

«Ponte al 100», a nationwide exercise and nutrition intervention program in Mexican children and Adolescents: study population and methodology

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ABSTRACT

Introduction: Mexico is the country with the highest prevalence of obesity in the world and ranks sixth in childhood obesity. Fueling this epidemic are physical inactivity and an unhealthy diet. Almost 60% of Mexican children are physically inactive. Physical fitness, an integrated measure of bodily functions involved in the performance of physical activity, is one of the most important markers of an individual's health status and its improvement has been shown to eliminate obesity related excess mortality. **Methods:** «Ponte al 100» is an ongoing, nationwide, prospective program that involves the evaluation of physical fitness and the prescription of an individualized dietary and physical activity schedule in order to improve physical fitness. After a baseline evaluation, follow-up evaluations are carried out on a trimester basis. Each evaluation involves gathering data on: (i) body composition; (ii) motor fitness; (iii) musculoskeletal fitness; (iv) cardiorespiratory fitness; and (v) neuropsychological fitness. All measurements are performed according to the Ponte al 100 manual. **Population:** Children

RESUMEN

Introducción: México es el país del mundo con más obesidad y el sexto en obesidad infantil. En el centro de esta epidemia están la inactividad física y los malos hábitos dietéticos. Aproximadamente el 60% de niños mexicanos son físicamente inactivos. La capacidad funcional, una medida que evalúa e integra todos los sistemas corporales involucrados en la realización de actividad física, es uno de los principales indicadores de la salud de un individuo, y su mejoría es capaz de anular el aumento en mortalidad atribuido a la obesidad. **Métodos:** «Ponte al 100» es un programa nacional y prospectivo en fase de reclutamiento que evalúa la capacidad funcional de los participantes y que prescribe un régimen dietético y de actividad física personalizada con el objetivo de mejorar la capacidad funcional. Se realiza una evaluación basal y mediciones subsecuentes trimestrales. En cada evaluación se obtienen datos sobre la composición corporal y las capacidades motora, musculoesquelética, cardiorrespiratoria y neuropsicológica. Todas las mediciones se realizan según el manual «Ponte al 100». **Población:** Niños y

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and adolescents attending official elementary schools throughout Mexico. Thus far, more than one million subjects have been enrolled. **Conclusion:** The emergence of the obesity epidemic is halting progress and prosperity of Mexico. The Ponte al 100 program is aimed at identifying and managing this problem through the evaluation of functional capacity. (REV MEX ENDOCRINOL METAB NUTR. 2016;3:175-81)

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Key words: Exercise. Obesity. Physical fitness.

SCIENTIFIC BACKGROUND AND JUSTIFICATION

Mexico is currently considered the country with the highest prevalence of obesity in the world¹. Approximately 70% of the Mexican adult population is either overweight or obese, but an even more worrisome scenario is a steadily increasing incidence of childhood obesity in the country¹. According to the Organisation for Economic Co-operation and Development (OECD), Mexico ranks sixth in childhood obesity, with almost one in three children being obese¹. The latest National Health and Nutrition Survey (ENSANUT) revealed that 9.7% of children under the age of five years, 34.4% of children between five and 11 years of age, and 35% of adolescents are either overweight or obese, with marked differences in different regions of the country^{2,3}.

Worldwide, the problem of obesity has reached epidemic proportions and obesity related comorbidities are among the most common causes of death⁴. Although the cause of the obesity epidemic is multifactorial, the two main culprits are undoubtedly physical inactivity and an unhealthy diet^{5,6}. Physical inactivity is responsible for 9% (5.1-12.5) of premature deaths worldwide and one of the main risk factors for most non-communicable diseases⁴. According to Mexico's ENSANUT 2012, 58.6% of children between 10 and 14 years of age and 22.7% of adolescents between the ages of 15 and 18 are considered to be physically inactive⁷. Physical activity significantly reduces the risk of all major causes of death⁴. It has been estimated that a 25% reduction in physical inactivity could save 1.3 million lives worldwide⁵. Avoiding physical inactivity would reduce

adolescentes que acuden a escuelas oficiales en todo México. Hasta el momento se ha enrolado más de un millón de sujetos. **Conclusiones:** La epidemia de la obesidad ha mermando el progreso y prosperidad de México. El programa «Ponte al 100» está dirigido a identificar y tratar este problema a través de la evaluación de la capacidad funcional.

