immediate postnatal period until the onset of puberty. The breast has no glandular tissue and the areola and papilla conform to the chest line.	No hair.
2	This is the bud stage, during which the breast and papilla are elevated as a small mound, and the diameter of the areola is increased. The development of the breast.	Small amount of long, slightly pigmented, downy hair.
3	The breast and areola are further enlarged and present an appearance rather like that of a small adult mammary gland with a continuous rounded contour.	Moderate amounts of more curly, pigmented hair: more lateral.
4	The areola and papilla are further enlarged and form a secondary mound projecting above the corpus of the breast.	Resembles adult public hair in coarseness and curliness, but does not extend to the medial surfaces of the thighs.
5	This is the typical adult stage with a smooth rounded contour, the secondary mound present in Stage 4 having disappeared.	Adult patter.

Images.

Stage	Breast development	Hair distribution
1		
2		
3		
4		
5		

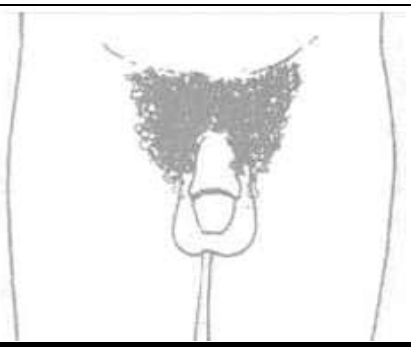
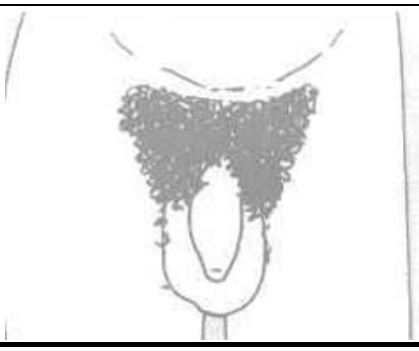
5.1.2. Boys

In boys, Tanner Stage should be assessed by the stage of genitalia development (penis size and testicular volume) and pubic hair distribution as denoted in **table 2.**

Table 2. Boys Tanner Stages by penis and scrotum development, and by hair distribution.

Stage	Penis and Scrotum Development	Hair Distribution
1	During this time the genitalia increase in overall size, but there is little change in general appearance. Testes volume <1.5 cc. Phallus is childlike.	No hair.
2	The scrotum has begun to enlarge, and there is some reddening and change in texture of the scrotal skin. Testes volume 1.6-6 cc. The scrotum is reddened, thinner and lager. The phallus is childlike.	Small amount of long, slightly pigmented, downy hair, along the base of the scrotum.
3	The penis has increased in length, and there is a small increase in breadth. There has been further growth of the scrotum. Testes volume 6 to 12 cc.	Moderate amount of more curly, pigmented, and coarser hair; more lateral extension.
4	The length and breadth of the penis has increased further and the glands have developed. The scrotum is further enlarged, and the scrotal skin has become darker. Testes volume 12 to 20 cc.	Resembles adult hair in coarseness and curliness, but does not extend to the medial surfaces of the thighs.
5	The genitalia are adult in size and shape. Tests volume >20 cc.	Adult patter.

Images.

Stage	Penis and Scrotum Development	Hair distribution
1		
2		
3		
4		
5		

5.2. Body composition

5.2.1. Body Mass Index (BMI)

Purpose	To measure body size.
Health relation	Higher BMI is associated with a worse cardiovascular profile.
Equipment	An electronic scale and a telescopic height measuring instrument.
Performance	Body weight in kilograms divided by the square of height in meters (kg/m^2).

Body weight

The child must stand on the platform of the scale without support. The child stands still over the centre of the platform with the body weight evenly distributed between both feet. Light underclothes can be worn, excluding shoes, long trousers and sweater.

Body height

Hair ornaments must be removed and braids must be undone. The child stands on the stadiometer with bare feet placed slightly apart and the back of the head, shoulder blades, buttocks, calves, and heels touching the vertical board. Legs must be kept straight and the feet flat. The tester must position the child's head so that a horizontal line drawn from the ear canal to the lower edge of the eye socket runs parallel to the baseboard (i.e., the Frankfort plane positions horizontally). The headboard must be pulled down to rest firmly on top of the head and compress hair.

Practice and number of test trials: Two measurements of both body weight and body height are performed and the mean of each one is retained.

Measurement	It starts when the child has reached the correct test position.
Scoring	Weight is recorded to the nearest 100 g. *Example:* a result of 58 kg scores 58.0. In height the reading must be taken to the last completed 1 mm. *Example:* a result of 157.3 cm scores 157.3.

