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IDENTIFICATION AND EVALUATION OF PHYSICAL QUALITIES SPECIFIC TO HANDBALL

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Abstract
*Aim.*The content of the handball game is very complex requiring speed, strength, skills and stamina. Analytical presentation of the development of each physical quality is imposed by general physical education goals, which have not disappeared from training of the economy. But the considerable increase of the role of specific training imposed by the increase of the number of international sport competitions and hence the national sport competitions, has specialized the content and methodology of trainings consistent with the necessities of the competition.
Experts in the field claim that physical actions in the handball game involve in the competition, especially in preparation, a mixture of strength, stamina, speed, flexibility and skill in a indistinguishable rate.
Given the characteristics of modern handball game (permanent aggression of defence), and the conditions of progress, the development of force is impetuous required. It does not have to be made in order to become stronger. On the contrary, the goal of force development is to serve to specific needs, to develop its specific strength or its combinations, in order to increase the performance of athletes at the highest possible level.
As it happens in most team sports, handball players are required to have the ability to sprint with maximum of speed over distances of 20 to 25 meters and to be able to repeat these sprints several times during the game (speed – strength , strength – stamina).
*Conclusions.*Internationally, especially in countries with highly developed handball, the scientific research has focused on those physical qualities specific which determine the quality of execution of technical and tactical actions. This is an expression that specifies very precisely the essence of specific physical training, so a shot on goal may be made by a particular process for which there is an optimal model of execution and which requires certain skills, but the most important aspect is that of the specific qualities which ensures its quality and efficiency, meaning execution speed, explosive speed, throwing accuracy, etc..
*Key words***:** specific physical qualities, handball, evaluation.

Introduction

The content of the handball game is very complex requiring speed, strength, skill and stamina. Analytical presentation of the development of each physical quality is imposed by general physical education goals, which have not disappeared from training of the economy. But the considerable increase of the role of specific training imposed by the increase of the number of international sport competitions and hence the national sport competitions, has specialized the content and methodology of trainings consistent with the necessities of the competition.
Experts in the field claim that physical actions in the handball game involve in the competition, especially in preparation, a mixture of strength, stamina, speed, flexibility and skill in a indistinguishable rate.

Given the characteristics of modern handball game (permanent aggression of defence), and the conditions of progress, the development of force is impetuous required. It does not have to be made in order to become stronger. On the contrary, the goal of force development is to serve to specific needs, to develop its specific strength or its combinations, in order to increase the performance of athletes at the highest possible level (Cazan, 2010b). As it happens in most team sports, handball players are required to have the ability to sprint with maximum of speed over distances of 20 to 25 meters and to be able to repeat these sprints several times during the game (speed – strength, strength – stamina) (Buchheit, 2008a).

A good level of aerobic endurance is a necessity, since the player must provide the same quality game even at the end of a game and because aerobic endurance also means a good rate of recovery after the game and between workouts/trainings.

High capacity and endurance is also the solid guarantee that the player will be able to cope with fatigue accumulated in the game and, as a result, there is less likelihood of technical or tactical mistakes.

Power is an important factor in handball, highlighted in game situations involving sprinting, changing of direction, jumping and physical contacts with the opponent. However, since the force actions are repeated several times during the game, the power-resistance has to be trained (Buchheit, 2008b).

In the game of handball we identify the following physical qualities specific to handball game, which should be measured:

- **Getaway speed**. In direct combat with the opposite, taking into account the limited space of the

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field, it is very important for the player to have a quick start in order to overcome their opponent directly. This can only be achieved if at the start of muscle contraction, the athlete is able to generate maximum force in order to create a high initial speed. The getaway speed is found in the structure of the following moments and technical and tactical actions: triggering the counterattack, quick attack, kick-off of the ball after goal, demarcation on the free spot in order to receive the ball, changes of the direction with or without the ball, direct or indirect demarcation, entering through defenders, retreat on defence after losing the ball or after a goal is scored, the entrance to intercept the ball which flies at low and medium height..

- **Speed of acceleration**. In a very short time from the start of the run, the athlete reaches maximum speed. This time depends on the strength and speed of muscle contraction, the acceleration depends both on force of arms and legs. The speed of acceleration is seen in the structure of the following moments and technical and tactical actions: counter attack, quick attack, kick-off of the ball after goal, changes of direction with or without the ball, demarcation, defensive retreat after losing the ball or after a goal is scored.

