

# 1.2 Examinations, assessments and monitoring

## The medical examination prior to participating in sports

### From the beginner to the professional

*Dr. Franchek Drobnic*

Continuous and regulated participation in a physical activity, in other words, playing sport during childhood, implies a risk of injury or functional alteration that can be damaging for the development and growth of the child or adolescent. Even at the professional level, the physical examination prior to starting an activity of this type is a habit that should be continued, not only to prevent possible injuries but also to offer guidance on best practices in exercise and correct sporting habits.

The health examination prior to playing sports or at the start of the regular season seeks mainly to keep the athlete safe during physical activity, and to detect illnesses or physical alterations that could turn taking part in physical exercise into a health risk.

Specifically, the medical examination performed prior to physical activity must have the following objectives:

- Identifying processes that impede or limit performance or participation in a sport.
- Diagnosing pathologies that may respond to treatment, as well as any undetected or asymptomatic illness.
- Prescribing a treatment or a rehabilitation plan with specific procedures.
- Preventing injuries through the identification and treatment of musculoskeletal alterations, especially injuries that have not been properly rehabilitated.
- Providing guidance to the athlete on which activities he can or should do, in order to improve his performance and safeguard his health.
- Satisfying legal and medical insurance requirements.

Every athlete must receive a medical examination at least once a season, and elite athletes should do so as required by events. It is totally incorrect to think that the elite athlete is a healthy individual. Many of the problems that appear in the context of sports might have been prevented by a thorough, periodic medical examination. (Drobnik, 2007, <https://goo.gl/jqFREH>).

The examination carried out prior to participation in sports must take place at least four weeks before the start of play in order to allow the individual to begin rehabilitation or take therapeutic measures, if necessary. An annual check-up is necessary, and additional monitoring or testing are not required, except for a specific reason, in which case the specialist physician will be responsible.

### **Tests that must be carried out**

- 1)** Medical examinations for an individual's participation in sports have some basic and fundamental features. The medical history, with emphasis on individual and family histories of cardiorespiratory and circulatory pathologies (sudden death, acute myocardial infarction, diabetes, asthma, etc.), and chronic or hereditary conditions. In addition to this, a complete physical examination and a resting twelve-lead electrocardiogram are essential. It is assumed that the physician who makes the assessment knows how to ask, examine, and interpret the verbal or physical responses (the signs and symptoms) – aspects that we shouldn't forget. (Table 1) (Drobnik and Serra-Grima, 2009).

**Table 1: Description of the different parts of a medical examination for participation in athletic activity**

| Medical examination category                         | <i>Basic -MSC-</i> | Type I             | Type II                     | Type III             | Type III P                                  |
|--|--------------------|--------------------|-----------------------------|----------------------|---|
|  |                    | Initiation         | Refinement                  | Competition          | Performance                                 |
| Sport  |                    | Up to 13 years old | Between 14 and 17 years old | > 17 years old       | Professionals or test of physical condition |
| Physical exercise                                    |                    | Up to 17 years old | Between 18 and 34 years old | 35 years old or over |   |
| Medical History (individual and family)              | X                  | X                  | X                           | X                    | X   |
| Physical examination (general by systems)            | X                  | X                  | X                           | X                    | X   |
| Examination of the musculoskeletal system            |                    | X                  | X                           | X                    | X   |
| <b>Complementary tests</b>                           |                    |                    |                             |                      |   |
| Electrocardiogram (ECG)                              | X                  | X                  | X                           | X                    | X   |
| Echocardiogram <sup>1</sup>                          | X                  |                    |                             | X                    | X   |
| Spirometry   |                    | X <sup>2</sup>     | X <sup>2</sup>              | X                    | X   |
| Sudden cardiac death (SCD) genetic test <sup>2</sup> | X                  |                    |                             |                      |   |
| Static podoscope examination                         |                    | X                  | X                           | X                    | X   |
| Basal parameters                                     |                    | X                  | X                           | X                    | X   |

<sup>1</sup> This is recommended at least once in an athlete's life in sports. If it was carried out prior to biological maturation, it is advisable to repeat it after the age of 18.