5.2.2. Waist circumference

Purpose	To estimate central body fat.
Health relation	A higher waist circumference is a risk factor for cardiovascular disease.
Equipment	Non-elastic tape.
Performance	The child wears little clothing so that the tape may be correctly positioned. The child stands erect with the abdomen relaxed, the arms at the sides and the feet together. The tester faces the child and places an inelastic tape around him/her, in a horizontal plane, at the level of the natural waist, which is the narrowest part of the torso, as seen from the anterior aspect. In some obese children, it may be difficult to identify a waist narrowing. In such cases, the smallest horizontal circumference should be measured in the area between the spina iliaca superior and the costal edge in the midaxillary line. **Practice and number of test trials:** Two measurements are performed not consecutively and the mean is used in the analyses.
Measurement	It starts when the child has reached the correct test position. The measurement should not be made over clothing, should be taken at the end of a normal expiration without the tape compressing the skin and with child's arms at the side.
Scoring	It is recorded to the nearest 0.1 cm. *Example:* a result of 60.7 cm scores 60.7.

5.2.3. Triceps skinfold thickness

Purpose	To measure subcutaneous fat and to estimate percentage body fat.
Health relation	A higher adiposity is a risk factor for cardiovascular disease.
Equipment	Skinfold calliper, non-elastic tape and pen.
Performance	The mid-upper-arm point is half the distance between the acromion process (the most lateral bony protuberance of the back of the shoulder) and the olecranon (the bony structure that stands out when the elbow is bent). The tester stands behind the child and picks up the skinfold about 1 cm above the midpoint mark over the biceps muscle, with the fold running downward along the midline of the back upper arm. The caliper jaws must be applied at right angles to the "neck" of the fold just below the finger and thumb over the midpoint mark. While maintaining a grip on the skinfold, the tester gently releases the caliper handles and allows the jaws to close on the fat fold for two seconds before taking the reading. **Practice and number of test trials:** Two measurements are performed not consecutively and the mean is used in the analyses.
Measurement	Child starts when he/she has reached the correct test position. Skinfolds must be measured not on the dominant side of the adolescent (it means that, when someone is right-handed than skinfolds must be measured on the left-hand side). The measurement should not be made over clothing.
Scoring	It is recorded to the nearest 0.1 mm. *Example:* a result of 21.2 mm scores 21.2.

5.2.4. Subscapular skinfold thickness

Purpose	To measure subcutaneous fat and to estimate percentage body fat.
Health relation	A higher adiposity is a risk factor for cardiovascular disease.
Equipment	Skinfold calliper, non-elastic tape and pen.
Performance	The subscapular skinfold is picked up on a diagonal, inclined infero-laterally approximately 45° to the horizontal plane in the natural cleavage lines of the skin. The site is just inferior to the lower angle of the scapula. The child stands comfortably erect, with the upper extremities relaxed at the sides of the body. To locate the site, the tester palpates the scapula, running the fingers inferiorly and laterally, along its vertebral border until the inferior angle is identified. For some children, especially the obese, gentle placement of the child's arm behind the back aids in identifying the site. The caliper jaws are applied 1 cm infero-lateral to the thumb and finger raising the fold. **Practice and number of test trials:** Two measurements are performed not consecutively and the mean is used in the analyses.
Measurement	Child starts when he/she has reached the correct test position. Skinfolds must be measured not on the dominant side of the adolescent (it means that, when someone is right-handed than skinfolds must be measured on the left-hand side). The measurement should not be made over clothing.
Scoring	It is recorded to the nearest 0.1 mm. *Example:* a result of 33.4 mm scores 33.4.