- **Travelling speed.** The modern game of handball today takes place in an alert rhythm, the streak of game phases is increasing which means a continuous flow of players, and increased travelling speed to be sustained for a longer period of time. The speed of acceleration is seen in the structure of the following moments and technical and tactical actions: counter attack, quick attack, kick-off of the ball after goal, defensive retreat after losing the ball or after a goal is scored.

- **Coordination Speed (turn of speed)**. The dynamics of handball game changes so suddenly that the athlete must change the direction quickly, with the least loss of speed and to speed back in the direction from whence he came. In order to increase the ability of rapid braking, for a rapid movement in the other direction, the turn of speed of movement must be trained. The speed of coordination is found in the structure of following moments and in technical and tactical actions: changes in direction with the ball or without the ball, demarcation, passing the ball in avourable entering threatening the goals, movement in lateral fundamental position, forward, backward, attacking the opponent with the ball, retreat on the semicircle.

- **Resistance at speed**. It refers to the ability to maintain or to repeat a high speed. This quality is found in handball, where it is necessary to repeat the same kind of speed, several times per game, as if counterattacks, or in quick kick-offs after goal. Therefore the players need to train and to develop an appropriate speed resistance.

- **Detention**. The power of detachment from the soil is a crucial element in handball, in which the handball player is trying to design the body in highest point in order to throw the ball to the goal. The height of jumping directly depends on the vertical force of the athlete applied to the ground in order to overcome the force of gravity. Detention is found in jumps of all handball players, for the players to shot on goal from 9m (inner and middle) but also from 6m (extremes and pivots), and in defence at jumps in order to block balls.

- **Resistance in jumps.** In the game of handball, the jumps are actions that have power as dominant motion. However, it would be a mistake if we consider that we need trainings only to develop power, given that in a game of handball, a large number of jumps are executed. While it is very important to high jump in order to block a ball thrown from the jump or in order perform a tossing from jumping, it is same important to double such jump. Consequently, in handball you must train both for power (power of detachment, tossing power, power of response at landing) but also for muscle resistance.

- **Explosive force of the tossing arm (detent of the arm).** All tossings on goal require speed and power, both for immediately/ from the spot tossings (tossing from 7m, 9m, launch of the counterattack) but also for tossing on the run, on foot or from jumps.

- **Segmentary strength.** In the game of handball, the force of a muscle contraction or the player's ability to manifest its force, is the determining factor in making quick movements. During trainings and matches, the external resistance to rapid movements of the players is determined by weight, environment and opponents. In order to overcome these adverse forces, the players must improve their strength, so that the increased muscle strength of muscle contraction should make them able to increase acceleration and to make a rapid item or technique (Cazan, 2010a).

Handball ultimately requires speed (mental and physical), coordination and skills in jump and every coach knowing all this will give a certain time for development exercises of these qualities.

Identification of specific physical qualities can be achieved by studying physical skills, which ensure the quality and efficiency of the game actions. To this end, we have prepared a table stating specific physical skills and activities in which these qualities are present in the game of handball (Table 1).

Objective measurement tools of specific physical qualities

Interdisciplinary scientific foundation

Data on physical development are very important and useful in all sports and at all levels of performance. And by the way we obtain them, they are of two kinds:

-Direct – values that we discover by measurements; it is about height, weight, diameters, perimeters, length of limbs, skin fold thickness, respectively

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-Indirect, at which we come entering the direct ones in certain formulas: BMI (body mass index), adiposity (fat percentage), lean mass, fat mass, optimum weight, total muscle mass and, crucially, the prognosis of height that the athlete will reach in adulthood.

The complex characterization of the athlete, in terms of physical development, it is necessary first of all in the selection, and further, until the growth ends. This is because the body has continuous and significant quantitative gains, resulting in changes in the amount and ratio of its components. But after 18 -19 years is very useful the assessment of physical development. This is because the accurate knowledge of the percentage of body fat or total muscle mass are tools for evaluating the effectiveness of training and / or diet and keeping your weight under and under the limits of optimum weight, is formed in priority targets, required to be met in order to hope to achieve a sportive fit. From the multitude of tests on order to determine the level of physical development, we have chosen the followings that we consider appropriate for the game of handball.