<sup>2</sup> Subject to medical discretion.

|  |   |                  |                  |                  |                  |
|--|---|------------------|------------------|------------------|------------------|
| Basic anthropometry  |   | X                |                  | X                | X                |
| In-depth anthropometry   |   |                  | X                | X                | X                |
| Submaximal ergometer test <sup>2</sup>   |   |                  | X                | X                | X                |
| Maximal ergometer test   | X |                  |                  | X                | X                |
| Indirect calorimetry test with assessment of exhaled air, lactate, etc. <sup>3</sup> |   |                  |                  | X                | X                |
| <b>Documentation</b>   |   |                  |                  |                  |                  |
| Informed consent <sup>4</sup>  | X | X                | X                | X                | X                |
| Sports medical record  | X | X                | X                | X                | X                |
| Medical Clearance for Sports <sup>5</sup>  | X | X                | X                | X                | X                |
| Monitoring of pathologies  |   | X                | X                | X                | X                |
| Others*  |   | X                | X                | X                | X                |
| <b>Approximate time</b>  |   | <b>20-30 min</b> | <b>30-45 min</b> | <b>45-60 min</b> | <b>60-90 min</b> |

Source: Prepared by the author

## Medical History

The Committee on Sports Medicine and Fitness of the American Academy of Pediatrics has defined two standard protocols for the rapid compilation of a sufficiently comprehensive medical history. It is important to consider all the systems and structures that could manifest an existing or latent problem

<sup>3</sup> Indicated only for subjects with a clinical or family history that would suggest that it is necessary.

<sup>4</sup> From the parents or guardians, if the individual is a minor.

<sup>5</sup> Medico-legal document containing publically available medical information for general use.

caused by sporting activity. There's a reason why exercise is good at "making loose screws rattle." The following is a health questionnaire for participation in sports, created by the American Academy of Pediatrics in 1991 (Fig. 1).



Figure 1. Health questionnaire for participation in sports

Initial History Questionnaire

FORM COMPLETED BY \_\_\_\_\_ DATE COMPLETED \_\_\_\_\_

**Name** \_\_\_\_\_

**ID NUMBER** \_\_\_\_\_

**BIRTH DATE** \_\_\_\_\_ **AGE**

Household

Please list all those living in the child's home.

| Name | Relationship to child | Birth date | Health problems |
|------|-----------------------|------------|-----------------|
|      |                       |            |                 |
|      |                       |            |                 |
|      |                       |            |                 |
|      |                       |            |                 |
|      |                       |            |                 |
|      |                       |            |                 |

Are there siblings not listed? If so, please list their names, ages, and where they live. \_\_\_\_\_

What is the child's living situation if not with both biological parents?  
 Lives with adoptive parents    Joint custody    Single custody  
 Lives with foster family

If one or both parents are not living in the home, how often does the child see the parent(s) not in the home?  
 \_\_\_\_\_

Birth History ■ Don't know birth history

Birth weight \_\_\_\_\_ Was the baby born at term? \_\_\_\_\_ OR \_\_\_\_\_ weeks  
 Were there any prenatal or neonatal complications?  
 Yes    No   Explain \_\_\_\_\_

Was a NICU stay required?    Yes    No   Explain \_\_\_\_\_

During pregnancy, did mother  
 Use tobacco    Yes    No   Drink alcohol    Yes    No  
 Use drugs or medications    Yes    No    Used prenatal vitamins  
 What \_\_\_\_\_ When \_\_\_\_\_

Was the delivery    Vaginal    Cesarean   If cesarean, why? \_\_\_\_\_

Was initial feeding    Formula    Breast milk   How long breastfed? \_\_\_\_\_

Did your baby go home with mother from the hospital?  
 Yes    No   Explain \_\_\_\_\_

General DK = don't know

Do you consider your child to be in good health?    Yes    No    DK   Explain \_\_\_\_\_

Does your child have any serious illnesses or medical conditions?    Yes    No    DK   Explain \_\_\_\_\_

Has your child had any surgery?    Yes    No    DK   Explain \_\_\_\_\_

Has your child ever been hospitalized?    Yes    No    DK   Explain \_\_\_\_\_

Is your child allergic to medicine or drugs?    Yes    No    DK   Explain \_\_\_\_\_

Do you feel your family has enough to eat?    Yes    No    DK   Explain \_\_\_\_\_

Biological Family History DK = don't know

Have any family members had the following?

|   |                              |                             |                             |           |                |
|---|------------------------------|-----------------------------|-----------------------------|-----------|----------------|
| Childhood hearing loss                        | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Nasal allergies                               | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Asthma  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Tuberculosis                                  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Heart disease (before 55 years old)           | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| High cholesterol/takes cholesterol medication | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Anemia  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Bleeding disorder                             | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Dental decay                                  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |
| Cancer (before 55 years old)                  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who _____ | Comments _____ |

(Biological Family History continued on back side.)