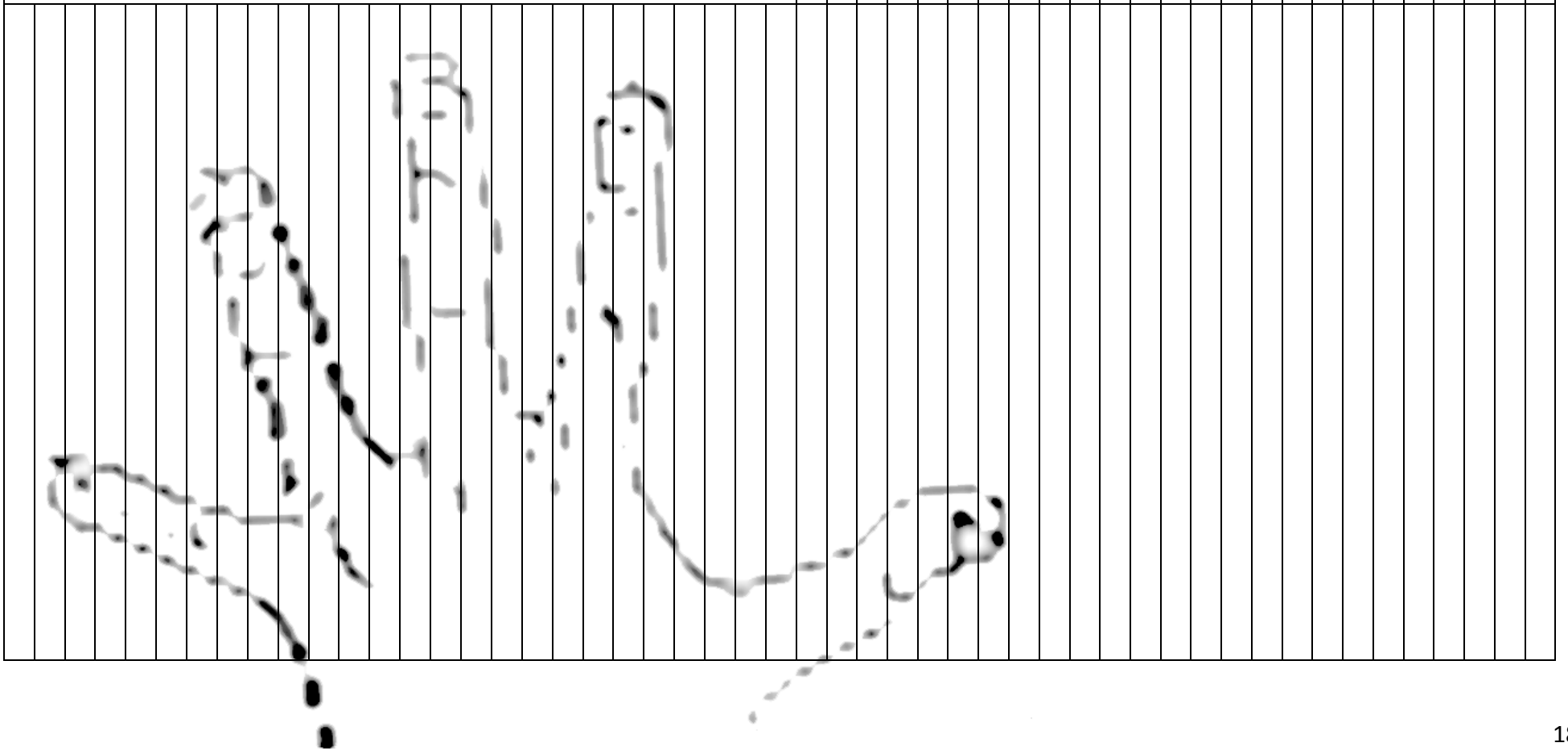
5.3. Musculoskeletal fitness

5.3.1. Handgrip strength

Purpose	To measure upper body isometric strength.
Health relation	Musculoskeletal fitness is inversely associated with established and emerging cardiovascular disease risk factors, back pain and with bone mineral content and density. Musculoskeletal improvements from childhood to adolescence are negatively associated with changes in overall adiposity.
Equipment	A hand dynamometer with adjustable grip (TKK 5101 Grip D; Takey, Tokio Japan) and a table-rule.
Performance	Child squeezes gradually and continuously for at least 2 seconds, performing the test twice (alternately with both hands) with the optimal grip-span (previously calculated, according to the hand size) and allowing short rest between measures. For each measure, the hand to be tested firstly is chosen randomly. The elbow must be in full extension and avoiding contacting with any other part of the body with the dynamometer, except the hand being measured. **Instructions:** "Take the dynamometer with one hand. Squeeze it forcefully as you can while holding the dynamometer away from your body. Don't let it touch you during the test. Squeeze gradually and continuously for at least 2 seconds. Do the test twice per hand: the best result scores." **Practice and number of test trials:** The tester shows the right performance. Both hands are to be tested twice, and the best result (of each hand) scored. Adjust the hand grip span according to the hand size (see next page).
Measurement	The maximal duration of the test is 3-5 seconds. Hand size should be measured in right hand at maximal width and by measuring the distance separating distal extremes of the first and fifth digits. The precision of the measure is 0.5 cm. The results of hand size should be rounded to the nearest whole centimetre. If you prefer, you can put the children's hand over the ruler-table to see the optimal grip span according to hand size (see ruler-table). During the test, the arm and hand holding the dynamometer should not touch the body. The instrument is held in line with the forearm and hangs down at the side. After a short rest, a second attempt is made. The indicator needs to be returned to zero after the first attempt.
Scoring	The result is expressed in kilograms, accurate to 0.1 kg. *Example:* a result of 24 kg scores 24.0.