Tab. No.1 Physical qualities specific for handball game and original forms of manifestations

FAVORABLE PHYSICAL QUALITIES	ORIGINAL FORMS OF MANIFESTATION
	Triggering the counterattack, quick attack, kick-off of the ball after goal, demarcation, entering at the goal, interception
Getaway speed	Counterattack, quick attack, kick-off of the ball after goal, changes of direction with or without the ball, demarcation, defensive retreat
Acceleration speed	Counterattack, quick attack , Kick-off after goal, retreat, travelling in defence
Travelling speed	Changes of direction, demarcation, passing the ball in entering, movement in lateral fundamental position , attacking the opponent with the ball, retreat on the semicircle
Coordination speed (turn of speed)	Counterattacks, quick avourable kick-offs after goal, retreat
	Tossing at goal from jump, blocking the balls from jumps,
Resistance at speed	accelerations, decelerations, changes of direction
Detention of lower limbs	Tossing at goal from jump, blocking the balls from jumps
	Tossing from 7m, 9m, launching the counterattack, tossings from
Resistance in jumps	running, from feet of from jump
Detention of upper limbs	Fight on semicircle, overruns, tossings, blocking of the ball, jumps.
Segmentary force/power	

FAVORABLE PHYSICAL QUALITIES	ORIGINAL FORMS OF MANIFESTATION
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Travelling speed	**Counterattack, quick attack , Kick-off after goal, retreat, travelling in defence**
Coordination speed (turn of speed)	**Changes of direction, demarcation, passing the ball in entering, movement in lateral fundamental position , attacking the opponent with the ball, retreat on the semicircle**
Resistance at speed	**Counterattacks, quick avourable kick-offs after goal, retreat**
Detention of lower limbs	**Tossing at goal from jump, blocking the balls from jumps, accelerations, decelerations, changes of direction**
Resistance in jumps	**Tossing at goal from jump, blocking the balls from jumps**
Detention of upper limbs	**Tossing from 7m, 9m, launching the counterattack, tossings from running, from feet of from jump**
Segmentary force/power	**Fight on semicircle, overruns, tossings, blocking of the ball, jumps.**

Body sizes and indices of physical development

Height(size) is measured using the taliometer between vertex and plan of plants. The subject is seated in an upright position with the joints in extension so that the vertical rod of the taliometer will reach the heels, the channel between buttocks and spine in the scapula. The head will be placed so that an imaginary line connecting the extreme angle of the eye to the top of the ear canal is parallel to the plan of the plants. The cursor of the taliometer will be supported on the vertex and will be read and the value will be recorded in avourable .

Weight – body weight measurement is carried out using scale for persons. It is measured in kilograms and grams.

The span is measured using a rigid rod graduated in avourable , placed between digital items. For measuring, the subject will be seated upright with the horizontal upper limbs and all joints in extension. It is measured in avourable .

Length of lower limbs – is measured from the ground to the trochanteric point.

The bust – represents the distance between the intertuberous line and vertex. In order to obtain exact figures, the vertical position of the trunk is well controlled, the basin is sitting on a stool of 50 cm high.

Body Mass Index (I.M.C.)

Recent studies consider body mass index (BMI) a formula for relevant and important determination of athletes body proportionality. It is calculated reporting weight in kilograms to height of the subject in square meters considering the formula:

$$\textbf{I.M.C.} = \frac{\text{Weight (kg.)}}{\text{Height } (m^2)}$$

The results are analyzed both for athletes and for sports under following criteria:

Classification of values for I.M.C.

Classification	Value I.M.C.
Skinny	under 18,5
Normal	18,5-25
Overweight	25-30
Obesity	over 30

Quetlet index(I.Q.) – (fatness or nutrition), known as anthropometric segment, is calculated with the formula :

$$\textbf{I.Q.} = \frac{\text{Weight (kg.)}}{\text{Height (dm)}}$$

The average for men is number 4, and for women 3.9 (each avourabl in height corresponds 4 respectively 3.9 kg). It is indicated the following scale for interpretation of the values: over 5 –obesity, between 5 and 4 starts obesity; between 5 and 4 the individ is very full-bodied, between 4 and 3.5 the individ is full-bodied, between 3.5 and 3 mediocre, between 3 and 2.5 debatable; below 2.5 skin.

The proportionality index (Adrian N. Ionescu)- is calculated as follows: B-T / 2 and shows the proportion of body height in centimetres in seated and standing position. With this formula it can be seen how shorter or longer the lower limbs than the bust or mid of waist is. The author gives as average values 5-6 cm for women, and 3-4 centimeters for men. These values vary with respect to constitutional type, age and sex.

