

Martínez-de-Haro, V.; Peral-Rodríguez, P.; Cid-Yagüe, L.; Álvarez-Barrio, M.J. (2022) New Approach to Health-Related Physical Fitness Tests. A Comparison between Two Seasons. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 22 (85) pp. 129-151 [Http://cdeporte.rediris.es/revista/revista85/artnueva1304.htm](http://cdeporte.rediris.es/revista/revista85/artnueva1304.htm)
DOI: <https://doi.org/10.15366/rimcafd2022.85.009>

ORIGINAL

NEW APPROACH TO HEALTH-RELATED PHYSICAL FITNESS TESTS

NUEVA FORMA DE ENTENDER LAS PRUEBAS DE CONDICIÓN FÍSICA EN RELACIÓN CON LA SALUD

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Código UNESCO / UNESCO CODE: 2411.99 Otras (Actividad Física y Salud) / Others (Physical Activity and Health)

Clasificación del Consejo de Europa / European Council Classification: 17 Otras (Actividad Física y Salud) / Others (Physical Activity and Health)

Recibido 23 de octubre de 2019 **Received** October 23, 2019

Aceptado 5 abril de 2020 **Accepted** April 5, 2020

ABSTRACT

The aim of this research was to propose a new way of understanding health-related physical fitness assessment in order to prevent inactivity and sedentarism. The background lies in the test batteries used from 1976 to the present. WHO's health concept was used. Tests were analysed based on functionality, economy, validity, reliability and specificity criteria. The following tests were chosen and the thresholds were calculated: 1,425s in the UKK walk test (P75), 6s in the 20-m sprint test (P75), 19 repetitions in the chair stand test (P25), 11 repetitions in the arm curl test (P25), -10.5cm in the back scratch test (P25), -17.5cm in the chair sit-and-reach test (P25). It was proposed that a universal and inclusive test battery be developed and the percentiles for the world population are determined with the help of big data.

KEYWORDS: health-related physical fitness, physical fitness test, assessment.

RESUMEN

El objetivo de este trabajo es mostrar una nueva forma de entender la evaluación de la “condición física en relación con la salud”, para evitar la inactividad y el sedentarismo. Los antecedentes se encuentran en las baterías de test utilizadas desde 1976 hasta la actualidad. Se utiliza el concepto de salud de la OMS. Se analizan pruebas con criterios de funcionalidad, economía, validez, fiabilidad y especificidad. Se eligen las siguientes pruebas y se calculan los umbrales: UKK Walk test (P75), 6” en sprint test 20 m (P75), 19 repeticiones en Chair Stand Test (P25), 11 repeticiones Arm Curl Test (P25), -10,5 cm Back Scratch Test (P25), -17,5 cm en Chair Sit and Reach Test. Se propugna la elaboración de una batería de test universal e inclusiva y elaborar percentiles mundiales ayudados por el big data.

PALABRAS CLAVE: Condición física en relación a la salud, test de condición física, evaluación

INTRODUCTION

We have been working on and, therefore, thinking about health-related physical fitness assessment in human beings for several years.

The aim of this manuscript is to present a number of proposals to the scientific community that would radically change the current concept of health-related physical fitness assessment, in order to prevent physical inactivity and sedentarism.

This reflection emerges after detecting several problems in the tests that are currently being used: they exclude a large part of the population, they are not conducted on a regular basis during life, they are not functional for daily living, and they do not establish a difference between sedentarism/lack of activity and physical fitness levels.

It is not our intention to fully solve all these issues in this first manuscript, but we do propose an initial reflection. At a second stage, new tests should be suggested that meet the proposed goals and are validated for the whole population.

Nevertheless, we have not settled for a theoretical reflection on the topic, but we have gone beyond to test our proposed assessment in a significant group of children and adolescents. However, these results should not be considered conclusive.

We will start by discussing the mistakes that, in our opinion, are being made, together with the proposals to solve them. Subsequently, a pilot test for this assessment will be presented, as well as the results obtained. Issues, where further research is needed, will be identified.

From the health point of view, it is interesting to assess physical fitness to make sure an individual is not sedentary or inactive.

Nowadays, a distinction is made between sedentary behaviour and inactivity (1). A sedentary behaviour appears when an individual remains seated or lying down and/or has an energy expenditure lower than or equal to 1.5 METs, while an inactive individual does physical activity below moderate or vigorous intensity (MVPA). This means that the metabolic expenditure of a sedentary person while awake is only 0.5 METs higher compared to their basal metabolism.

It is widely known that physical fitness values reflect the adaptation level of every physical capacity. These adaptations should reflect that the individual is far from sedentarism. Therefore, we will look for muscle normotrophy, good joint mobility, an efficient cardiorespiratory system to achieve good cardiovascular endurance, and a nervous system able to control the efforts.

In 2004, the WHO (2) developed a plan for the prevention and control of non-communicable diseases by controlling three risk factors: obesity, tobacco use and sedentarism.