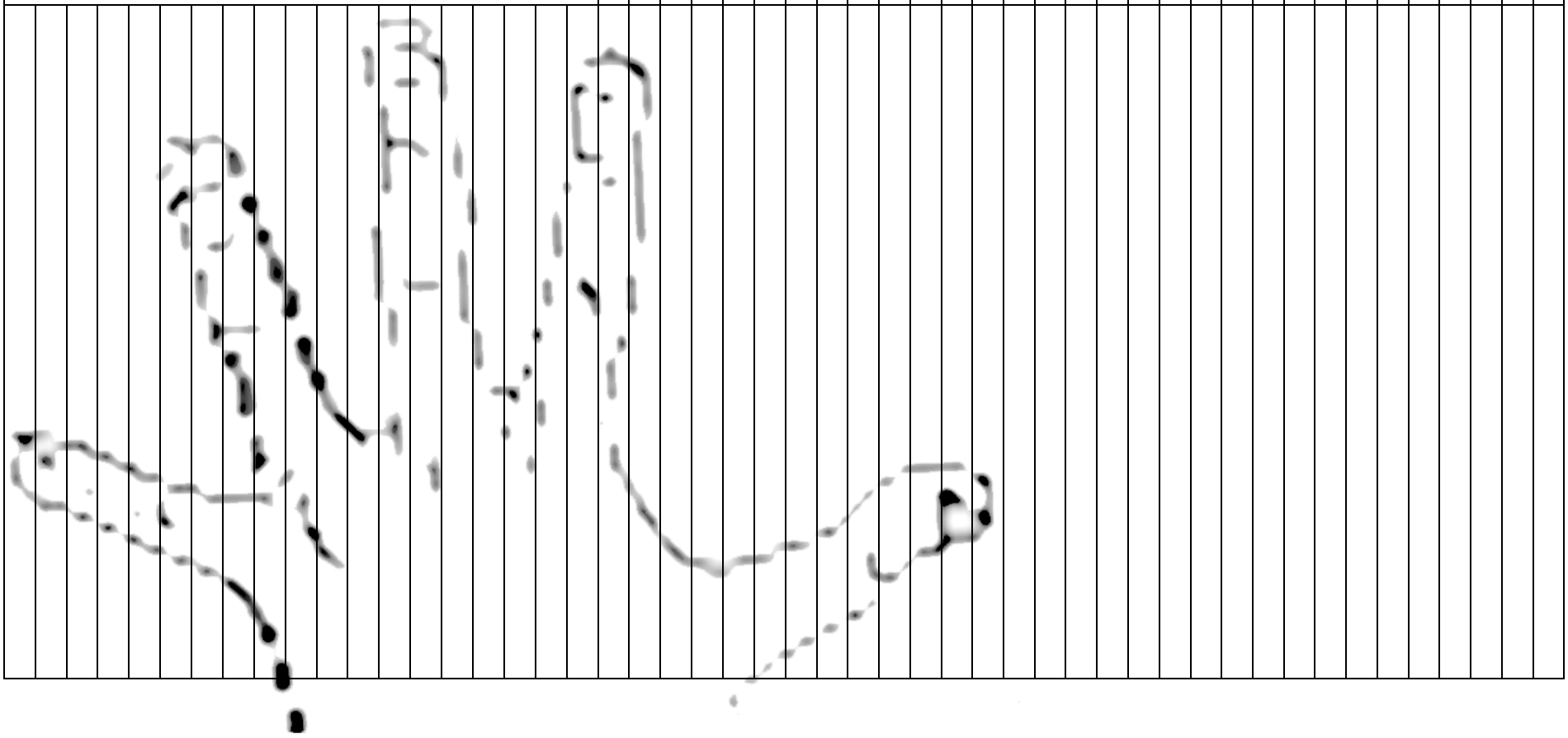
Ruler-table. Optimal grip span for **children** (6-12 years) according to hand size. The grip span is calculated from the equation by España-Romero et al. (J Hand Surgery [Am], 2008 Mar;33(3):378-84.): y = x/4 +0.44 for boys and y = 0.3x -0.52 for girls, where x is the hand size, and y is the grip span.

GRIP SPAN (cm) for FEMALES (Mark it with a circle)	3.5	3.7	3.8	4.0	4.1	4.3	4.4	4.6	4.7	4.9	5.0	5.2	5.3	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.7	6.8	7	7.1
GRIP SPAN (cm) for MALES (Mark it with a circle)	3.8	3.9	4.1	4.2	4.3	4.4	4.6	4.7	4.8	5.0	5.1	5.2	5.3	5.4	5.6	5.7	5.8	5.9	6.1	6.2	6.3	6.4	6.6	6.7	6.8
HAND SIZE (real cm)	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25	25.5



Ruler-table. Optimal grip span for **adolescents** (13-18 years) according to hand size. The grip span is calculated from the equation by Ruiz et al. (J Hand Surg, [Am]. 2006 Oct;31(8):1367-72): y = x/7.2 +3.1 for males and y = x/4 +1.1 for females, where x is the hand size, and y is the grip span.

GRIP SPAN (cm) for FEMALES (Mark it with a circle)	36	37	39	40	41	42	44	45	46	47	49	50	51	52	54	55	56	57	59	60	61	62	64	65	66	67	69	70	71	72	74
GRIP SPAN (cm) for MALES (Mark it with a circle)	45	46	46	47	48	48	49	50	50	51	52	53	53	54	55	55	56	57	57	58	59	59	60	61	62	62	63	64	64	65	66
HAND SIZE (real cm)	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25