Palabras clave: Obesidad. Ejercicio. Capacidad funcional.

all-cause mortality by 7.35% (95% CI: 5.88-8.83)⁸. Improving cardiorespiratory fitness of obese patients by means of a moderate-to-intense exercise program considerably decreases or even eliminates the risk of all-cause mortality, including cardiovascular and cancer-related mortality, independent of weight loss^{8,9}. Furthermore, increasing cardiorespiratory fitness usually leads to significant cognitive improvements, including memory and attention span, as well as psychological well-being¹⁰⁻¹².

An inverse relationship has been described between physical activity and all major health-related adverse outcomes, highlighting the need of developing effective methods for prescribing exercise that would avoid overexertion and unnecessary discomfort and would take into account the physiological adaptations associated with improved health^{8,13-15}. The latter can only be achieved by promoting physical fitness, which is an integrated measure of bodily functions (musculoskeletal, cardiorespiratory, endocrine and neuropsychological) involved in the performance of physical activity¹⁶. Physical fitness is one of the most important markers of an individual's health status and has become a robust predictor of cardiovascular and all-cause mortality, even beyond classical or conventional risk factors such as smoking, arterial hypertension, hypercholesterolemia and an elevated body mass index (BMI)¹⁷⁻¹⁹. A change in physical fitness from unfit to fit reduces the risk of all-cause mortality and cardiovascular mortality with RR of 0.56 (95% CI: 0.41-0.75) and 0.48 (95% CI: 0.21-0.74), respectively¹⁹. A recent meta-analysis demonstrated that the risk of all-cause mortality among physically fit obese individuals was similar to that of normal-weight fit individuals (HR: 1.21; 95% CI: 0.95-1.52)²⁰. In contrast to the inconsistent association between cardiopulmonary fitness and

neuropsychological performance, the benefits of physical fitness on neuropsychological performance has been clearly established²¹⁻²³. Physical fitness is also a useful parameter to evaluate the impact of interventions such as diet and exercise on health¹⁶.

Physical fitness measurement typically involves the evaluation of body composition, musculoskeletal fitness, motor fitness and cardiopulmonary fitness; unfortunately, however, neuropsychological fitness is seldom evaluated²⁴. This can be objectively measured in the laboratory, yet its use is limited in the school setting due to the necessity of sophisticated instruments, qualified technicians, and time constraints. Numerous batteries of field tests have been developed for this purpose and have proven to be a reasonable alternative since they are time-efficient, low in cost and equipment requirements, and can be easily administered to a large number of people simultaneously^{24,25}. Physical fitness is now being evaluated in several populations across the globe, especially in children²⁶⁻³⁰.

«Ponte al 100» (reach out to 100%) is a program developed by a physical education teacher and training coach (Professor Juan José Palacios) and a sports medicine specialist (Dr. Juan Manuel Herrera-Navarro) with the purpose of systematically prescribing individualized exercise schedules to children and adolescents attending official elementary schools throughout the entire Mexican territory. Initially validated by the National Sports and Physical Culture Commission of the Federal Government (Comisión Nacional de Cultura Física y Deporte [CONADE]), «Ponte al 100» is currently a program endorsed by the federal Ministry of Health. «Ponte al 100» has developed its own methods to evaluate and measure physical fitness and includes nutritional and dietary supervision. The purpose of the present report is to describe in detail the methodology and procedures used in the «Ponte al 100» program.

METHODS

Outline

«Ponte al 100» is an ongoing, nationwide, prospective program. Participating subjects undergo a baseline

evaluation before starting an individualized exercise and nutrition program. Follow-up evaluations are carried out every three months for six years in almost 10% of the global baseline evaluated population. Both the baseline and the follow up evaluations are carried out on two consecutive days and gather data in the following areas: (i) body composition (weight, height, BMI, weight on push-ups position, percentage of lean and fat mass, waist and hip circumference and arm span); (ii) motor fitness (arm, leg and abdomen muscle strength and flexibility); (iii) musculoskeletal fitness (equilibrium, speed and agility); (iv) cardiorespiratory fitness (maximal oxygen consumption during a 20-meter shuttle run test); and (v) neuropsychological fitness (memory and attention evaluated by a standard memory challenge test).