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Initial History Questionnaire



| Biological Family History <small>(Continued from front side.)</small> DK = don't know  |                              |                             |                             |         |  |          |
|--|------------------------------|-----------------------------|-----------------------------|---------|--|----------|
| Liver disease  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Kidney disease   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Diabetes (before 55 years old)   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Bed-wetting (after 10 years old)   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Obesity  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Epilepsy or convulsions  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Alcohol abuse  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Drug abuse   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Mental illness/depression  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Developmental disability   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Immune problems, HIV, or AIDS  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Tobacco use  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Who     |  | Comments |
| Additional family history _____  |                              |                             |                             |         |  |          |
| Past History DK = don't know   |                              |                             |                             |         |  |          |
| Does your child have, or has your child ever had,  |                              |                             |                             |         |  |          |
| Chickenpox   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | When    |  |          |
| Frequent ear infections  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Problems with ears or hearing  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Nasal allergies  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Problems with eyes or vision   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Asthma, bronchitis, bronchiolitis, or pneumonia  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Any heart problem or heart murmur  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Anemia or bleeding problem   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Blood transfusion  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| HIV  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Organ transplant   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Malignancy/bone marrow transplant  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Chemotherapy   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Frequent abdominal pain  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Constipation requiring doctor visits   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Recurrent urinary tract infections and problems  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Congenital cataracts/retinoblastoma  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Metabolic/Genetic disorders  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Cancer   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Kidney disease or urologic malformations   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Bed-wetting (after 5 years old)  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Sleep problems; snoring  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Chronic or recurrent skin problems (eg, acne, eczema)  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Frequent headaches   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Convulsions or other neurologic problems   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Obesity  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Diabetes   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Thyroid or other endocrine problems  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| High blood pressure  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| History of serious injuries/fractures/concussions  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Use of alcohol or drugs  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Tobacco use  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| ADHD/anxiety/mood problems/depression  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Developmental delay  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Dental decay   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| History of family violence   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Sexually transmitted infections  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Pregnancy  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| (For girls) Problems with her periods  | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> DK | Explain |  |          |
| Has had first period   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | Age of first period         |         |  |          |
| Any other significant problem _____  |                              |                             |                             |         |  |          |
| <p><b>This American Academy of Pediatrics Initial History Questionnaire is consistent with <i>Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents</i>, 3rd Edition.</b></p> <p>The recommendations in this publication do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.</p> <p>Copyright © 2010 American Academy of Pediatrics. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher.</p> |                              |                             |                             |         |  |          |
| HE0328   |                              |                             | 9-223/0109                  |         |  |          |

Source: American Academy of Pediatrics, 1991.



## Physical Examination

After compiling the player's medical history, a thorough physical examination should be carried out via proper exploration of structures and systems. This involves detecting possible alterations that might temporarily or permanently impede participation in sports. This examination will also be useful as a reference against which to evaluate the player's progress, either in relation to growth or to training, or in the event that the player receives an injury during the season.

Periodicity: this must take place annually, both at the beginner and professional levels.

**Assessment of the musculoskeletal system:** carrying out the simple basic tests described in Table 2 allows us to assess an athlete's musculoskeletal system – both comprehensively and with a high level of accuracy. The physician must not only assess possible muscular weaknesses in terms of their symmetry, but should also evaluate signs of discomfort when movements are made, given that the patient may attempt to hide a symptom, fearing that he may be disqualified from a particular athletic activity.

**Table 2: Comprehensive assessment of the musculoskeletal system**

| Procedure or instructions  | Observation  |
|--|--|
| Stand before the examining physician.  | Acromioclavicular joints. General bearing.                             |
| Look at the ceiling and at the floor. Touch ears with shoulders.                 | Mobility of the cervical spine.  |
| Raise shoulders against resistance.  | Strength of the trapezium.   |
| Lift arms to 90°. With resistance from the examining physician.                  | Strength of the deltoids.  |
| External and total rotation of the arms.   | Mobility of the shoulder.  |
| Flexion and extension of the elbow.  | Mobility of the elbow.   |
| Both arms to the side and elbows at 90°, pronation and supination of the wrists. | Mobility of the elbow and the wrist.                                   |
| Extension and flexion of the fingers, making a tight fist.                       | Mobility of the hands and fingers, assessment of possible deformities. |
| Contract, then relax, quadriceps.  | Symmetry and mobility of the kneecaps.                                 |
| Walk forwards like a duck, touching the heels to the buttocks.                   | Mobility of the hip, knee, and ankle.                                  |
| Turn away from the examining physician.  | Symmetry of back and shoulders (scoliosis).                            |
| Touch toes while keeping knees straight.   | Scoliosis, mobility of the hip, strength of the ischial musculature.   |
| Stand on tip-toes, then rock back onto heels.                                    | Symmetry and strength of the calf muscles.                             |

Source: Adapted from De Smith, 1983.