5.3.2. Standing long jump

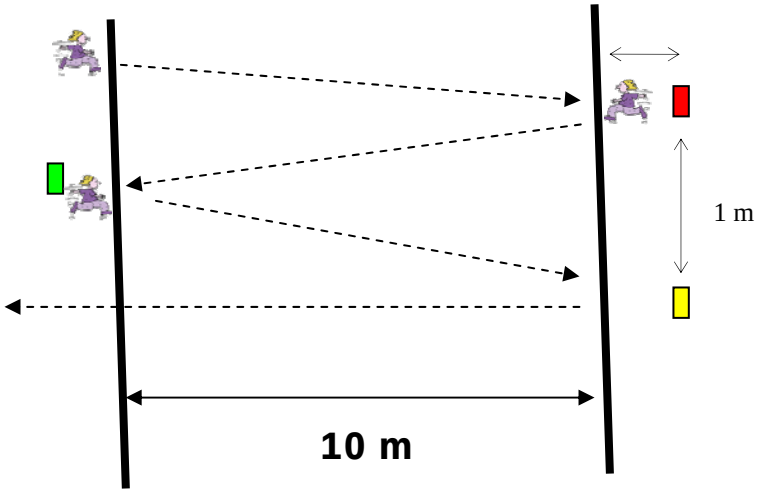
Purpose	To measure lower body explosive strength.
Health relation	Musculoskeletal fitness is inversely associated with established and emerging cardiovascular disease risk factors, back pain and with bone mineral content and density. Musculoskeletal improvements from childhood to adolescence are negatively associated with changes in overall adiposity.
Equipment	Non-slippery hard surface, stick, tape measure, adhesive tape, and cones.
Performance	Jumping for distance from a standing start and with feet together. **Instructions:** "Stand with your feet at the shoulder's width, and toes just behind the line. Bend your knees with your arms in front of you, parallel to the ground. As you swing both arms, push off vigorously and jump as far as possible. Try to land with your feet together and to stay upright. The test is done twice and the best attempt is recorded." **Practice and number of test trials:** The tester shows the right performance. Two trials are carried out and the best result is scored.
Measurement	Horizontal lines are drawn on the landing region 10 cm apart, parallel to and starting 1 m from the take-off line. A tape measure perpendicular to these lines gives accurate measurements. Stand on one side and record the distances jumped. The distance is measured from the take-off line to the point where the back of the heel nearest to the take-off line lands on the ground. A further attempt is allowed if the child falls backwards or touches the mat with another part of the body.
Scoring	The result is given in cm. *Example:* a jump of 1 m 56 cm scores 156.

5.4. Motor fitness

5.4.1. 4x10m shuttle run test

Purpose	To measure speed of movement, agility and coordination.
Health relation	Improvements in speed/agility seem to have a positive effect on skeletal health.
Equipment	Clean, non-slippery floor. Stopwatch, adhesive tape, tape measure, three sponges of different colours and four cones.
Performance	A running and turning (shuttle) test at maximum speed (4x10 m). Two parallel lines are drawn on the floor (with tape) 10 m apart. In the start line there is one sponge (B) and in the opposite line there are two sponges (A,C). When the start is given, the child (without sponge) runs as fast as possible to the other line and returns to the starting line with the sponge (A), crossing both lines with both feet. The sponge (A) is changed by the sponge B in starting line. Then go back running as fast as possible to the opposite line and change the sponge B by the C one and run back to the starting line (see figure, next page). **Instructions:** "Get ready behind the line. One foot should be just behind the line. When the start is given, run as fast as possible to the other line without sponge and return to the starting line with the sponge A, crossing both lines with both feet. Thereafter, change the sponge A by sponge B and go back running as fast as possible to the opposite line, where the sponge B must be changed by the C one. Finally, run back to the starting line without getting down speed before crossing it. Do the test twice: the best result is the score." **Practice and number of test trials:** The tester shows the right performance. Two trials are performed and the best time scored.
Measurement	Make sure that both feet cross the line each time, that he/she remains in the required path and that the turns are made as quickly as possible. Call out the number of cycles completed after each one. The test stops when the child crosses the finishing line with one foot. The child should not slip or slide during the test, so a slip-proof floor is necessary.
Scoring	The result is scored in seconds with one decimal. *Example:* a time of 21.6 sec is expressed as 21.6.

Graphic description.



Sponge A

Sponge B

Sponge C

5.5. Cardiorespiratory fitness

5.5.1. 20m shuttle run test

Purpose	To assess cardiorespiratory fitness.
Health relation	High cardiorespiratory fitness during childhood and adolescence is strongly associated with a healthier current and future cardiovascular health.
Equipment	A gymnasium or space large enough to mark out a 20m track, four cones, tape measure, CD-player and a pre-recorded CD of the test protocol.
Performance	Children are required to run between 2 lines 20m apart in time with an audio signal. The initial speed of the signal is 8.5 km/h and is increased by 0.5 km/h/min (1 minute equal to 1 step). The test finishes when the child fails to reach the end lines concurrent with the audio signals on 2 consecutive occasions. Otherwise, the test ends when the child stops because of fatigue. This test is done once. **Instructions:** "The shuttle run test gives an indication of your maximal aerobic capacity, i.e. the endurance, and involves running there and back along a 20m track. Speed will be controlled by means of a tape emitting buzzing sounds at regular intervals. Pace yourselves so as to be at one end of the 20m track or the other when you hear a sound. Accuracy to within one or two metres is enough. Touch the line at the end of the track with your foot, turn sharply and run in the opposite direction. At first, the speed is low but it will increase slowly and steadily every minute. Your aim in the test is to follow the set rhythm for as long as you can. You should therefore stop when you can no longer keep up with the set rhythm or feel unable to complete the one minute period. Remember the number announced by the recording when you stop, that is your score. The length of the test varies according to the individual: the fitter you are, the longer the test lasts. To sum up, the test is maximal and progressive, in other words easy at the beginning and hard towards the end. Good Luck!" **Practice and number of test trials:** Only one trial is performed.
Measurement	Select test site, preferably in a 25 m long gym. Allow for a space of at least one metre at either end of the track. The wider the area used, the more the number of children that can be tested simultaneously: one metre between each child is recommended. The surface should be uniform but the material of which it is made is not specifically important. The two ends of the 20m track should be clearly marked. Check the functioning of the sound track and CD player. Ensure that the device is powerful enough for group testing. Listen to the contents of the sound track. Note the numbers on the CD player timer so as to be able to locate the key sections of the track quickly.
Scoring	After the child has stopped, the last completed half-step is retained. *Example:* a score of 6.5 stages. If a higher precision is required (eg. intervention studies aiming to detect small changes), the final time spent in the test expressed in seconds, instead of half stages, can be retained.