On day one, a physical activity and dietary habits questionnaire is filled out (see Appendix 1 in Supplementary Data), followed by the measurement of vital signs (resting oxygen saturation and heart rate), and anthropometric and neuropsychological parameters. On day two, anaerobic (strength, flexibility, speed and agility) and aerobic (20-m Shuttle run) tests are performed as part of the physical fitness indicators. All data are recorded on the “functional capacity data capture sheet” (see Appendix 2 in Supplementary Data).

All the information is entered into a digital platform that calculates the subject's physical fitness level (see Appendix 3 in Supplementary Data). The platform automatically generates a report explaining the subject's performance in each test as well as giving a personalized diet and physical activity prescription (see Appendix 4 in Supplementary Data). During each follow-up visit, the nutritional and physical activity parameters are reevaluated and a new physical fitness score is calculated, generating the pertinent modifications to the individual exercise and nutrition prescriptions.

Study population

The target population comprises children and adolescents attending official elementary schools throughout the entire Mexican territory. First, the State health and educational authorities are approached, seeking

authorization to implement the program. Although the studied population does not represent a random sample of the target population, most elementary schools, particularly those located in urban areas, participate in the program. Each authorized school was approached in the same way: students and parents, as well as teachers, are first invited to an informative meeting which takes place at the school campus and whereby the program is described in detail. Participation in the study is absolutely voluntary. At the end of the meeting, all attending parents receive an information brochure along with the appropriate consent forms (Appendix 5). Thus far, the program has enrolled over one million children and adolescents and data regarding the outcome of this intervention is currently being analyzed.

Also on a voluntary basis, teachers are invited to participate as evaluators. Those agreeing to participate undergo a training course whereby they learn the different measuring techniques, the appropriate handling of the equipment, and the registration of the data.

Measurements

Details on technical aspects of the equipment and procedures for measurements can be consulted in (see Appendix 6 and 7 in Supplementary Data), respectively.

Dietary and physical activity questionnaire

This is a 15-item, validated questionnaire that explores the frequency of intake of the major food groups, as well as the use of alcohol and recreational drugs; it also ascertains the baseline level of physical activity³¹ (Appendix 1).

Vital signs

Vital signs are obtained at rest and in a seating position. Heart rate and oxygen saturation are simultaneously measured by means of a pulse oximeter during at least three minutes. Blood pressure is measured by means of wrist digital Baumanometer®. If a pulse, blood pressure, or oxygen saturation reading is found to be out

of range (using the World Health Organization normal ranges for age and gender for children and adolescents aged 6-17), the participant is immediately referred to a primary care facility for evaluation and treatment and is excluded from the program.

Body composition

Height

Standing height is measured with a portable stadiometer, according to standard anthropometric guidelines, while the participant is standing straight on a Frankfurt plane. Seating height is measured using the same technique, but with the patient seated in the stadiometer platform. Seating height is used to establish the amount of work with sit-ups.

Weight and proportion of body fat

Total weight and body fat percentage are determined using a bioelectrical impedance scale (Tanita® model UM-081, Tanita International Division, UK).

Arm span

Arm span is measured with the subject standing, and upper limbs held horizontal, with palms facing upwards. For the purpose of this study, it is considered as the distance from the base of the hands (wrist) to the intersection of the inner surface of the limb with the pectoral muscles.

Waist and hip circumference

Waist and hip circumference are measured at the level of the umbilicus and pubic symphysis, respectively.

Postural assessment

A posturometer is used to assess three aspects of posture, namely left to right symmetry, anterior to

posterior symmetry, and type of footprint. The subject is placed in a standing position in the center of the posturometer. Left to right symmetry is evaluated with the examiner standing behind the subject to observe deviations of the spinal column, pelvis, or knees to the left or right of the central bar. Results for spinal column and pelvis are registered as left, normal, or right deviation. Knee symmetry is registered as varum, normal, or valgus. Anterior to posterior symmetry is evaluated with the examiner standing lateral to the subject and observing deviations of the upper spine to the back (kyphosis) and lower spine to the front (lordosis). Results are recorded as normal or backward for kyphosis, and normal or forward for lordosis. Type of footprint is classified as high arch, flat arch, or normal arch as observed by the examiner.