The development of this research was based on the definition of health provided by the WHO, which has been graphically represented by our group as follows (3, 4):

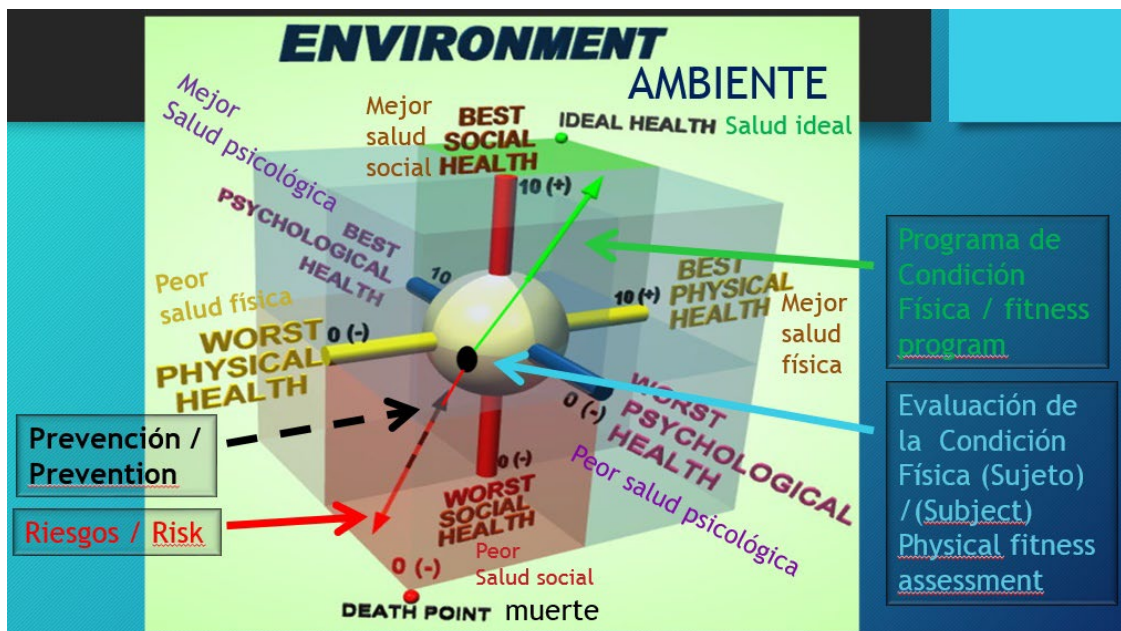


Figure 1. Health cube

A minimum of 30 minutes of moderate-intensity physical activity is recommended every day, which reduces the risk of cardiovascular disease, diabetes, colon cancer and breast cancer. Muscle balance and strength training can reduce falls and improve functional status among older adults. Increased activity helps to manage weight (2).

The WHO established the aim to reduce the prevalence of insufficient physical activity by 10% and, consequently, to foster and promote physical activity for all ages and to assess it in order to develop effective and cost-efficient actions (5).

Since then, multiple studies have been published regarding the effect of physical activity on health. It is well known that removing any of these factors (tobacco use, obesity and physical inactivity) significantly reduces disease incidence, and that being active, even if obese or a smoker, has positive effects on health.

The physical capacities that have traditionally been related to health are strength, flexibility, endurance and body composition (6).

This paper includes velocity (sprint and plate tapping test) since we believe this capacity is related to injury prevention and also facilitates youth social inclusion. This population group engages in sports activities in which being fast is

important (track and field, football, rugby, basketball, handball, gymnastics...) and a lack of velocity may be a reason for social exclusion. The decision of including this test among health-related tests is in agreement with Vanhelst et al. (7).

It must be noted that the health paradigm presented here focuses on WHO's definition of health: a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Therefore, when evaluating physical fitness, the aim is to measure not only physical but also psychological, social and environmental health.

Body composition is not considered to be a physical capacity, but the morphological expression that will lead to certain results and that will be modified through the physiological adaptation achieved by means of physical capacity training. Consequently, only height and body weight will be requested to indirectly calculate maximal oxygen consumption during the UKK walk test (8). At the same time, body composition must be checked, in particular the muscle and adipose panicle. From an anthropometric point of view, we would recommend collecting, at least, the following data:

MINIMUM ANTHROPOMETRY SHEET				
Código / Code	Edad / Age	Sexo / Sex		
A code is added to ensure anonymity	Chronological age or date of birth	Mujer / Female (F)	Hombre / Male (M)	Fecha prueba / Test date
Pruebas / Tests	Medida / Measurement			
Peso / Weight kg				
Estatura (altura total) / Height m				
Perímetro de cintura / Waist circumference cm				
Perímetro de cadera / Hip circumference cm				

With the purpose to calculate BMI, fat percentage (9) and waist-hip ratio, and considering the following. We know that BMI does not work well in growing children or adolescents, who grow in width or length in different periods and this may be mistakenly interpreted as overweight or underweight, or in athletes, as muscle is heavier than fat and this can be wrongly interpreted as overweight. It would be important to measure the fat percentage through skinfolds or impedance. The waist-hip ratio is a very good estimate of cardiovascular risk.

By contrast, the values of endurance, strength, velocity or flexibility that are related to sedentarism or inactivity are still unknown. In fact, most of the authors who talk about health-related physical fitness associate health with high physical fitness values. But this is controversial, as high values require very

demanding and sustained efforts that may damage psychological or social health.

The definition of physical fitness that we consider most accurate is the one provided by Clarke: the ability to perform daily tasks with vigour and alertness, without undue fatigue, and with ample energy to enjoy leisure pursuits and to meet unforeseen emergencies (10).

After having analysed the existing health-related test batteries, it was concluded that they were designed for specific age groups, they excluded populations with diseases, they mostly used tests that were not functional for daily living and their results could not be compared during life.

Besides, we believe that, in order to have a clear image of physical activity levels worldwide, it is necessary to design tests that can be conducted in every inhabited place, by everyone and without any sophisticated material.

Based on the above ideas, a few basic suggestions will be provided in the present manuscript.