Physical tests

Since the value and performance of the athlete depend on the physical performances, knowing these is very important both for the athlete himself and for those around him: coaches, physical trainers etc. It is known that an athlete's physical potential is expressed in several ways, namely:

-that of the general resistance (aerobic capacity)

- the resistance to repeated sprints,
- the speed
- the turn of speed
- the force and power.

Depending on the sport practiced – for team games – even after one or more of the aforementioned plans, they have a higher importance, they automatically become primary in defining physical potential of the athlete. For example, in road cycling, background samples of athletics, rowing, physical tests should focus almost exclusively on assessment of aerobic performance, while in other sports such as weightlifting, boxing, wrestling, etc., knowledge of anaerobic capacity (performance) and strength and power, should enjoy special attention. The most complicated situation we have in case of games, as athletes tasks they have to perform in the field, are very complex. In fact many of the activities and actions of those players, suppose the simultaneous expression of multiple physical qualities (strength, speed, proficiency), all of course due to the higher level of resistance (Weineck, 1997).

In these circumstances, it becomes clear that the choice of physical tests and establishing the most avourable moment for administration, shouldn't be done at random.

Physical tests not only assess the physical capacity of athletes to individualize training, but also allow assessment of progress in order to demonstrate the relevance of proposed physical training.

Speed test

Speed of getaway and speed of acceleration

In order to assess this component, we selected the speed running test on 5m and 10m. The test aims to determine the speed on 5m and 10m distance. Athletes

need to run individual with the highest speed on the distance of 10m.

Equipment needed:

- adequate space for marking the route, with a surface that will not slip in order to allow athletes a good contact with the ground,
- tapes for tracing
- photo-electric cells,
- stopwatches.

The test consists of speed running on the distance of 10 m, at start, at 5m and at finish, being located photo-electric cells. It is performed in handball shoes, the start takes off by feet individually, behind the start line. The stopwatch will be triggered by photo-electric cells placed at the start line, the time will be taken at 5m by photo-electric cells placed at here and also cells located at finish line at 10m, will take the final time. All results are expressed in seconds and tenths of a second.

For an accurate assessment, the start will be taken standing in a balanced position with the front foot in contact with the ground, the impulse being made in back foot. The start is made from the line, the athlete must be careful not to lift the front foot off the ground or not to move it sideways also must be careful not to go the knee of the front foot forward and not to make moose from the body. It is prohibited to take off the start with elan and to cross the finish line with plunge.

Travelling speed

In order to assess this component we selected the speed running test of 30m. The conditions are identical to the previous test. All results are expressed in seconds and tenths of a second.

Testing the turn of speed

Interdisciplinary scientific foundation

The turn of speed (A) is a very important quality in sport, but enjoyed less interest in Romania. Still, it deserves attention from coaches and athletes because:

- in many subjects, the athlete must perform a large number of sprints that contain changes in direction (SSD), and on the other hand
- it turned out that trainings for sprint in a straight line, does not affect or influence SSD.

Classic, A was simply defined as: the ability to quickly and accurately change the direction of travelling. Recently, however, scientists have realized that in sport, A must be defined in such a way as to take into account both the perceptual and the decision-making components but also proper physical component (mainly requests of force and power) which enable the instantaneous execution of those decided by the athlete in the action.

Thus, the Australian researchers – very concerned on A- defined it as a fast move of the entire body with changes of speed and / or direction in response to a stimulus. According to this vision, the A concept is applied only in open skills, ie the execution of those tasks which cannot be pre-planned, as it must be considered a response (in a reply) to one or more stimuli. Therefore, at present, in addition to simple A, it is also speaking of the so-called reactive A (AR); which can be temporal AR (the load has no doubt on the nature of space, but requires a temporal uncertainty), spatial AR (the reverse is true) and universal AR , which implies the existence of both types of uncertainty.

Therefore, according to the new guidelines, it is not only conditioned on the existence of changes of direction, the agility task of being the action of an athlete to accelerate or decelerate quickly, in straight line (in order to escape the opposite, for example) because that chain of movements is not pre-planned, but it is only in terms of, and only in response to initiatives, reactions and counter-reactions of the opponent. For these reasons, and others, which we do not develop here, the same Australian researchers claim that A is not overlapping the sprint / swiftness (quickness) concept used mainly in the U.S.A.

