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<u>THEME</u>

Evaluation of the physical qualities and morphological profile of the middle-distance athletes of the national military team of Algeria.

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Thanks

" When you sit, you see nothing and bring nothing back.
When you stand up, you see the things of the world.
Move and you will reap them. "

Berber proverb.

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Dedications

I dedicate this modest work:

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I hope to be the image you have of me, my God keep you and bless you.

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List of abbreviations

Abbreviation	***Definition***
STAPS	Sciences and techniques of the Physical and sports activities
BMI	The body mass index
SA	Surface Area
WHO	Word Health Organization
VAM	Maximum Aerobic Speed
VO2max	Maximal Volume of oxygen
FAA	Algerian Athletics Federation
IOC	International Olympic Committee
OG	Olympic Games
ATP	Adenosine triphosphate
CV %	Coefficient of variation

Introduction

Introduction

Athletics is the first Olympic discipline. It is defined as all individual sports involving running, jumping, and throwing (**Larousse Bordas-1997, first edition**). It is the basis for many team sports such as basketball, handball, and soccer.

For the categorization of races, the international association of athletics Federation (World Athletics) grouped the distances according to disciplines. The sprint race is defined from (60 to 400 meters), the middle-distance race (800 to 3000 meters), and the long-distance race (5000 meters to marathon).

According to **Humphreys J, Holman R. (1985),** and **Camus G. (1992)** middle-distance running is defined as races between 800 and 3000 m that require between 2 and 10 minutes to complete. Races in this range rely heavily on an integrative contribution from both aerobic and anaerobic energy systems (**Brandon, L.J., & Boileau, R.A. 1992**). A middle-distance runner must have the ability to link rapid acceleration, high concentration, and responsiveness during the event where his or her muscles are used throughout the course, as well as control of breathing and finally the implementation of tactics. The best athletes are mainly from the African continent.

The notion of training in everyday language is used in a wide variety of fields and most often refers to a process that, through physical exercise, aims to reach a more or less high level depending on the objectives envisaged. (**Weineck, 1983, p. 15**).

High performance requires long-term planning, individual monitoring, and hard work. Therefore, it is necessary to design training plans to help achieve high-level performance. Indeed, the achievement of performance is the result of the interaction of factors called performance factors.

As in any other sport, performance in athletics is the result of a set of factors (biological, physical, physiological, technical, etc.) among which physical qualities (strength, speed, endurance, coordination, flexibility) and morphological characteristics (height, body composition, diameters, circumference, skin folds and lengths of the body's limbs) which are considered as one of the most important parameters in sports and are often indispensable factors for the practice of certain sports. Achieving a sports performance is above all the result of a serious follow-up of adapted and structured training.

The interest of several authors in the physical qualities and morphology of high-level middle-distance runners makes clear the importance of these factors as components of performance (**Dierks and Davis, 2007; Bachero-Mena B et al., 2017; Mytton et al., 2015; Foster et al. 1978; Boileau et al. 1982; Camus 1992; Arrese, A.L.; Ostáriz, E.S. 2006; Vučetić, V., R Matković, B., & Šentija, D. 2008**).

Performance in the middle-distance specialty is largely dependent on the athlete's maximal aerobic speed and therefore the relative amount of oxygen consumed per kilometer (**Millet & Candau, 2002**). Athletes who have (or) acquired the optimal physique for a particular event are more likely to succeed than those who lack the general characteristics (**Carter, 1984**).

Anthropometric characteristics are important in their application to training. In athletes, there is a correlation between the physical qualities of the athlete and the morphotype, and the role of the physical constitution as a factor of sports ability (**Weineck, 1990**). Although the morphological criteria represent the first level of the determining factors of the performance. They are often considered basic factors for any sports selection (**Schürch, 1984**). In athletes, body composition measurements are widely used to prescribe desirable body weights, optimize performance in competition, and evaluate training effects (**Sinning, 1996**). (**Ripari et al., 2008**) indicate in this sense that the determination of somatotype thus represents an important starting point to choosing the most suitable sport for each subject.

Our study is interested in the physical qualities and morphological characteristics of Algerian runners selected in the senior military national team in the discipline of middle-distance, to determine the physical and morphological characteristics for this athletic specialty, as well as to compare them to international standards.

From the introduction of this event in Algeria until today, the middle-distance has always been considered the most spectacular event in all athletics meetings. Indeed, the national records are significant compared to the world records. Numerous titles and records were achieved with brilliance during the first years of the 90s by **Noureddine Morceli** with an Olympic gold medal plus 3 gold medals at the world championship and **Hassiba Boulmerka** with a gold medal at the Olympic Games plus 2 gold medals at the world championship and from the years 2012 **Toufik Makhloufi** achieves 3 Olympic medals, which makes the Algerian middle-distance is recognized at the global level.