MATERIAL AND METHOD

Test Selection

Functional tests related to daily living have been searched for. Daily living was understood as anything one can do, regardless of being very active (athletes, manual workers...) or not.

Regarding endurance, some test involving the most common displacements, like walking. Regarding flexibility, some test assessing hip and shoulder joints, which are the ones with the greatest mobility. Regarding strength, some test assessing trunk, lower-limb and upper-limb strength, as well as displacement velocity over a short distance.

In order to select the tests, 13 health-related test batteries were analysed: AAHPERD, 1976 (11), CAHPERD, 1980 (12), NCYFS (13, 14), EUROFIT (15), FITNESSGRAM 1994 (16), health-related Eurofit for adults (17), AFISAL-INEFC (18, 19), CPAFLA (20), UKK (21), FITNESSGRAM 1999 (22), Physical Best AAHPERD 1999 (23), SENIOR FITNESS TEST (24-26), and ALPHA-FIT (27). As well as more than 300 individual tests.

Test Characteristics

After the above analysis, the following tests were selected. For endurance: 2-km UKK walk test (21). For lower-limb strength: chair stand test by Rikli and Jones (2001) (24-26). For upper-limb strength: 1-kg arm curl test. For shoulder flexibility: back scratch test by Rikli and Jones (2001) (24-26). For hip and trunk flexibility: chair sit-and-reach test by Rikli and Jones (2001) (24-26). For velocity: 20-m sprint test.

Those tests that require costly, specific or uncommon material, or that can only be conducted in certain testing facilities, like laboratories, were discarded. The same occurred with those that did not measure capacities that are useful for daily living, despite being very interesting for certain sports. Those for which complex technique or advanced coordination was required were also dismissed. The same happened with those that were not easy to conduct with as little staff as possible and autonomously once the participant had learned the protocol. The time spent on the tests must be short, not to generate fatigue in the participants, as it would reduce the concentration level. Tests that could not be performed by everyone, regardless of their disabilities, were discarded. As well as those that were not advisable for everyone's health or that could be harmful or generate a risk for the participant's health.

The selected tests presented the following characteristics:

- Tests that assess the main health-related physical fitness components (strength, flexibility, endurance and velocity).
- Tests that have direct application to daily living tasks (displacements [long or short and fast] and manipulation tasks [strength and range of movement]).
- Tests that can be performed by everyone, from children to older adults to individuals with a disability or disease.
- They are easy to conduct and score.
- They do not require highly-accurate measuring instruments.
- They are conducted in a short time.
- They are motivating and attractive to the participants being tested.
- They require little space and material, so that they can be conducted almost everywhere and under any circumstances.
- They are inexpensive.
- They are safe even without a prior medical check for healthy people with little injury risk, but also for those with some disease or deficit.
- They are valid and reliable.
- Warm-up is not needed before the tests, although it is highly recommended.

- They can be performed under any weather conditions or in any environment.

Test Administration

Tests should be easy to perform by the participants so that every person is able to take the test and assess their own level. Obviously, children and people with an impairment or disability can take the tests, but under supervision.

Physical activity professionals are needed for test procedure teaching, execution control, data collection and test assistance.

The tests can be performed on the same day in any order, always allowing enough rest between consecutive tests. The total time needed to perform all tests is estimated to be one and a half hours. The tests can also be performed on different days. It is recommended that they are conducted in the same week.

It is recommended that they are repeated once a year if there is no reason to conduct them more often (e.g. having sedentary or inactive physical fitness status and having started an activity programme), but never earlier than three months. According to the general adaptation syndrome, three months is considered to be the minimum training period necessary to generate long-term adaptations.

Apart from the objective test results, qualitative data were collected by the testers, who asked the participants to provide their perceived exertion (Borg scale, 1 to 10), and to indicate how they had felt personally (psychological assessment, 0 to 10) and how they had felt regarding others (social assessment, 0 to 10) after every test. If we aim to truly assess health, we should not only collect the purely physical data, but also evaluate the psychological and social dimensions.

Ethical Rules

For this study, approval was requested to and provided by the Research Ethics Committee (CEI, initials in Spanish) of the Autonomous University of Madrid.

The participants and their families were informed about the study purpose and procedure. Participation was voluntary and the relevant permissions were requested to the participants or their parents or guardians, in case of minors or incapacitated people with disability.

Data privacy and reliability, as well as participants' anonymity, were ensured.

Data Collection

The data sheet below was used, although some further adaptations have been made at a later stage.

Table 1. AFES-UAM individual sheet

Código / Code A code is added to ensure anonymity	Año de nacimiento / Year of birth	Edad / Age	Sexo / Sex Mujer / Female (F) Hombre / Male (M)	Fecha prueba / Test date	Estatura / Height cm / feet and inches	Peso / Weight Kg / pounds
Pruebas / Tests		Marca / Result	Percepción esfuerzo físico / Perceived physical exertion 0-10	Valoración de bienestar psicológico / Psychological well-being assessment 0-10	Valoración de bienestar social / Social welfare assessment 0-10	Pulso / Heart rate ppm
UKK walk test 2-km endurance test (time to be measured in seconds)						
20-yard walk test (18.288m) (time to be measured in seconds)						
1-mile walk test (1,609.34m) (time to be measured in seconds)						
20-min fast walking endurance. Distance covered to be measured						
20-m velocity (seconds)						
20-yard velocity (18.288m)						
10-s leg velocity						
50-rep plate tapping test (s)						
30-s chair stand test [sitting and standing up] (repetitions)						
Forearm plank (1 min max.)						
30-s 1-kg right arm curl test [forearm flexion-extension] (repetitions)						
1-kg left arm curl test [forearm flexion-extension] (repetitions)						
Back scratch test, right side (cm)						
Right shoulder flexion (above the shoulder)						
Right shoulder extension (under the shoulder)						
Back scratch test, left side (cm)						
Left shoulder flexion						
Left shoulder extension						
Chair sit-and-reach test, right side (cm)						
Chair sit-and-reach test, left side (cm)						
Right hand dynamometry						
Left hand dynamometry						