Seeing now how complex A is, it is easy to accept that it depends on many factors, from the anthropometric, continuing with the physical ones (force basically reactive power, and power) and technical ones (technique of footrace), and ending with the cognitive ones. Each of them has a greater or lesser involvement or influence in the implementation of A tasks. But do not forget, it must be seen in terms of specific duties and tasks that the athlete has in the proper competition.

The test of turn of speed, proved to be not only reproducible, but particularly valid for sports games.

The special value of this test (which use three pairs of photocells), is that for the first time in the history of A testing, it proposes to the tested one a complex task with spatial and temporal uncertainty, this allowing us to say that with his help, we can evaluate universal AR. What makes it particularly useful, both for identifying athletes of perspective – when given to children and youth – and to value tie-break, or to diagnose of sport form, in case of seniors (http://www. Martinbhuchheit.net).

Turn of speed test

Equipment needed:

- adequate space for marking the route, with a surface that will not slip in order to allow athletes a good contact with the ground, to allow blocking the movement for a quick turn.
- tapes for tracing,
- photo-electric cell,
- stopwatches.

Two lines of 2m will be drawn, with distance of 5m between them. Photo-electric cells will be placed next to each line.

Athletes will start individually from the feet, behind the first line, and will run with the greatest

speed to the other line that they have to touch with one foot and return quickly to the start line. The test will be held 4 times a 5m distance without stopping, with the obligation that at every return, the line should be touched with one foot.

The return must not be made by detouring but by sudden stop and turn to 180 º. For an accurate assessment it is recommended that the ground surface is not tartan, but the parquet, floor or taraflex. The conditions are identical to the previous test. All results are expressed in seconds and tenths of a second.

Testing the anaerobic capacity

Interdisciplinary scientific foundation

The concept of anaerobic capacity (C An) proved to be a difficult to assess metabolic construction, and even in this moment we don't have a broad consensus of experts, not even on its definition. However, in order to have a comprehensive vision of this concept, and on what is actually to quantify, the testing will have to start all the way from its physiological meaning:

C An is the largest amount of ATP that can be synthesized – by anaerobic mean – by the entire body (ie not only the muscles involved) when a subject performs a supreme effort (all-out, in English) as intensity and short duration.

Understandably that, given that the definition itself of the concept is still under discussion, the arsenal of methods for testing C An and is in a continuous process of renewal and (re) evaluation, which also applies to laboratory tests and for those that can be managed in "the field".

That is, until recently, under conditions of the "field" we had to be content only by indirect clues, that the sprint of 10 (or 20) m and vertical jumps (SV) gives us on anaerobic performance of the lower body. Especially on SV testing, if it is done with the help of a contact platform, it gives us very specific relationships in terms of power, which can be of great help to the coach.

For the assessment of C An, even the most reliable "field" test, credited as giving relations on the power developed by the athlete (maximum, minimum and average power) and about the fatigue that occurs in this plan, we propose sprint the Anaerobic sprint test (TSA), developed by specialists of the University of Wolherhampton (UK), and considered that it replaces, under "field" conditions, Wingate Test, the most known test and used for evaluating C An but unfortunately it is performed only in laboratory, on ergometer bicycle.

In the TSA, subjects must perform a number of sprints over a defined distance, with stops fixed to each other. After this, the achieved times are inserted in some special calculations. The fact that the sprint is the task that should be carried out, makes this test to be recommended, and very useful for all subjects based on footrace, and in which the athletic performance (competitor's performance) depends to a considerable extent on anaerobic performance (http://www. Martinbhuchheit.net).

Anaerobic sprint test

The test consists of 12 speed runnings on a distance of 20 m with a break of 25 seconds between runs. The 25 seconds pause will rigorously respected, during this athletes must move to the start line and prepare for the next start. It will run individually. The conditions are identical to the previous test. All results are expressed in seconds and tenths of a second.

In order to make the analysis of the fatigue, the average of the 12 performances will be compared with the best performance and then the difference between the best and worst performance will be made.

Testing the force and the power

Theoretical basis:

About how important strength and power are in the game of handball, we have already mentioned in previous chapters. We would like to emphasize, however, that they should not be seen only through the support that it provides to the expression of the athlete competitions, in physical and / or technical plan, but also through the involvement they have in the occurrence of injury and new injuries. For these reasons, although coaches and athletes would be tempted 'to leave them behind ", or even give up the tests of strength and power, we advise them to reconsider their options, and necessarily to include them in set of assessments / tests.