*This examination takes one-and-a-half minutes. It is designed to reveal orthopedic anomalies in those individuals who have not been previously examined or who have undergone physical alterations that have not been rehabilitated (or have been rehabilitated incorrectly) which might affect their athletic performance.*

Evaluation of the state of bone maturity: if this is considered necessary, it is because the patient has not reached his adult height and therefore needs a growth study. Bone age and chronological age may not correspond. This information is useful as a guideline for the intensity of the workload. For example, in order to begin training related to muscle strength, in the identification of sporting talent, or to estimate the prognosis of certain pathologies (scoliosis in children, spondylolysis, etc.). This test can be carried out twice a year, so that an accurate prediction of the patient's height over time can be made. Greater frequency does not yield more information.

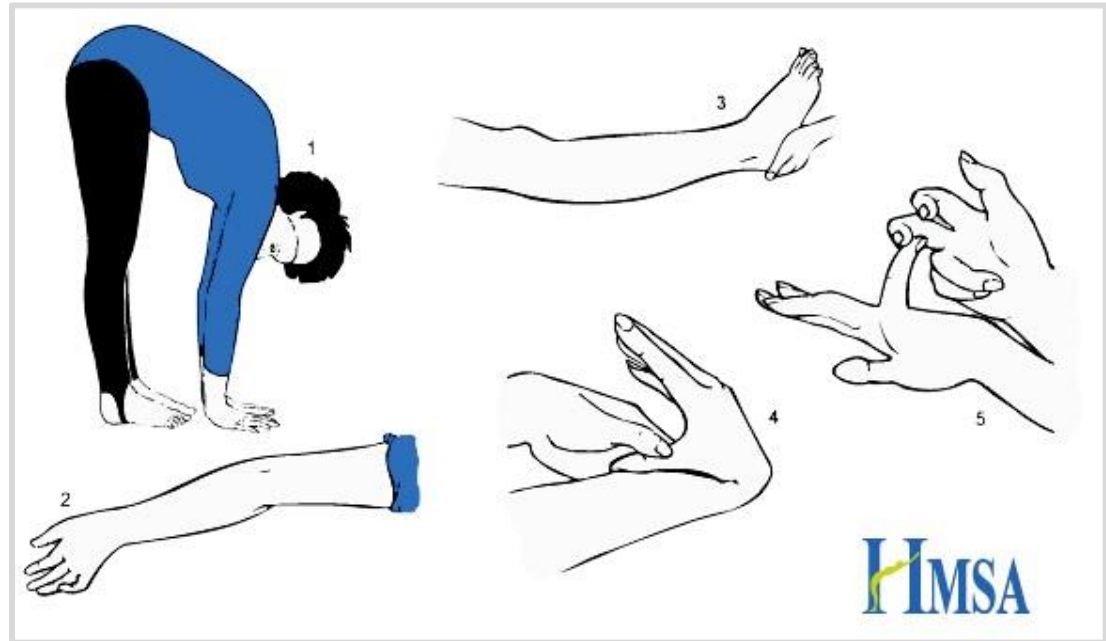
Assessment of ligamentous laxity: it is known that ligamentous hyperlaxity can predispose a patient to suffering certain injuries with increased frequency. This point is expounded upon brilliantly in Drobnic F. Puigdemívol J and Bove A (2009). While the Hospital del Mar scale (Barcelona, Spain) is quite complete and will provide the physician with a great deal of information, we believe that the Beighton Scale (1973), with nine simple tests, will indicate whether an athlete does or does not suffer from hyperlaxity (Table 3). This will allow us to recommend complementary tests in order to diagnose other possible anomalies which could affect not just athletic performance, but also the health and future of the athlete (collagen disorders, coagulation disorders, valvular diseases, etc.). It will allow us to arrange for appropriate preventative measures.