Trunk dynamometry					
Lower-limb dynamometry					
15-kg two-arm raise					
30-s 3-kg right-arm suitcase raise					
30-s 3-kg left-arm suitcase raise					
Comments (disability, injury, disease, special situation or working conditions, aids, facilities or material). Conditions under which the test has been conducted.	ICD-10 Diseases	Main activity Very active Active Inactive		Walking aids used Guide or guide dog Cane Crutches Prosthesis Wheelchair Walker	
Lugar de realización de las pruebas (País) / Place of test conduction (Country)	Madrid (Spain)	Temperatura ambiental (°C / °F) y meteorología / Temperature (°C / °F) and meteorology			

Participants in the Exploratory Study

Non-probabilistic or incidental sampling was applied to obtain a sample of voluntary participants.

Sample (n=413):

Age	Boys	Girls	Total
6-7 years	21	20	41
8-9	43	41	84
10-11	30	36	66
12-13	27	29	56
14-15	34	34	68
16-17	28	32	60
21-33	19	19	38

Among all the participants tested, the majority were healthy subjects (267), but there were also individuals with autism (2), an ankle injury (2), a knee surgery (2), intellectual disability (24), physical disability in a wheelchair (1), and a deaf-blind person (1).

Data Processing

The data were handled using the statistical software PASW Statistics 18.0.0®, and the most relevant descriptive statistics were calculated: mean, mode, standard deviation, range, asymmetry and kurtosis. Percentiles were also calculated and values were compared. Graphs and tables were built using the software Microsoft Excel®.

RESULTS AND DISCUSSION

It was intended to propose a new approach to health-related physical fitness assessment by selecting the most functional tests for daily living. The aim was to determine the so-called 'threshold for physical inactivity and sedentarism'.

A pilot study using the designed test battery is presented and discussed.

About the Tests

The tests meeting the aforementioned criteria were selected.

To assess endurance, the UKK walk test was selected because a running test did not seem truly relevant for daily life, as opposed to a test that can be performed by the whole population and from which maximum oxygen consumption can be indirectly obtained. The walking test entails hardly any risk and can be adapted to people in a wheelchair. Furthermore, nowadays we know VO₂max percentiles, like those published by Graves et al. (28), and we can use them. (28)

Another aim was to assess the strength in the lower limb, the trunk stabiliser muscles and the upper limb.

The chair stand test undoubtedly measures the lower-limb extension strength. However, that movement is not used in daily life and such strength should be directly related to the walking and running results, since it is applied during these activities. No statistical relationship has been found between them. Evaluating each lower limb separately was considered unnecessary. Obviously, this test cannot be performed by people who are unable to complete a lower-limb flexion-extension due to injury or disability. Furthermore, the trunk stabiliser muscles strength plays an important role in this movement.

No specific test has been found for the trunk stabiliser muscles strength. Abdominal muscle tests are not considered appropriate in this case and the Biering-Sorensen and modified or inverted Biering-Sorensen tests were checked; the latter was created by inverting the position of the former to a supine position. Both tests were discarded due to the insecurity and fear that they generated in participants of all ages.

The arm curl test was used to measure strength in each upper limb. Nonetheless, this selection is not deemed satisfactory. Upper-limb strength has some particularities, since maximum strength is used to carry loads grabbing them with one or two hands, while precision strength is applied to grab objects without crushing them. The most suitable test found was the arm curl test; however, it is not considered completely appropriate. It would be more relevant to perform upper-limb flexion-extension movements from a standing position to vertically lift a dumbbell along the upper-limb axis, which would be equivalent to lifting a bag or suitcase, or even to create a test to assess maximum strength by holding a load for a certain time, i.e. maintained static strength or isometric

strength. The difficulty in this test would be to establish the weight for every age range.

Separate tests for the right and left arms were proposed, although it must be noted that there is a high correlation between the results of both sides (arm curl test, $r=.781$; back scratch test, $r=.530$ and chair sit-and-reach test, $r=.925$). Therefore, the results of one arm would be enough in order to get the absolute values and percentile graphs, although the participant and the tester must aim to assess symmetry and muscular balance in every person. Individual tests for every limb were proposed in case a person was missing one of them.

The back scratch test was chosen to assess shoulder flexibility. It is conducted on both shoulders and we considered it appropriate to measure shoulder mobility. Nevertheless, it does not work for people who can only move one upper limb. We are working on a new version of Apley's Test used in clinical practice but including reference values, like a point in the spinal column or the scapula, both for flexion and extension. That test would be applied to the whole population. It is emphasised that the tests are universal and equal for everyone.

We considered the chair sit-and-reach test as the most suitable one to measure hip and lower-back flexibility because it can be performed by older adults and people in a wheelchair. Of course, reference points for trunk flexion must be determined for those people who are not able to extend their lower limbs or are in a wheelchair.

When the test is conducted in a seating position, the seat height must be so that the flexed leg is at a right angle. The same seat would not be suitable for everyone. This requirement was met for all participants, from 6-year-old children to short or very tall adults.