Equilibrium test

Equilibrium is evaluated on a rubber mat by asking the subject to stand on one foot (the dominant foot), with eyes closed and hands on hips, and the time (measured in seconds) that the subject can remain standing is registered. The best of three attempts is recorded.

Attention test

This is carried out using the memory challenge test by JIA®, played on Mode 2 and should take place in quiet area in order to avoid distraction. Briefly, the participant is asked to recall 10 randomly produced sequences of light and sound. Three attempts are allowed and the number of successfully recalled sequences is registered.

Exercise testing

Warm up

Several stretching routines are performed before the aerobic and anaerobic exercise tests, followed by 3-5 minutes of light aerobic exercise with speed increments.

Arm strength (push-ups)

The subject places himself in a horizontal position with body resting on the toes and the palms of the hands, with arms completely extended and perpendicular to the floor. The hands are separated at a distance that corresponds to the shoulder girth. The subject is asked to lower his/her body by flexing the elbows only until the chest touches the floor. The number of repetitions correctly performed in 30 seconds is recorded.

Abdominal strength (sit ups)

The subject lies on his/her back, hands crossed over the chest, and knees flexed to 90 degrees with respect to the floor. The number of flexions of the trunk beyond 90 degrees with respect to the floor is recorded on the result sheet.

Leg strength (vertical strength)

The subject is asked to stand lateral to a potentiometer, with the dominant arm horizontal and elbow flexed at 90 degrees with respect to the arm, and fingers extended. The height of the tip of the middle finger is recorded. The subject is asked to perform a vertical jump, keeping the trunk straight and the knees together. The maximum increment in height of the middle finger obtained after three jumps is recorded.

Flexibility test (V-sit test)

The subject sits on a mat with a measuring line between the legs, with the soles of the feet placed immediately behind the baseline, heels separated by a distance that corresponds to the shoulder width. The hands are clasped together, one on top of the other with palms facing down, and placed on the measuring line. With the legs held flat against the mat, the subject slowly reaches forward as far as possible. After two practice tries, the subject holds the third reach for two seconds while that distance is recorded. Care should be taken to ensure that there are no jerky movements, and that the fingertips remain level and the legs flat.

Speed and agility test

For this test, an area of 10 x 5 m is required. Five-meter long start and finishing lines are drawn. The distance between both lines is 10 m. Immediately before the start line and immediately after the finish line, three circles each measuring 30 cm in diameter are drawn in red, white, and green. Inside each of the three circles at the finish line, two wooden blocks, measuring 5 x 5 x 10 cm in size, are placed. The participant is asked to stand at the start line with his back facing the finish line. Upon the "ready" signal the participant is instructed to give a step forward and turn to face the finish line. Upon the "time" signal, the participant is instructed to run as fast as he can to the finish line, pick-up the first block with his right hand, and return to the start line where he should place the block into the corresponding circle at the start line. This procedure is immediately repeated using the left hand to pick-up the second block. The time required to complete this test is recorded in seconds.

20-meter shuttle run test

The 20-meter shuttle run (20MSR) test consists of one-minute stages of continuous, incremental speed running. The initial speed is 8.5 km/h, and increases by 0.5 km/h per minute. The individual is required to run between two lines 20 m apart, while keeping pace with audio signals emitted from a pre-recorded cassette or compact disk. The test ends when the individual fails to reach the end lines concurrent with the audio signals on two consecutive occasions. This test is used to estimate maximal oxygen consumption. All subjects are given instructions that if they should present any of the following symptoms during this test they should stop the test and inform the evaluator immediately: dyspnea, chest pain, nausea, dizziness, claudication of any extremity, and blurred vision.

Data storage

Data is stored on an online electronic platform, where each participant can only access his own data by means of a user name and password. Only members of the Ponte al 100 team can access participant data.

Calculation of functional capacity

For the calculation of physical fitness in quantitative terms, the results of each test are converted into units of power (Watt), and thus, the subject's capacity to perform work is quantified. This calculation, along with the exercise and dietary prescription, is performed automatically with the software Sistema Nacional de Desarrollo de la Capacidad funcional®, registration number 03-2014-061309405600-01. The exercise prescribed is directed at improving strength, agility, flexibility, and resistance of the different body parts and consequently physical fitness improves.