Resuming to the essence, we will say that muscle strength refers to the ability of the muscle to develop active tension while by muscle power we understand the muscle production rate of mechanical work, or work done per unit time. Knowing that the mechanical work means force multiplied with the distance (or displacement), it results that the power is a measure of the ability to rapidly produce power. We understand therefore that strength and power are inextricably linked to sport and that, in fact, power can be seen as a consequence (result) of action of force.

Without going into theoretical details, we note that in the sport practice, the functional strength is interested, so not the force itself, pure force, but rather its consequences, or effects that are obtained by its development (exercise), by the muscle.

It is known that for a long time, the attention was focused almost exclusively on general dynamic force, the force which is estimated by testing the maximum voluntary dynamic strength (FDVM). Characteristic to FDVM tests, is that they suggest that the athlete should lift as much weight, or to overcome resistance as significant, opposed from outside by specially designed machines. The problem with these tests is, however, that their movements are relatively simple (many times in a single plane) analytic and carried out at low speed. Which gives a rather low relevance in practical terms.

In opposition to this kind of movement, there is a modern concept, which became very popular in recent years. It is the concept of integrated multidimensional movement, which takes into account the fact that movements in sport are not simple. On the contrary, most of them are movements which developed in several plans, engaging and assembling a variety of sequences of muscle contractions, performed at different speeds and with different amplitudes.

Therefore, in recent times, the dynamic explosive force (FDE) and reactive/ response dynamic power (FDR) are in trend. And an advantage of tests by which these two alternatives of power are investigated, is that the results we obtain give us both about relationships about force and about power.

A similar type of approach is now considered to have the greatest relevance and practical utility for coaches (and of course for the athletes). This is because the data obtained helps them to know the level of training that they have, and to conceive – knowingly – future training programs, to estimate the effects of different periods of application of a specific training program and, in some cases, to prognosticate the performance to be obtained of next competitions.

Given the above, we have prepared a modern battery of tests, validated by rigorous studies and worthy of the highest trust. And as a result of using the contact platform and photoelectric cells, these tests allow us to record and calculate a large number of performance parameters than usual. Subsequently, by complex interpretation of these parameters, we obtain a true and at the same time very nuanced performance of strength and power, which the athlete is capable of at the time (period) of testing.

For reasons easy to guess, most tests that we propose address to the lower body and are based on the implementation of different types of jumps, especially in the range of vertical jumps (SV).

Since some of them might seem curious, the special attention that we announced to give to SV, we believe that some clarification would be welcome. SV is a multi-articular movement, explosive, requiring substantial muscular effort at the ankles, knees and hips. Which, in case the upper limbs are left free during the jump it is added the contribution of muscles, arms, and even back. But SV is considered to be the main method for testing the strength and operational power, not only because of the many groups of muscles which they engage, but also because the results obtained by the tested athlete, give us relations on the rate of activation of physical units, all depending at the same time, in a good measure also on coordination. Moreover, generally speaking, the ability to jump gives us multifunctional information. Hence the large number of methods for evaluation of physical potential of the athletes, in which the SV or other types of jumps, it constituted in task-tests.

Turning now to SV, we all know that there are many variants. In turn, these varieties can themselves be made in several ways, depending on the type of "beating" (on both legs, on the preferred one or on the dis-preffered one), or by the rules set on the upper limbs, which can be left free or mandatorily held on the hips.

What should be noted, however, in this context of testing force and power, is the fact that, in terms of the information that we procure, all these variants and sub-variants of SV are not excluded, but they complement each other. Which is why it would be advisable that the athlete to be tested even in some of the following:

-SV with countermovement (SVC);

-SV in sitting without take-off;

SV-multiple (linked between them);

-SV in semi-squat.

Testing the explosive strength of the lower limbs

Measurement and evaluation of neuromuscular qualities of handball players in explosive effort by a simple, non-specific move, vertical jump, can guide the muscle preparation both in force-velocity relationship but also in the overall control of movement phases of lower train. Lower body muscles, isolated by arm position with hands on hip, can characterize the entire motor behaviour of the tested athlete by relatively large report that this musculature has in relation to the total musculature of the whole body, but also by the analysis of phases and of kinematic characteristics and dynamic impulses and loosening from the ground. Important parameters investigated are: height of centre of gravity, due to the design by impulse in a single maximum effort or using elastic muscle component and take-off, or the average of heights obtained by repeated jumping exercises under different effort conditions, as physical action, that by its shape is part of phases of competition exercises of basic techniques in handball and essential phases of the game (Bompa, T., 2002).