**Table 3**

| <b>Beighton Criteria (1973) for ligamentous hyperlaxity</b>  | <b>R</b> | <b>L</b> |
|--|----------|----------|
| Passive dorsiflexion of the 5th finger beyond 90°.   | 1        | 1        |
| Passive apposition of the thumbs to the superficial flexor muscles of the forearm.                       | 1        | 1        |
| Active hypertension of the elbows beyond 10°.  | 1        | 1        |
| Hyperextension of the knees beyond 10°.  | 1        | 1        |
| Forward flexion of the trunk, with the knees extended, so that the palms of the hands rest on the floor. | 1        |          |
| TOTAL  |          |          |
| Positive if → 5 points   |          |          |

Source: Beighton (1973)

**Figure 2: Beighton ligamentous hyperlaxity score**



Source: Retrieved from [goo.gl/jLnZRFcontent\\_copy](http://goo.gl/jLnZRFcontent_copy)

## **Differential diagnosis of excessive growth**

This should be performed on a player who is new to the team, especially if she is still growing. This is discussed in a separate chapter, given its particular relevance to this sport.

## **Respiratory system**

The physician should carry out a visual examination of the structure of the thorax in order to identify anomalies or deformations that could indicate growth-related diseases or possible respiratory system difficulties. Front and back auscultation of the thoracic cavity should be carried out, in a symmetrical and comparative fashion. The mobility of the thorax should also be evaluated and the thoracic girth measured (Hirtz index). This examination should be complemented by a forced basal spirometry test. A quick examination of the upper respiratory tract should be carried out (nasal permeability, pharynx, lymph node pathologies, etc.), which will no doubt help to flesh out the medical history. In theory, a chest x-ray is not required, although it might be recommended in order to quantify the development of a previous illness, or to prevent a current asymptomatic disease (bronchiectasis, fusion of the pleura, primary nodules, hilar lymph node pathologies, scarring, etc.).

## **Cardiovascular system**

The correct functioning of the cardiovascular system is vital for performing physical exercise. We will therefore give it our full attention. We first perform auscultation, and will take the peripheral pulse rate, the heart rate, and the blood pressure. The examination is completed with a resting electrocardiogram (ECG). This is both necessary and obligatory during the examination of every athlete, whatever their age or level, since it provides a great deal of information and can be performed easily. Although an echocardiogram is required for professional athletes, it is a study that everyone should have every two or three years, provided that there are no anomalies.

## **Abdomen**

Examine the athlete while he is lying on the examining table with his knees and hips flexed, and also in a standing position in order to rule out visceromegaly and potential hernias. This examination can also be used to assess the tone of the abdominal musculature, the rectus sheath, and the oblique muscles, with the objective of preventing future weaknesses. Experience suggests that the presence of hernias or painful orifices should prompt preventive action. We should take advantage of the abdominal examination to check for axillary and inguinal lymph node pathologies.

## **Genitals**

This examination is necessary to evaluate the sexual maturation of both males and females. (Tanner stages). Through this, we can profile the development of the athlete with respect to his or her chronological age. This is an obligatory complement to the evaluation of maturity made via x-rays.

## **Nervous system**

Emphasize the testing of deep tendon reflexes. Rule out potential equilibrium disorders originating in the vestibular or cerebellar systems. A quick check of the cranial nerves is recommended.

## **Lymphatic system**

Assess the state of the cervical, inferior maxillary, axillary, and inguinal gangliated cords.

## Complementary tests

### Nutritional analysis

It is important to know the athlete's nutritional habits, in order to establish the level of any mineral or vitamin deficiency, and to detect any potential imbalance in the ingestion of macronutrients. To do this, it is necessary to qualitatively investigate the athlete's daily intake, rather than just checking his weight. The dietary questionnaire consists of the recording, and later assessment of all the foods ingested in the course of a week. The weight of the food ingested, how it was cooked, and when it was eaten should all be recorded. This assessment provides us with information on the athlete's general habits, and gives us a breakdown of the different nutrients. This in turn helps us to be objective in the detection of existing irregularities, and to make the pertinent corrections. We can adapt dietary guidelines in order to meet the specific training objectives of different periods of the season. The athlete should adapt her diet to fit her training and competition schedule. (López, 2010, <https://goo.gl/nKwFeH>).

Personnel: nutritionist trained in sports nutrition.

Materials: software designed for diet analysis.

Periodicity: This must be annual, both at the beginner and professional levels, and monitoring must be carried out depending on the medical history of the athlete.

### Body Composition

Kinanthropometry is the study of the human being in movement. This discipline helps us to describe and quantify the physical characteristics of athletes. Anthropometric data is processed in order to obtain information on body composition, somatotype and proportionality. This enables us to assess the morphological characteristics, and to track them over the course of the season. It is also used in the detection of sporting talents, in the study of growth and maturation of young players, and in the tracking of players who must follow special diets. This topic will be dealt with more deeply in a later chapter.