The initially selected lower-limb velocity test was the 5x10m test from EUROFIT battery. Nevertheless, it was observed that those participants with ankle, knee or hip problems felt insecure while turning and were at risk of getting injured. Therefore, a (20-m) linear test was chosen. Velocity was considered to be a health-related capacity, firstly to prevent accidents (for example, being run over or crushed by a falling object), and secondly, mostly among youth, related to social health, since a minimum velocity is needed in the majority of activities they engage in, like sports and games. It is emphasised that physical health is as important as psychological and social health. For those cases in which 20 metres are not available for the test, we are considering an alternative: seating on a chair, to alternatively tap with the feet on the floor for 10 seconds and to count the number of repetitions.

For upper-limb velocity, we are considering the EUROFIT tapping test (29).

The selected tests have been validated for very specific and limited population groups (youth, healthy people, older adults); it would be necessary to validate the tests for the whole population.

About the Test Administration

It is advisable to ask about the current health status in order to adapt the effort during the tests. It is not contraindicated to take the tests while suffering from an impairment or disease except if the disease is in an acute stage or the performance of some of the tests has been formally contraindicated by the doctor. However, this should not be frequent, as the movements involved are present in daily living.

Auditory, visual and tactile starting signals were provided, in case of any sensory impairment. No big preparation was needed to start and complete the tests. The three signals 'ready, steady, go' were not necessary. One starting signal (sound, visual signal or touch) was enough. Excellent technique training was not necessary, as the aim was not high performance, but the best performance of every individual at that moment and in that situation, and the lower limits were the most important. The aim was to determine the borderline for physical inactivity or sedentarism. We wish to detect and warn those people that are vulnerable to sedentarism or inactivity, as well as to determine the results in the physical fitness tests that would be equivalent to 1.5MET or 3MET.

If any individual needs aid for the walking tests, either endurance or velocity tests, they are allowed to use it (cane, walker, wheelchair or helper), provided that the helper or walking aid only stabilises and does not propel the participant. The proposed tests were performed by people with various diseases using a cane or in a wheelchair. And we believe these results should be included in the databases but be accompanied by the corresponding disease according to ICD-10.

Given the low test intensity, a warm-up would not be necessary, but it would be desirable and advisable. It is also recommended to teach the correct execution before performing the tests as this will improve the results. The participants should be requested to achieve the best result possible but they can reduce the intensity in case of discomfort or injury risk. One of the issues observed in the percentiles was that some groups did not push themselves when they were told that it was not necessary. They showed good mobility though. That is the reason why the instructions were modified and now the participants are requested to perform as well as possible. We must be cautious when conducting the tests in groups, especially in minors and people with disability, as they are usually very competitive and we are not looking for the best individual here, but for the best that everyone can perform, although the group as a whole is also important.

It is recommended that the tests are conducted once a year to check the adaptations. However, in the case of inactive or sedentary people, it is recommended that this period is reduced to 3 to 6 months, according to the tester.

It is important that the tester is observing during the test in order to conduct a qualitative assessment and prevent incidents.

The participants must be informed that, upon completion of the test, they will be asked to rate their perceived exertion from 0 to 10 (0 means no effort, 10 means maximal effort) and to indicate how they had felt personally during the test (psychological self-assessment) from 0 to 10, and how they had felt regarding the group (social assessment) from 0 to 10 (see sheet). We must insist once more that not only the physical assessment is relevant, but also the psychological and social health aspects. In some cases, good results were found in strength, endurance, velocity and flexibility tests, but the participants gave themselves a low psychological score regarding their mood that would have never been detected in light of the physical results.

About the Test Analysis

The inclusion of all the results in a database is proposed in order to calculate the percentiles of the whole population and to determine the "normal" (between the 25th and 75th percentiles) and the concerning values (above the 75th percentile for walking and velocity tests and below the 25th percentile for the rest). Percentile graphs based on the results obtained are shown.

High data concentration can be observed in some age groups like 10-11 years, especially among boys, while data are more spread in the rest.

The purpose is that every person can draw and analyse their graph to monitor their capacities over time.

About Endurance

The exploratory analysis yielded significantly better endurance results for boys than girls in all age groups. Only in the 12-13-year group, this difference was not significant.

Significant differences were found between the majority of age groups and between genders, except between 6-7-year-old and 8-9-year-old boys and between 14-15-year-old and 16-17-year-old boys. This would suggest that boys' evolution is limited in the first age groups and it stabilises again in the last ones. By contrast, the evolution was more progressive in girls.

A possible future approach would be to find variables or criteria other than age and sex to be considered in endurance assessment. For instance, anthropometrical parameters, like participants' size. We must bear in mind that grouping by age and sex is based on apparently good subjective criteria, since they yield significant objective differences, but they may not be the only or the most appropriate ones. For example, there could be men with less endurance than women or young people with better results than adults.