6. REFERENCE VALUES

Body Mass Index (weight in kg / height in m^2)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 16.7	16.8 - 18.0	18.1 - 22.2	22.3 - 25.7	≥ 25.8
14 y	≤ 17.5	17.6 - 19.0	19.1 - 23.3	23.4 - 26.5	≥ 26.6
15 y	≤ 17.9	18.1 - 19.5	19.6 - 23.8	23.9 - 26.7	≥ 26.8
16 y	≤ 18.0	18.1 - 19.6	19.7 - 23.7	23.8 - 26.4	≥ 26.5
17 y	≤ 19.0	19.1 - 20.5	20.6 - 24.6	24.7 - 27.5	≥ 27.6
Girls					
13 y	≤ 17.5	17.6 - 19.0	19.1 - 23.2	23.3 - 26.4	≥ 26.5
14 y	≤ 17.6	17.7 - 18.9	19.0 - 22.8	22.9 - 25.6	≥ 25.7
15 y	≤ 18.1	18.2 - 19.4	19.5 - 23.0	23.1 - 25.6	≥ 25.7
16 y	≤ 18.3	18.4 - 19.6	19.7 - 23.1	23.2 - 25.8	≥ 25.9
17 y	≤ 18.2	18.3 - 19.5	19.6 - 23.2	23.2 - 25.8	≥ 25.9

Adapted from Moreno et al. Anthropometric body fat composition reference values in Spanish adolescents. The AVENA Study. *Eur J Clin Nutr* 2006; 60: 191-196.

Waist circumference (cm)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 62	63 - 66	67 - 78	79 - 87	≥ 88
14 y	≤ 65	66 - 69	70 - 80	81 - 88	≥ 89
15 y	≤ 67	67 - 71	72 - 81	82 - 89	≥ 90
16 y	≤ 67	68 - 71	72 - 81	82 - 88	≥ 88
17 y	≤ 70	71 - 73	74 - 83	84 - 91	≥ 92
Girls					
13 y	≤ 61	62 - 65	66 - 75	76 - 83	≥ 84
14 y	≤ 61	62 - 64	65 - 73	74 - 80	≥ 81
15 y	≤ 63	64 - 66	67 - 75	76 - 81	≥ 82
16 y	≤ 63	64 - 66	67 - 75	76 - 81	≥ 82
17 y	≤ 62	63 - 65	66 - 74	75 - 80	≥ 81

Adapted from Moreno et al. Body fat distribution reference standards in Spanish adolescents: the AVENA Study. *Int J Obes* 2007; 31: 1798-1805.

Triceps skinfold thickness (mm)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 6	7 - 8	9 - 15	16. - 23	≥ 24
14 y	≤ 6	7 - 8	9 - 15	16 - 21	≥ 22
15 y	≤ 6	7 - 8	9 - 14	15 - 19	≥ 20
16 y	≤ 5	6 - 7	8 - 13	13 - 18	≥ 19
17 y	≤ 6	7 - 8	9 - 14	15 - 19	≥ 20
Girls					
13 y	≤ 10	11 - 12	13 - 20	21 - 25	≥ 26
14 y	≤ 10	11 - 12	13 - 19	20 - 23	≥ 24
15 y	≤ 10	11 - 12	13 - 19	20 - 23	≥ 24
16 y	≤ 11	12 - 13	14 - 20	21 - 24	≥ 25
17 y	≤ 10	11 - 13	14 - 20	21 - 25	≥ 26

Adapted from Moreno et al. Body fat distribution reference standards in Spanish adolescents: the AVENA Study. *Int J Obes* 2007; 31: 1798-1805.