Personnel: personnel qualified to carry out measurements.

Materials: plicometer (also called a pachymeter or an anthropometer), measuring tape, calipers, scales with a precision of 10 g to 150 kg, height rod, horizontal height rod.

Periodicity: quarterly, to begin with. More specific monitoring should be carried out depending on the athlete's medical history and performance objectives.

## **Vision test**

Since good eyesight is important for playing sport, it is useful to carry out a simple eye exam (optometry) in order to make an initial assessment. On the basis of this examination, the specialist can add additional tests. This is an essential part of new medical records.

Personnel: a specialist physician for the optometry.

Materials: materials related to optometry.

Periodicity: This must be annual, both at the beginner and professional levels, and monitoring must be carried out depending on the medical history of the athlete.

## **Dental examination**

This is an essential part of new medical records, and should also be carried out at the beginning of each season. A badly treated cavity, a loose tooth or a septic mouth can cause an oral infection that could prevent a player from training or competing for a specific period, to the detriment of her team or club.

Personnel: physician

Periodicity: must be performed annually, both at the beginner and professional level.

## **Resting Electrocardiogram**

An essential test for athletes over 30 years of age, and for the elite athlete. It is a simple and inexpensive test that yields a great deal of information. We must study the individual characteristics of the elite athlete's electrocardiogram, in order to detect and monitor pace disorders, vagal hypertrophy, myocardial hypertrophy, or alterations in repolarization. So-called "athlete's heart" must only be accepted if hypertrophic cardiomyopathy has been ruled out.

Personnel: A graduate nurse, evaluated by a specialist physician.

Materials: an electrocardiogram.

Periodicity: must be performed annually, both at the beginner and professional level.

## **Echocardiogram**

This test is advisable for any athlete who wishes to obtain elite status, since it allows us to rule out structural cardiac pathologies, such as hypertrophic cardiomyopathy (the principal cause of sudden death in athletes under the age of 25). Although these are rare, an echocardiogram is an important test to have. In athletes over 30, and in student athletes, this test is recommended when the medical history or physical examination suggest cardiovascular disease. It is a basic tool in the detection of excessive growth disorders.

Personnel: physician specializing in echocardiography. An experienced cardiologist must be made available.

Materials: ultrasound machine, gel.

Periodicity: At the professional level it should be annual, and at the beginner level it should be carried out every two or three years, if there is no clinical need.

## **Baseline forced vital capacity spirometry test**

This is an essential examination for any athlete. It enables us to observe the static values for pulmonary ventilation, and, indirectly, the capability of the respiratory musculature. It helps to diagnose and indicate the presence of chronic obstructive, restrictive, or mixed respiratory processes, even if these have not previously been noticed. Furthermore, it is a good tool with which to monitor treatment and its progress. It is an inexpensive and simple test that yields a great deal of information and is therefore obligatory prior to any stress test.

Personnel: An expert in the test (a graduate nurse, or a physician).

Materials: a spirometer that enables us to obtain a flow chart, disposable mouthpieces, and thermal paper.

Periodicity: If no clinical need exists, it should be administered annually both to beginners and to professional athletes.

## Stress Test

This test enables us to observe the response of the metabolic, cardiovascular, and respiratory systems to exercise. According to current general consensus, it is not necessary to perform this test on individuals under 45 who exercise regularly and do not present any unusual symptoms. However, we believe that a sports medicine examination would not be complete if we did not assess the cardiovascular and respiratory response of the body to exercise. The test must be simple and applicable to any player, whatever their age or skill level. For professional players, a maximal exertion test is recommended, with cardiac monitoring (using an ECG) and calorimetric measurement (in order to assess the consumption of oxygen and the elimination of anhydrous carbon), at least at the start of the season. In the case of new medical records, we recommend that everyone, of any age, should have this test; for professional athletes, we recommend it at the beginning of every season. Of course, whenever cardiorespiratory or metabolic pathologies, or a lack of cardiorespiratory adaption, are suspected, this test should be performed at any point during the season. During the assessment, the ergometer can be a cycloergometer or a treadmill, in accordance with the subject's ability to run, the presence of recent injuries, or an ongoing recovery process. It must be considered that a common drawback of the cycloergometer is that the pedals and straps are small, the bicycle seat is often short, as is the distance between the bicycle and the handlebars, and the bicycle seat cannot be adjusted to at a height that allows for the proper extension of the extremity that is used for pedaling. Furthermore, the crank corresponding to the pedal is short for a very tall player, and the range of circular motion is small. This isn't particularly relevant if we only intend to submit the athlete to a progressive routine in order to evaluate the correct response of the metabolic systems to differing workloads, and we are not attempting to establish a working model based on the workload of routines that have been performed.