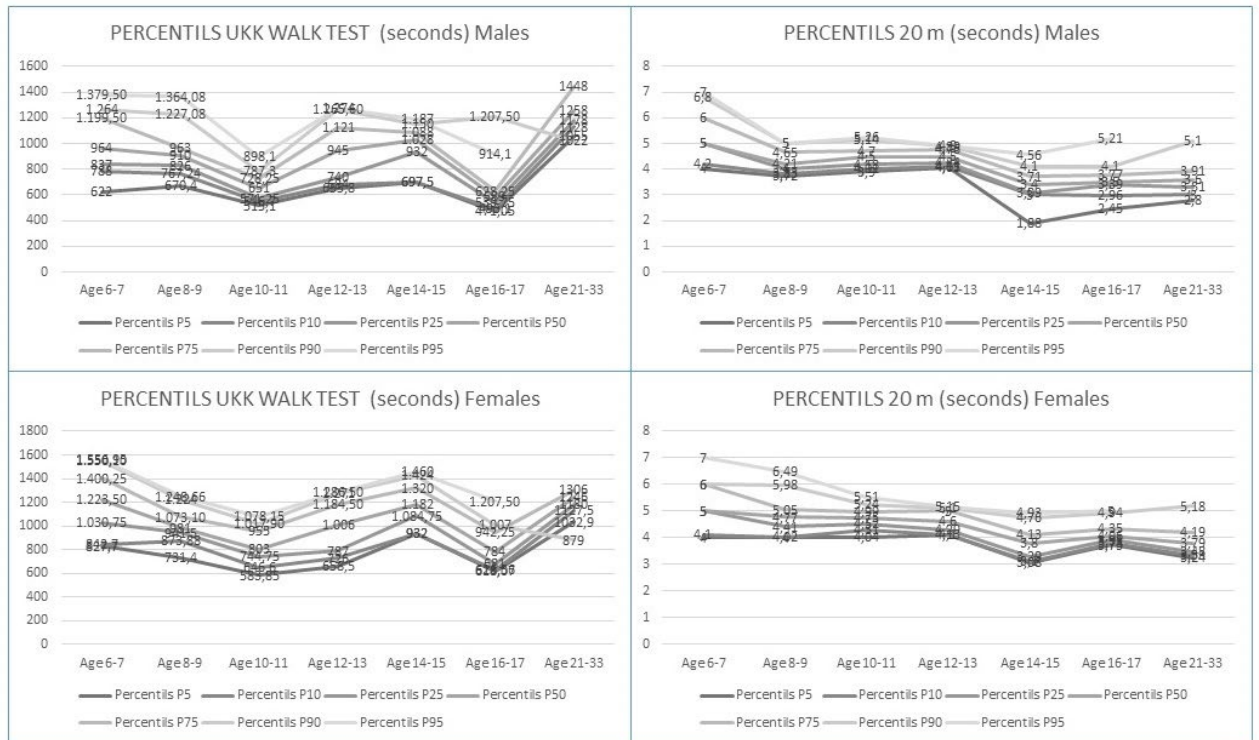


Figure 1. UKK walk test and 20-m speed test (displacement tests) percentiles

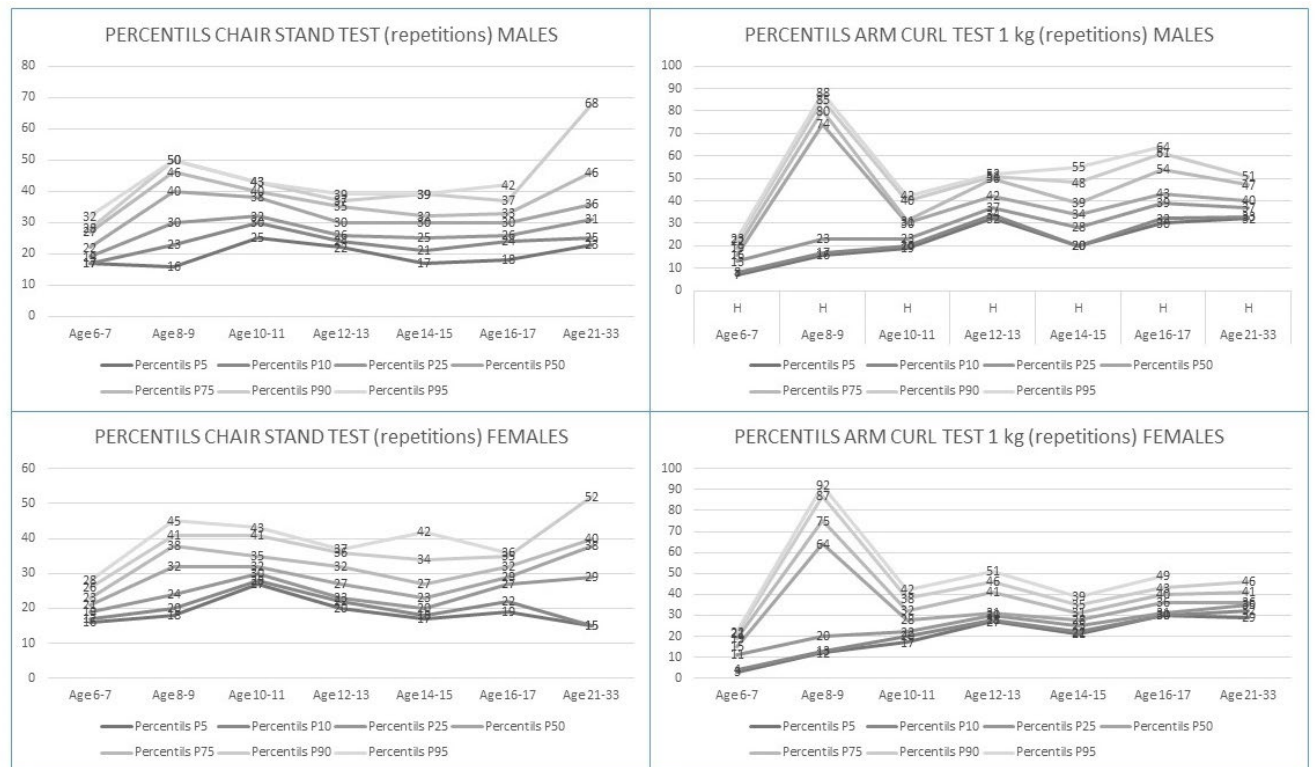


Figure 2. Chair stand test and arm curl test (strength tests) percentiles

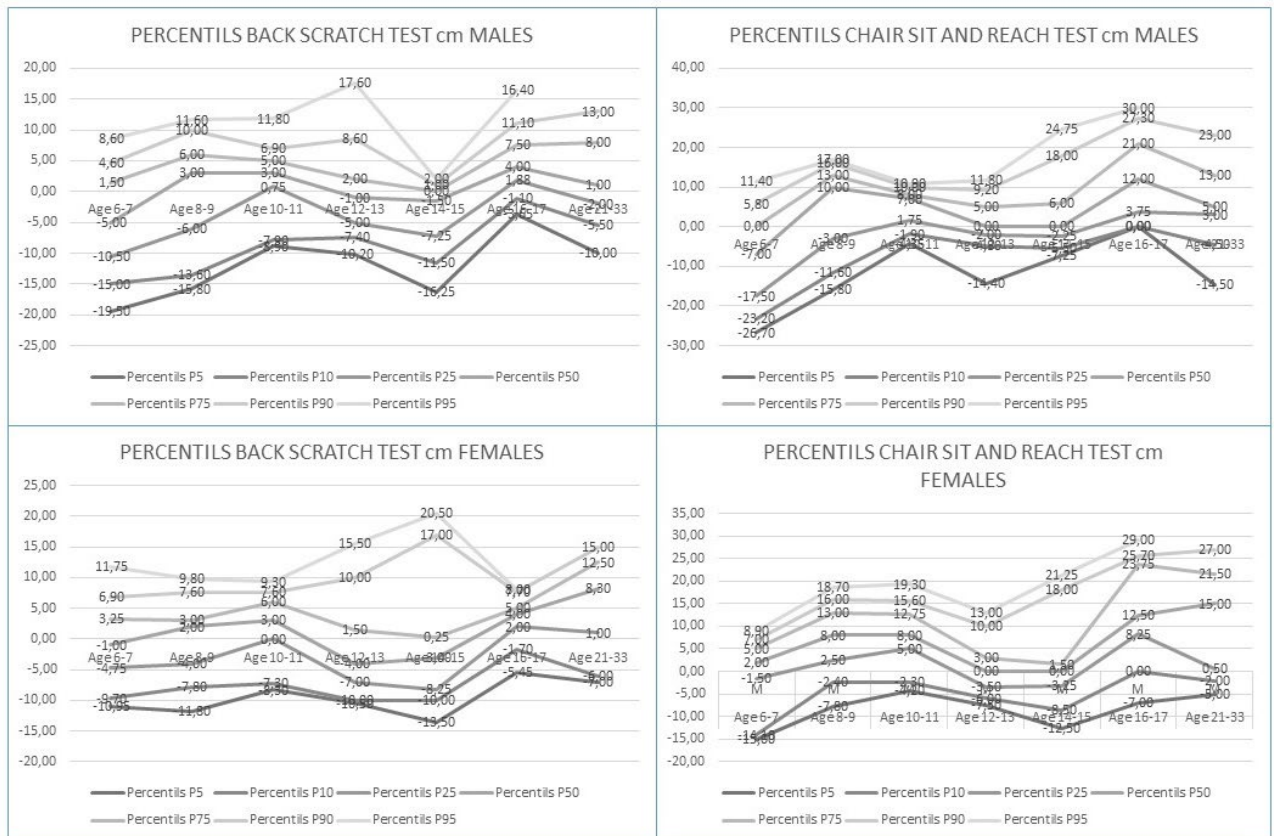


Figure 3. Back scratch test ad chair sit-and-reach test (flexibility tests) percentiles

About Velocity

When comparing the group based on age and sex, it is noteworthy that boys achieved better mean results in all group ages, except for the 6-7-year group, where the difference was tiny. The 14-15-year-old boys' group presented the best mean value, while the 6-7-year-old boys showed the worst mean value. Girls' evolution seemed to stabilise between 8 and 13 years old, while boys showed significant improvement between 8-9 years and 10-11 years old, stabilisation until 12-13 and a new increase in adolescence. No significant differences were found between boys and girls either at 6-7 years or at 12-13 years old. These can be considered as two stabilisation periods, at the beginning of childhood development and adolescence.

Lower-Limb Strength

Upon group comparison based on sex and age, it can be stated that the resulting graphs are similar, with the only difference that girls achieved the best results at 10-11 years old, while boys did at 8-9. In both cases, the participants presented the worst results at the age of 6-7 and a decline in strength was detected at the age of 14-15. The results from both groups revealed that strength did not increase with age, but there were ups and downs. However, in the case of boys, a negative trend was observed in lower-limb strength between 8-9 and 16-17 years old.

Upper-Limb Strength

After the comparisons based on age and sex, the above data were confirmed. Thus, the participants of both genders presented the best results at the age of 8 and the worst at the age of 6. The five lowest values of both groups were achieved at the age of 6, while the five highest values were obtained at the age of 8.