CONCLUDING REMARKS

There is extensive epidemiological and experimental evidence supporting the notion that physical inactivity and a sedentary lifestyle are deleterious to the general health of a population^{4,8,17-19}. This is true across the highly variable sociodemographic and economical strata of the world population¹⁹. Although some ethnic groups may be more susceptible than others to such deleterious effects, it can confidently be stated that promoting physical activity effectively reduces the incidence of several chronic diseases, such as obesity, diabetes, and the metabolic syndrome, and results in significant improvements in health-related quality of life^{19,20}. Over 80% of the Mexican population is comprised of Mestizo individuals who, like other ethnic groups with a significant Native-American genetic component, are particularly prone to develop these chronic conditions that ultimately lead to an increased cardiovascular risk². It is quite evident that the emergence of the obesity epidemic is halting the progress and prosperity of developing countries like Mexico. It is therefore of paramount importance to develop global strategies aimed at the early identification and management of this problem.

The «Ponte al 100» program is a nation-wide effort to evaluate the functional capacity of the school population of Mexico. It constitutes a large-scale project that is fully supported and endorsed by the federal Ministry of Health and, as of 2016, is backed up academically by

the Mexican Society for Nutrition and Endocrinology. Economic resources for this program are obtained through specific grants from private organizations, and the local state governments contribute financially as well, covering the stipend of the many physical education teachers that participate in the project. This program includes a personalized dietary and physical activity prescription, which is intended to improve the individual's physical fitness. This prospective cohort will enable us to study the effects of a dietary and exercise structured intervention in several aspects of childhood and adolescence health and development.

DECLARATION OF INTEREST

None of the authors has a conflict of interest.

SUPPLEMENTARY DATA

Supplementary data is available at *Revista Mexicana de Endocrinología, Metabolismo & Nutrición* (<http://www.endocrinologia.org.mx>).

This data is provided by the author and published online to benefit the reader.

The contents of all supplementary data are the sole responsibility of the authors.