The protocol must be the same for all members of the team and must be known to the examiner from the testing laboratory that performs the functional tests. It is recommended that this be a progressive, triangle test which includes peak exertion. The speed at the beginning of the test is 6-8 km/h, and an increase in speed of 1 km/h is made each minute until the maximal sustained exertion is achieved. The incline is kept at 1%, and must not exceed 3% in any case.

Personnel: a physician who is an expert in stress testing and a graduate nurse.



Materials: ergometer, treadmill or cycloergometer, indirect calorimetric measurement system with a built-in ECG display, and a crash cart with a cardioverter system. While not essential, a lactate analyzer can be an interesting complement to a player's evaluation.

Periodicity: As a baseline in new medical records, and whenever necessary for clinical guidance if assessments are made in the field.

## **X-ray examination**

**Muscle ultrasound:** of recent injuries or those from the previous season, for new medical records, or when there is a doubt about the healing process.

**Regular X-Ray:** of the joints involved in each sport (ankles, hands, knees, hips, or the lumbar spine), and of those joints that have suffered injuries. For new medical records belonging to players at a professional level. If the clinical examination or the patient's pathological history makes us suspect some type of injury, other studies, such as a CAT scan (computed axial tomography) or an NMR scan (nuclear magnetic resonance) are recommended.

**Magnetic resonance:** this is not justified at any age as a standard test for new medical records. However, our experience suggests that for the medical records of professional athletes, it is a useful diagnostic procedure, and an important reference, due to the diverse, and often florid, lumbosacral pathologies seen in this class of athletes. We believe that it should be performed if the means and opportunity are available.

**Periodicity:** on the basis of, and depending on, medical history. In the case of professional athletes, it must be performed annually and as determined by their medical history.

**Table 4: Basic X-Ray Examination**

|                       | Regular x-ray           | Ultrasound           | NMR                       |
|-----------------------|-------------------------|----------------------|---------------------------|
| Location              | Projection              |                      |                           |
| Thorax                | AP and profile          | Patellar             | Lumbar Spine <sup>7</sup> |
| Lumbar spine          | AP and lateral          | ligament             |                           |
|                       | Obliques <sup>1</sup>   | Achilles             |                           |
| Knees                 | AP and lateral          | tendon               |                           |
|                       | Axials <sup>1</sup>     |                      |                           |
| Ankles                | Sideways                | Ischial              |                           |
|                       | Oblique                 | Muscle <sup>1</sup>  |                           |
| Feet                  | AP                      | Quadriceps           |                           |
|                       | Sideways                | muscle               |                           |
| Wrist and hand        | AP                      | Rotator cuff         |                           |
| Shoulder <sup>1</sup> | Special AP              | muscles <sup>1</sup> |                           |
| Cranium <sup>6</sup>  | Lateral (Sella turcica) |                      |                           |

### Podiatric study

It is always advisable to carry out both a static and dynamic podiatric study. Its main objective is the prevention of certain pathologies, as well as to improve an athlete's performance. Through the use of a static podiatric study, it is possible to assess the structure of the foot and to evaluate its axes and pressure points, as well as its relationship with the rest of the lower extremity. In order to do this, a podoscope with a mirror can be utilized. On the basis of this simple study, a decision can be made whether to request more comprehensive dynamic podiatric study. This study consists of recording images using a complex piece of equipment that allows for the storage of all the data so that it might be analyzed later using a specific software program. This study should be performed on professional athletes, as well as on all athletes who experience discomfort when practicing their sport.

Our experience has shown that there are two main areas to check during the physical examination of the athlete: foot hygiene and toenail care. Orientation must be given to the athlete on these points. An irregular growth, a dystrophic nail, or deficient hygiene can cause a pathological alteration that may result in sidelining an athlete for several days. An effective

<sup>6</sup> Shoulder and cranium: Performed depending on medical history

<sup>7</sup> Place in the professional record whenever possible



prevention program based mainly on education, would be useful and well-received by the player.

Periodicity: on the basis of, and depending on, medical history. In the case of professional athletes, annually.