In order to assess the performance of athletes, the testing method was used by Bosco test applied force measurement platform Miron Georgescu.

SV of semi-squat (Squat jump) – the test entails a vertical jump of semi-flexible position of the knee, 90 ° or full squat without additional thrust into the ground, with arms bent, hands on hip, in order to avoid any involvement of elastic muscle component. It is important that the stand-up to be performed avoiding any countermovement, however small. The inaction of arms decreases the performance by about 10 cm, that is why the results as reference data are apparently weak but justified from 24 cm – 38 cm for women and 26 cm – 45cm for men. SV performance describes: the ability to jump and the explosive strength (maximum) of the legs, the neural – motor recruit ability, the amount of fast fibres.

SV in sitting position, (Counter movement jump) **–** the test requires the performance of a vertical jump identical with SV test, but departing from sitting. It is perfomed a vigorous flexion followed by extension and vertical jump, the arms can help for take-off. Landing

should be on your toes or on the whole foot and with stretched legs in the knee joint. The differences between the two tests are the "elastic" skills of athletes. The performance of the test describes: evaluation of explosive force FV (maximum) of legs and quality of reusing muscle elasticity, neuro-motor recruiting ability, the ability to use the visco – elastic force in the muscle tissue.

SV multiple interrelated (Continuous jump with straight legs) – series of 5 -10 maximum jumps with straight knees(short elastic contact with the ground). The test performance describes: the muscle elasticity assessment of leg extensor, jump technique and tolerance to straight impact, the amount of fast fibres. The test is more technical and in order to be validated it requires a high motility of feet. The objective is to obtain the best compromise between jump height and speed of detachment, only an active detachment with the whole sole will reduce the time of contact with the ground.

Testing the explosive force of the upper limb

Speed of tossing the ball on goal from a position

In order to test the speed of the tossing, it can be used:

- a handball field with goal
- handball balls
- a radar gun type Bushnell 101 900 in order to determine ball speed.

Athletes will toss the handball ball on the empty goal, from the tossing line of 7m, from a fixed position, without treading this line. The tossing is performed over the shoulder and not laterally with the support foot opposite to the tossing arm and space must be on the area of the goal, in order to be considered a valid attempt. Each athlete is allowed two attempts, registering the best performance. The radar gun will be located behind the gate in order to detect the speed at which the ball will enter the goal area.

Tossing speed of the ball with steps 2-3 take-off steps

This test is the same as before, only now athletes will toss at the gate with 2-3 take-off steps. The take-off can be made with added or crossed steps.

In addition to these new tests to determine the strength and power of athletes in the upper and lower limbs, we also propose several classical tests for determining the level of maximal muscle strength.

Tests of strength

Long jump off place: The player performs two consecutive jumps without a break between them, noting the best result. Before jumping it is allowed the arms take-off with a single swinging. It is measured from the top of the legs (starting position) to the heels (landing position). The results are recorded in meters.

Abdominal strength: In this test the player, in the dorsal lying position gets the trunk up to 90 ° and returns to dorsal sleep. Many repetitions are performed for the duration of 30sec. The stopwatch is started when the player starts making first lift. When the stopwatch is stopped, it is considered as a repetition and it is recorded if the player got his trunk up vertically. The results are recorded in the number of repetitions.

Squats: Standing, with feet distant at the level of the shoulder, with hands more distant than shoulders width, the bar is laid on the shoulders, with palms forward. With the straight back, looking forward, always keeping the bar parallel to the ground, bend your knees slowly down the trunk. In order to emphasize the involvement of gluteal, lower until thighs are 5-7 cm under position parallel to the ground. Without balance in the lower position, shrink the thighs and gluteal in order to lift in initial position.

Pull-upps: Din Hung from a safe bar and high enough so that the feet have no contact with the ground, catch the bar in the supine position, the distance between the arms is equal to the distance between the shoulders. From this position the lifting of the trunk is performed until the chin of the athlete passes the bar, with bent of the arms and pulling elbows back.

Pushing from reclining position: The exercise calls in particular the lower pecs, but stimulates the entire breast-deltoid-triceps area. Lying on the bench, the dumbbell is cought by using a socket twice wider than shoulder width. Lower the dumbbell slowly, elbows away from your body until the bar reaches plexus area. Push the bar, focusing on the movement until it reaches the original position.