REFERENCES

- Obesity update 2014. Available at: <http://www.oecd.org/els/health-systems/Obesity-Update-2014.pdf>. [Accessed 20 de June 2016].
- Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, et al. Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública (MX), 2012.
- Davila-Torres J, Gonzalez-Izquierdo JJ, Barrera-Cruz A. [Obesity in Mexico]. *Rev Med Inst Mex Seguro Soc*. 2015;53:240-9.
- Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*. 2012;380:219-29.
- The nutrition transition and obesity: FAO. Available at: <http://www.fao.org/FOCUS/E/obesity/obes2.htm>. [Accessed 20 June 2016].
- Stevens G, Dias RH, Thomas KJ, et al. Characterizing the epidemiological transition in Mexico: National and subnational burden of diseases, injuries, and risk factors. *PLoS Med*. 2008;5:e125.
- Medina C, Janssen I, Campos I, Barquera S. Physical inactivity prevalence and trends among Mexican adults: results from the National Health and Nutrition Survey (ENSANUT) 2006 and 2012. *BMC Public Health*. 2013;13:1063.
- Ekelund U, Ward HA, Norat T, et al. Physical activity and all-cause mortality cross levels of overall and abdominal adiposity in European men and women: the European Prospective Investigation into Cancer and Nutrition Study (EPIC). *Am J Clin Nutr*. 2015;101:613-21.
- Lee DC, Siu X, Blair SN. Does physical activity ameliorate the health hazards of obesity? *Br J Sports Med*. 2009;43:49-51.
- Harverson AT, Hannon JC, Brusseau TA, et al. Acute effects of 30 minutes resistance and aerobic exercise on cognition in a high school sample. *Res Q Exerc Sport*. 2016;87:214-20.
- Chang YK, Chi L, Etnier JL, Wang C-C, Chu C-H, Zhou C. Effect of acute aerobic exercise on cognitive performance: Role of cardiovascular fitness. *Psychol Sport Exerc*. 2014;15:464-70.
- Lees C, Hopkins J. Effect of aerobic exercise on cognition, academic achievement, and psychosocial function in children: a systematic review of randomized control trials. *Prev Chronic Dis*. 2013;10:E174.
- Ekelund U, Steene-Johannessen J, Brown WJ, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *Lancet*. 2016;388:1302-10.
- da Cunha FA, Farinatti Pde T, Midgley AW. Methodological and practical application issues in exercise prescription using the heart rate reserve and oxygen uptake reserve methods. *J Sci Med Sport*. 2011;14:46-57.
- Freedson PS, Cureton KJ, Heath GW. Status of field-based fitness testing in children and youth. *Prev Med*. 2000;31:S77-85.
- Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in childhood and adolescence: a powerful marker of health. *Int J Obes (Lond)*. 2008;32:1-11.
- Blair SN, Kohl HW 3rd, Paffenbarger RS Jr, Clark DG, Cooper KH, Gibbons LW. Physical fitness and all-cause mortality. A prospective study of healthy men and women. *JAMA*. 1989;262:2395-401.
- Blair SN, Kohl HW 3rd, Barlow CE, Paffenbarger RS Jr, Gibbons LW, Macera CA. Changes in physical fitness and all-cause mortality. A prospective study of healthy and unhealthy men. *JAMA*. 1995;273:1093-8.
- Kampert JB, Blair SN, Barlow CE, Paffenbarger RS Jr, Gibbons LW, Macera CA. Changes in physical fitness and all-cause mortality. A prospective study of healthy and unhealthy men. *JAMA*. 1995;273:1093-8.
- Kampert JB, Blair SN, Barlow CE, Paffenbarger RS Jr, Gibbons LW, Macera CA. Changes in physical fitness and all-cause mortality. A prospective study of healthy and unhealthy men. *JAMA*. 1995;273:1093-8.
- Barry VW, Baruth M, Beets MW, Durstine JL, Liu J, Blair SN. Fitness vs. fatness on all-cause mortality: a meta-analysis. *Prog Cardiovasc Dis*. 2014;56:389-90.
- Chomitz VR, Slining MM, McGowan RJ, Mitchell SE, Dawson GF, Hacker KA. Is there a relationship between physical fitness and academic achievement? Positive results from public school children in the north-eastern United States. *J Sch Health*. 2009;79:30-7.
- Kalantari HA, Esmaeilzadeh S. Association between academic achievement and physical status including physical activity, aerobic and muscular fitness tests in adolescent boys. *Environ Health Prev Med*. 2016;21:27-33.
- Andersen MP, Mortensen RN, Vardinghus-Nielsen H, Franch J, Torp-Pedersen C, Bøggild H. association between physical fitness and academic achievement in a cohort of Danish school pupils. *J Sch Health*. 2016;86:686-95.
- Ruiz JR, Castro-Piñero J, España-Romero V, Artero EG, Ortega FB, Cuenca MM, et al. Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. *Br J Sports Med*. 2011;45:518-24.
- Ortega FB, Cadenas-Sánchez C, Sánchez-Delgado G, et al. Systematic review and proposal of a field-based physical fitness-test battery in preschool children: the PREFIT battery. *Sports Med*. 2015;45:533-55.
- Catley MJ, Tomkinson GR. Normative health-related fitness values for children: analysis of 85347 test results on 9-17-year-old Australians since 1985. *Br J Sports Med*. 2013;47:98-108.
- Dobosz J, Mayorga-Vega D, Viciana J. Percentile values of physical fitness levels among Polish children aged 7 to 19 years--a Population-based study. *Cent Eur J Public Health*. 2015;23:340-51.
- Ortega FB, Artero EG, Ruiz JR, et al. Physical fitness levels among European adolescents: the HELENA study. *Br J Sports Med*. 2011;45:20-9.
- de Miguel-Etayo P, Gracia-Marco L, Ortega FB, et al. Physical fitness reference standards in European children: the IDEFICS study. *Int J Obes (Lond)*. 2014;38(Suppl 2):S57-66.
- Santos R, Mota J, Santos DA, Silva AM, Baptista F, Sardinha LB. Physical fitness percentiles for Portuguese children and adolescents aged 10-18 years. *J Sports Sci*. 2014;32:1510-8.
- L'Gamiz A, Palacios JJ, Peschard V, Rodríguez E. Validación de un Instrumento de Evaluación de la Capacidad Física en Individuos. *Revista del Centro Estatal de Vigilancia Epidemiológica y Control de Enfermedades*. 2014;1:11-6.