Subscapular skinfold thickness (mm)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 5	6 - 7	8 - 12	13 - 19	≥ 20
14 y	≤ 6	7 - 8	9 - 12	13 - 19	≥ 20
15 y	≤ 6	7 - 8	9 - 12	13 - 17	≥ 18
16 y	≤ 6	7 - 8	9 - 12	13 - 16	≥ 17
17 y	≤ 7	8 - 9	10 - 13	14 - 18	≥ 19
Girls					
13 y	≤ 7	8 - 9	10 - 16	17 - 22	≥ 23
14 y	≤ 7	8 - 9	10 - 14	15 - 20	≥ 21
15 y	≤ 8	9 - 10	11 - 14	15 - 19	≥ 20
16 y	≤ 8	9 - 10	11 - 15	16 - 20	≥ 21
17 y	≤ 8	9 - 10	11 - 15	16 - 21	≥ 22

Adapted from Moreno et al. Body fat distribution reference standards in Spanish adolescents: the AVENA Study. *Int J Obes* 2007; 31: 1798-1805.

Body fat (%)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 10.0	10.1 - 12.9	13.0 - 24.3	24.4 - 36.4	≥ 36.5
14 y	≤ 10.1	10.2 - 13.0	13.1 - 24.0	24.1 - 35.1	≥ 35.2
15 y	≤ 9.6	9.7 - 12.2	12.3 - 22.0	22.1 - 31.4	≥ 31.5
16 y	≤ 9.9	10.1 - 12.5	12.6 - 21.8	21.9 - 30.4	≥ 30.5
17 y	≤ 11.3	11.4 - 14.1	14.2 - 24.0	24.1 - 32.9	≥ 33.0
Girls					
13 y	≤ 17.8	17.9 - 21.0	21.1 - 29.5	29.6 - 35.3	≥ 35.4
14 y	≤ 17.6	17.7 - 20.4	20.5 - 28.1	28.2 - 33.3	≥ 33.4
15 y	≤ 18.3	18.4 - 21.0	21.1 - 28.1	28.2 - 32.9	≥ 33.0
16 y	≤ 19.0	19.1 - 21.8	21.9 - 29.2	29.3 - 34.1	≥ 34.2
17 y	≤ 18.6	18.7 - 21.7	21.8 - 29.7	29.8 - 35.1	≥ 35.2

Adapted from Moreno et al. Anthropometric body fat composition reference values in Spanish adolescents. The AVENA Study. *Eur J Clin Nutr* 2006; 60: 191-196.

Equations to estimate body fat (%)

Females:
Body fat (%) = 1.33 (tric+subsc) – 0.013 (tric+subsc)^2 – 2.5

Females when tric+subsc > 35mm:
Body fat (%) = 0.546 (tric+subsc) + 9.7

Males pre-pubertal (Tanner stage 1):
Body fat (%) = 1.21 (tric+subsc) – 0.008 (tric+subsc)^2 – 1.7

Males pubertal (Tanner stage 2, 3 y 4):
Body fat (%) = 1.21 (tric+subsc) – 0.008 (tric+subsc)^2 – 3.4

Males post-pubertal (Tanner stage 5):
Body fat (%) = 1.21 (tric+subsc) – 0.008 (tric+subsc)^2 – 5.5

Males when tric+subsc > 35mm:
Body fat (%) = 0.783 (tric+subsc) + 1.7

Body fat (%) estimated from equations reported by Slaughter et al. (*Hum Biol* 1988: 60: 709–723) using triceps and subscapular skinfolds.

Cardiorespiratory fitness: 20m shuttle run test (stages)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 3.0	3.5 - 4.5	5.0 - 6.0	6.5 - 7.5	≥ 8.0
14 y	≤ 3.5	4.0 - 5.5	6.0 - 6.5	7.0 - 8.5	≥ 9.0
15 y	≤ 4.0	4.5 - 5.5	6.0 - 7.0	7.5 - 8.5	≥ 9.0
16 y	≤ 4.0	4.5. - 5.5	6.0 - 7.0	7.5 - 8.5	≥ 9.0
17 y	≤ 4.5	5.0 - 6.0	6.5 - 7.5	8.0 - 9.0	≥ 9.5
Girls					
13 y	≤ 2.0	2.5 - 2.5	3.0 - 3.5	4.0 - 4.5	≥ 5.0
14 y	≤ 2.0	2.5 - 3.0	3.5 - 4.0	4.5 - 5.0	≥ 5.5
15 y	≤ 2.0	2.5 - 3.0	3.5 - 4.0	4.5 - 5.0	≥ 5.5
16 y	≤ 2.0	2.5 - 3.0	3.5 – 4.0	4.5 - 5.0	≥ 5.5
17 y	≤ 2.0	2.5 - 3.0	3.5 – 4.0	4.5 - 5.0	≥ 5.5

Adapted from Ortega et al. Physical fitness levels among European adolescents: The HELENA study. *Br J Sports Med*. 2010 Jun 11. [Epub ahead of print].