Upper-Limb Flexibility

The same overall results were found when comparing by age and sex: a graph with highs and lows, with two relevant flexibility peaks at 10-11 and 16-17 years old in both boys and girls. Consequently, flexibility did not improve linearly with age, and no differences were observed between genders. Nevertheless, when analysing every age group, girls achieved slightly better mean values, except in the 12- and 16-year-old groups, where boys presented better results.

Left Lower-Limb Flexibility

Data were more spread in girls than in boys, the latter presenting lower values. P25 corresponded to -17.5cm and P75 to 23.75cm.

After comparing by age and sex, the same differences were detected among boys and girls. Significant differences were observed between the pairs 6-7 and 8-9-year-old groups, 10-11 and 12-13 groups, and 14-15 and 16-17 groups. This justifies that the age sub-grouping is made every two years.

About the Psychological and Social Assessment

As it can be seen in the data collection sheet, apart from recording the test result, the participants were asked to rate their perceived exertion and to indicate how they had felt personally during the test (psychological assessment) and how they had felt regarding the group (social assessment). Every participant gave a score on these three scales, where 0 was the worst value and 10 was the best one. Perceived exertion was observed to be useful to determine the effort made by the participant, which was closely related to their own psychological and social circumstances. The psychological assessment allowed us to detect some cases of depression and the social assessment revealed that all participants had felt very good with the group while performing the tests. This was a goal set by the research team in order to motivate the participants to take the tests and to learn to perform them on their own for the future. These scales were not valid for participants under 12 years old or with intellectual disabilities, as they were not able to provide an accurate score or to understand what they were asked. The team developed pictorial questionnaires that worked well with children. This type of questionnaire could be further developed in the future in order to understand how these participants feel during the tests.

In summary, our team has detected the following differences between the traditional approach to health- or performance-related physical fitness assessment and our proposed approach:

Table 2. Comparison between the traditional physical fitness assessment and a health-related assessment

Physical Fitness Assessment (Performance or Health) from a traditional perspective	Physical Fitness Assessment from a health-related perspective (authors' proposal)
Based on performance (results).	Based on sedentarism and inactivity prevention.
The aim is to achieve the best results possible.	The aim is to achieve the minimum results that allow for differentiation between active and inactive or sedentary participants, although they are requested to perform as well as possible.
It is assumed that every test assesses the participant's health. Achieving a good result means having good health.	Tests are selected based on their functionality for daily living. The aim is to score higher than a minimum, which is considered the threshold for sedentarism.
Tests are selected based on age groups, sex and interests, and rarely based on functionality.	Tests that everyone (age, sex, interests, condition, health), at any age or under any circumstance can perform, are selected.
Unhealthy people are excluded or specific groups for people with impairments, injuries or diseases are created.	Tests that everyone can perform are selected (age, sex, interests, condition, health).
Test administration is instruction-based. Impartial judges are needed.	Tests are self-administered (own body knowledge), except in minors or non-autonomous people with disability. The professional acts as a guide/helper.
The judge announces the results and assesses them.	The participant assesses their own results and monitors their evolution over time.
Only the physical aspect is assessed: the result.	The aim is to assess the three aspects (physical, psychological and social) plus the environment.
The results need to be accurate.	The measurements need to be simple; error is minimised as much as possible, but is allowed as long as it is within reasonable limits. High accuracy is not necessary.
Additional aids are not allowed.	Additional aids are allowed if the participant needs them due to their health status (cane, walker, guide...).
Some tests entail high injury risk.	The selected tests entail a very low injury risk and do not require

	overexertion.
The material used may be very sophisticated.	The material used is simple and accessible everywhere and to everyone. The material and facilities do not need to be standardised or highly accurate.

We propose the creation of web-based health-related physical fitness databases worldwide.

These web pages should allow for anonymous data introduction for every test included.

One example is the Faculty of Sports of the University of Ljubljana in Slovenia, which coordinates the European network FitBack. It supports the monitoring of children and youth's physical fitness, which we consider exclusive. In the context of this project, a free online platform has been created (www.fitbackeurope.eu). It offers practical tools aimed at two main groups: a FitBack graphic report system available for teachers, trainers, doctors and parents to create and download information about physical fitness specific for their own performance standards; and key information available for policymakers at the national, regional or local level to assist them in establishing their own physical performance monitoring system for children in their region. This last aspect must be cautiously and ethically treated so that it does not lead to malicious interpretations.

There are also some examples of countries that are already implementing national physical fitness monitoring systems (e.g. SLOfit in Slovenia; Fitescoula in Portugal; NETFIT in Hungary; Serbian national system and Move! in Finland).

CONCLUSIONS

A new approach to the way of understanding, finding and administering health-related physical fitness tests was proposed.

The following tests were suggested: UKK walk test, chair stand test, arm curl test, back scratch test, chair sit-and-reach test and 20-m sprint test. A more functional alternative should be found for the arm curl test and a one-sided alternative test should be found for the back scratch test.

We should be able to establish a UNIVERSAL functional test battery that would allow us to determine the limits of human inactivity and how physical fitness varies around the world.

The following P25 and P75 values, which would correspond to the threshold values, have been obtained: 1,425s in the UKK walk test (P75), 6s in the 20-m sprint test (P75), 19 repetitions in the chair stand test (P25), 11 repetitions in the arm curl test (P25), -10.5cm in the back scratch test (P25), -17.5cm in the chair sit-and-reach test (P25). Can we talk about inactivity when referring to results

that are above these P75 or below these P25 values? Would they constitute the threshold for inactivity? A big-data policy could be useful to provide some general guidelines.

One major aim of the health-related physical fitness assessment should be not to exclude anyone.

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