## **Evaluation of strength manifestation**

The general objectives that lead us to assess the different manifestations of strength include the making up of a dynamometric profile within the set of characteristics that are specifically required for participation in sports. In the case of an injury, this information will be useful to monitor the progress of the rehabilitation process. Thus, we will be able to determine the progress made in the training program given by the physical trainer over the course of the season. Specifically, we can evaluate the potential imbalances between different muscle groups. As a simple test, the throwing of a medicine ball is useful for evaluating the upper body, and the vertical jump test is useful for evaluating the lower body. There are also tests that require more sophisticated technology, which is not accessible to most clubs (Bosco ergo jump tests, and isometric tests). A test of the abdominal muscles should also be included, as well as an assessment of the lumbar musculature (the athlete's lumbar pathologies, strength evaluation, etc.). It is important to evaluate the athlete's flexibility (flexibility box test) in order to schedule the stretching exercises necessary.

Periodicity: this must take place annually, both at the beginner and professional levels, if no clinical need exists.

## **Blood Analysis**

A complete blood count or urinalysis is especially recommended for new medical records and at the beginning of each season. At regular intervals during the season, it is often useful to carry out a partial blood test, a complete blood count, or to test for parameters associated with a muscular injury or hormonal system overload. Our experience has shown us that doing complete analyses every two or three months does not yield any practical information. It is a significant expense for the club and creates an aversion to the test on the part of the athlete, whose cooperation with us is important.

Remember that it isn't clear whether iron deficiencies without anemia affect physical performance. However, this empirical indication will always persist, based on the fact that iron has been found to play an implicit role in

the production of hemoglobin, in addition to various enzymatic reactions of the body. Iron deficiency anemia is frequently found among adolescent girls and sportswomen, particularly those who play endurance sports, run, cycle, etc. An athlete can benefit from the monitoring of serum iron, transferrin, and ferritin, but above all from the transferrin saturation index.

As a form of preventive medicine, and on account of the training athletes receive, the analysis of a new medical record for a professional athlete requires obligatory serologic tests for infectious diseases, hepatitis, the human immunodeficiency virus, the Epstein-Barr virus (EBV), cytomegalovirus, chlamydia pneumoniae, and paramyxoviruses, at the discretion of the club's health service. We require the EBV analysis because this virus can cause systematic symptoms, affecting the musculoskeletal system and resulting in feelings of fatigue. Additionally, an assessment of IgG (immunoglobulin G) basal cells allows us to identify possible later contacts and to make or confirm a diagnosis that may be ruled out for other reasons. With respect to intracellular respiratory bacteria, it is useful to take an objective measurement of the level of response in players with a history of asthma or respiratory diseases, above all those who have suffered recurring infections of the upper respiratory tract. Our experience of paramyxoviruses indicates that making a one-time assessment of the level of response to the mumps virus, and then vaccinating those athletes who present this characteristic, ensures that the illness will not appear (although its absence does not indicate a lack of immunity). However, it is unusual in adults from a country with an adequate vaccination schedule. In order to obtain information on certain infectious diseases, authorization is required from the subject of the analysis.

Personnel: A graduate nurse.

Materials: a contracted clinical analysis laboratory.

Periodicity: On the basis of, and depending on, medical history. In the case of professional athletes, a complete quarterly analysis. In very active subjects, it is often useful to request a complete blood count and a metabolic profile to check for iron deficiency, but only if actual monitoring is going to be performed. A hormonal profile can be requested for the periodic monitoring of workloads on a quarterly or bimonthly basis (but only if there is going to be real monitoring).

# References

Beighton PH, Solomon L, Soskolne CL. Articular mobility in an African population. *Ann Rheum Dis.* 1973;32: 413-17

**De Smith, N. J.** (1983). *Sports Medicine: Health Care for Young Athletes.* Evanston, US: American Academy of Pediatrics.

**Drobnic F, Puigdellivol J and Bove A, editors.** (2009). *Bases científicas para la salud y el rendimiento en Baloncesto.* Publisher: Ergón, C/Arboleda 1 28220, Madrid. 2009. ISBN: 978/-84-8473-738.-4

**Drobnic, F., Serra-Grima, J. R.** (2009). La valoración cardiológica obligatoria en el deportista. *Med Clin*, 132(18), 706-8.

**Drobnic, F.** (August 29, 2007). Cuando los controles no bastan. *el Periódico* [digital edition]. Retrieved from <https://www.elperiodico.com/es/deportes/20070829/cuando-los-controles-no-bastan-5472356>

**López, P. A.** (October 8, 2010). Antropometría y análisis nutricional en el reconocimiento médico de los fichajes de futbolistas profesionales [Published on a blog]. Retrieved from: <http://ndsalud.blogspot.com.ar/2010/10/antropometria-y-analisis-nutricional-en.html>