Upper-limb maximal strength: handgrip strength test (kg)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 21.4	21.5 - 24.7	24.8 - 27.8	27.9 - 31.8	≥ 31.9
14 y	≤ 26.3	26.4 - 30.4	30.5 - 34.0	34.1 - 38.5	≥ 38.6
15 y	≤ 31.3	31.4 - 35.7	35.8 - 39.7	39.8 - 44.3	≥ 44.4
16 y	≤ 35.9	36.0 - 40.0	40.1 - 43.7	43.8 - 48.1	≥ 48.2
17 y	≤ 39.9	40.0 - 43.5	43.6 - 46.7	46.8 - 50.6	≥ 50.7
Girls					
13 y	≤ 19.9	20.0- 22.5	22.6 - 24.8	24.9 - 27.6	≥ 27.7
14 y	≤ 21.5	21.6 - 24.1	24.2 - 26.4	26.5 - 29.2	≥ 29.3
15 y	≤ 22.5	22.6 - 25.1	25.2 - 27.4	27.5 - 30.3	≥ 30.4
16 y	≤ 22.9	23.0 - 25.4	25.5 - 27.8	27.9 - 30.8	≥ 30.9
17 y	≤ 23.9	24.0 - 26.4	26.5 - 28.9	29.0 - 32.1	≥ 32.2

Values expressed as average of right and left hands.

Adapted from Ortega et al. Physical fitness levels among European adolescents: The HELENA study. *Br J Sports Med*. 2010 Jun 11. [Epub ahead of print].

Lower-limb explosive strength: standing broad jump test (cm)

	Very low	Low	Average	High	Very high
Boys					
13 y	≤ 135	136 - 152	153 - 167	168 - 184	≥ 185
14 y	≤ 151	152 - 169	170 - 183	184 - 200	≥ 201
15 y	≤ 165	166 - 182	183 - 196	197 - 212	≥ 213
16 y	≤ 175	176 - 192	193 - 206	207 - 221	≥ 222
17 y	≤ 184	185 - 201	202 - 215	216 - 229	≥ 230
Girls					
13 y	≤ 118	119 - 133	134 - 147	148 - 163	≥ 164
14 y	≤ 121	122 - 137	138 - 151	152 - 167	≥ 168
15 y	≤ 123	124 - 138	139 - 151	152 - 167	≥ 168
16 y	≤ 126	127 - 141	142 - 154	155 - 169	≥ 170
17 y	≤ 129	130- 144	145 - 157	158 - 172	≥ 173

Adapted from Ortega et al. Physical fitness levels among European adolescents: The HELENA study. *Br J Sports Med*. 2010 Jun 11. [Epub ahead of print].

Speed/agility: 4x10m shuttle run test (sec)

	Very low	Low	Average	High	Very high
Boys					
13 y	≥ 13.0	12.3 -12.9	11.8 - 12.2	11.2 - 11.7	≤ 11.1
14 y	≥ 12.6	11.9 - 12.5	11.4 - 11.8	10.9 - 11.3	≤ 10.8
15 y	≥ 12.1	11.5 - 12.0	11.0 - 11.4	10.5 - 10.9	≤ 10.4
16 y	≥ 11.8	11.1 - 11.7	10.7 - 11.0	10.2 - 10.6	≤ 10.1
17 y	≥ 11.8	11.1 - 11.7	10.7 - 11.0	10.2 - 10.6	≤ 10.1
Girls					
13 y	≥ 13.9	13.1 - 13.8	12.5 - 13.0	11.9 - 12.4	≤ 11.8
14 y	≥ 13.8	13.0 - 13.7	12.4 - 12.9	11.8 - 12.3	≤ 11.7
15 y	≥ 13.7	13.0 - 13.6	12.4 - 12.9	11.8 - 12.3	≤ 11.7
16 y	≥ 13.6	12.9 - 13.5	12.3 - 12.8	11.7 - 12.2	≤ 11.6
17 y	≥ 13.5	12.9 - 13.4	12.4 - 12.8	11.8 - 12.3	≤ 11.7

Lower scores indicate better performance.
Adapted from Ortega et al. Physical fitness levels among European adolescents: The HELENA study. *Br J Sports Med*. 2010 Jun 11. [Epub ahead of print].

ALPHA Health-Related Fitness Test Battery for Children and Adolescents

Measurements

Name of the child: _____ **Sex**: Male / Female **Date of birth**: _____

Tanner stage			
Breast development		Hair distribution	
Penis and Scrotum Development		Hair distribution	

Body composition			
Weight (kg)		Weight (kg)	
Height (cm)		Height (cm)	
Waist circumference (cm)		Waist circumference (cm)	
Triceps skinfold thickness (mm)		Triceps skinfold thickness (mm)	
Subscapular skinfold thickness (mm)		Subscapular skinfold thickness (mm)	

Musculoskeletal fitness			
Handgrip strength - right hand (kg)		Handgrip strength - right hand (kg)	
Handgrip strength - left hand (kg)		Handgrip strength - left hand (kg)	
Standing long jump (cm)		Standing long jump (cm)	

Motor fitness			
4x10m shuttle run test (sec)		4x10m shuttle run test (sec)	

Cardiorespiratory fitness	
20m shuttle run test (stage)	

Notes: (e.g. reasons for exclusion, problems occurring during the test)

Name of the tester: _____ **Date**: _____

7. WORKING GROUP

The ALPHA health-related fitness test battery was developed under the framework of the ALPHA study thanks to the team work of the following group of experts:

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13. Michael Sjöström, Karolinska Institutet, Sweden
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