Testing the cardiorespiratory recovery capacity

The test: 30-15 Intermittent Fitness Test

In sports, recent studies (research) on the modelling of effort in competition has allowed significant training of programming the training content. In this respect Martin Buchheit has designed and developed in March 2000 a new field test that also responds to specific requirements of handball game, 30-15 Intermittent Fitness Test (30-15IFT).

This test allows the estimation of maximum oxygen consumption (VO2 max) and the determination of the maximum aerobic speed (VMA). The difference from other tests is given in the form of shuttle flight (bout), and especially the intermittent manner of the exercise. So far the test has been applied to over 700 athletes, elite handball teams of women and men, handball training centres, allowing scientific validation and acceptance.

Presentation of the test:

The test consists of exercise period of 30 seconds interrupted by periods of active recovery of 15 seconds. In times of stress, the athlete performs a race as shuttle (bout), on a distance of 40 meters at a speed indicated by an audio CD that emits beeps at certain time intervals.

During active recovery period, the athlete will move away to the nearest line, line which will be the start for the next effort period. A period of effort and one of recovery have a duration of 45 seconds and is a resting place. Initially the run speed is 8 km / h, and then it

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increases by 0.5 km / h at each resting place. The terms of effort and rest places determine the action of performed biochemical processes that control the supply of power needed to sustain the intermittent effort, depending on the number of performed rest places (Buchheit, 2005).

Materials needed:

- Audio-CD of 30-15IFT;
- a sports field with a minimum length of 40 meters;
- some cones (milestones) in order to delimit the different areas of interests for athletes;
- a start line (line A), an intermediate line (in the centre of the running space, line B and a return line, line C);
- 3 tolerance zones with a width of 3 meters on both sides of each line.

Progressive test of running, schuttle type on the distance of 20m

This test aims to determine maximal aerobic power (maximum aerobic capacity). Maximal aerobic capacity is obtained in ml O2/kg body/ min or in mets. 1 met is the resting metabolism and is considered arbitrarily that equals 3.5 ml O2/kg body/ min. Athletes will run as much as possible, boat on a distance of 20m at speeds imposed, growing every minute, according to reproduced sounds of a CD player (Leger and Lambert, 1982).

Equipment needed:

- adequate space in order to mark the land on which the run will be performed. The minimum distance between the athletes is 1m.
- CD with recorded sound and CD player
- visual indicator for tracking the levels of (speeds) running.

Tab. No.2 Identification of specific physical qualities and of assessment tests

Specific physical quality	Test	Materials
Speed of getaway	**Speed running at**	
Acceleration speed	**5 m**	
Speed of travelling	**10 m**	**Photoelectric cells**
Speed of coordination	**30 m**	
	4x5 m	
Resistance at speed	**Speed running at 20 mx12**	**Photoelectric cells**
	Rest= 25 sec	
Explosion of lower lumbs	**- vertical jump with arm take-off (sve)**	**Bosco test**
	- vertical jump with hands on hips and knees bent at 90 ^{0}	**Bosco test**
	6 Maximum jumps repeated with hands on hips	**Bosco test**
Index Explosive	**2x10 – (cmj/10)**	**= 2 x 10 –(sve/10)**
Explosion of upper limbs	**Tossing the ball from 7m from fixed position**	**Radar**
	Tossing the ball with 2 steps of take-off	
Maximum Force/Segmentary power	**Abdominal strength**	**Weightliftings of different weights, stopwatch, meter**
	Long jump off place	
	Squats with dumbbell on the shoulders	
	Pull-upps from hung position	
	Pushing from reclining position	
Aerobic capacity and cardiorespiratory recovery	**Schuttle-type test at 20m**	**In the room listening a CD**
	30-15 ift	**In the room listening a CD**

Conclusion

Internationally, especially in countries with highly developed handball, the scientific research has focused on those physical qualities specific that condition the quality of execution of technical and tactical actions. This is an expression that specifies very precisely the essence of specific physical preparation, so a toss on goal may be made by a particular process for which there is an optimal model of execution and requires certain skills, but the most important aspect is that of the specific qualities which ensure quality and efficiency, ie execution speed, explosive speed, tossing accuracy, etc.. The most important specific physical qualities are those that are

involved with the technical and tactical actions in order to increase the play efficiency of the team and of the players (Table No.2) and therefore requires a strict evaluation of these physical qualities with appropriate and effective assessment tools.

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