By analyzing the results obtained by our athletes on this event during the years, we note that middle-distance is the specialty that brings the most awards to Algerian athletes.

This leads us to the following problematic:

Do the military athletes selected for the senior men's national team have physical qualities that meet international standards and morphological profiles that place them on the international scene?

Part one: literature review

Chapter one : The middle-distance

I. History of athletics:

Athletics is one of the oldest sports in the world. It can be defined, according to the micro-Robert as "a set of physical exercises practiced by athletes». It is essential in most physical activities of the competition. According to Jean Louis Hubiche and Michel Pradet "athletics is a codified activity, standardized respecting rules little evolving. Requiring both a strong energetic involvement and a great technical mastery, this activity is expressed by closed coordination leading to a reduction of motor uncertainties". (Jean Louis Hubiche and Michel Pradet, 1993).

This discipline is one of the oldest sports practices. It fascinates today, as it did more than 2000 years ago, an audience that follows the exploits of the "gods of the stadium" in a pathetic atmosphere and grandiose staging. In ancient times, athletics was only intended to develop the physical qualities of warriors. Around 1500 BC, the Greeks began to organize competitions with a more peaceful perspective. This orientation is not new, on Egyptian reliefs dating back to 3500 years before Christ, there are figures of men running. But it is the Greek civilization that gives its real dimension to the "athletic religion". Games were organized in honor of some of their gods, and athletics had an important place. The most famous were those of Olympia from where comes the name of the Olympic Games dedicated to Zeus.

Sporting and athletic education was an integral part of the society described and sung by Homer; it corresponded to one of the characteristics of athletics: the exaltation of human life. Thus, in the Odyssey, it is said that man must "exercise his feet and his hands". The first specialized competition areas appeared in Olympia where, according to the legend, the straight track measuring 192.27m long would have been calibrated by the juxtaposition of 600 feet of Heracles. This gave birth to the stadium, a unit of measurement that is otherwise rather imprecise. The athletics competitions that developed throughout Greece included speed events, long races (7 to 24 stadia), jumps, and throws (discus and javelin). These sports and religious festivals, which brought together an often very divided Greek community, took on great importance. Modern athletics appeared in the 19th century with the organization of pedestrians' races in the English universities of Oxford and Cambridge. But it was the famous Rugby College (which gave birth to the sport of the same name) that organized, in 1837, the first foot race: the "Crick Run", reserved for students over 17 years old. This competition quickly spread to other colleges, such as Eton, and then to universities.

Thus Cambridge, soon imitated by Oxford, organized its Athletics Championships in 1857. This was followed in 1866 by the creation of the English Athletics Federation, which became the Amateur Athletic Association in 1880. In the United States, the New York Athletic Club was founded in 1868. In France, the Racing Club and the Stade François appeared in 1883, while the first French Championships were organized at the Croix-Catalan in 1888. But the main impetus given to athletics was in 1896 with the renovation of the Olympic Games at the initiative of Baron Pierre de Coubertin. The history of modern athletics then became inseparable from that of Olympism. A world organization, the International Amateur Athletic Federation or IAAF, created in 1912 in Stockholm, has more than 150 member countries. It has codified this sport, on a worldwide scale, by setting very strict rules for the organization of competitions, to guarantee their regularity, but also the authenticity of performances. The IAAF has also established a vast development program by creating major competitions such as the World Cup, and the World Championships (the first being organized in 1983 in Helsinki) according to a four-year rhythm. It has also promoted the winter practice of athletics with the establishment of a World Indoor Championship and a World Cross Country Championship. While records are more and more difficult to break, and doping is becoming a real scourge, the IAAF multiplies the controls to protect the health *of athletes and guarantee the value of performances.*

I.1. Introduction of athletics in Algeria:

After soccer and handball, and well before martial arts with boxing and karate at their head, athletics is the third most popular sport in Algeria.

Algerian athletics is governed by the FAA, the Algerian Athletics Federation, which is in charge of organizing the various national and international sports events that Algeria could host. It is also responsible for enforcing a regulation that it has itself issued, and to designate the quota of Algerian athletes by clubs in all age categories for international competitions.

In a national competition, a club stands out from the lot, it is the athletics section of the club Omnisport of MC Algiers. Since 2009, all sports sections of this club, except soccer, have taken the name GSP "Groupe Sportif Pétrolier".

Algerian athletics has always been honorable in international competitions. It has already distinguished itself in men's categories, as well as in women's categories, in Olympic, world, African, but also Mediterranean and Arab competitions.

Algeria has also hosted many sporting events on its soil concerning athletics, including the African games in 1978 and 2004, and 2018 but also the Mediterranean in 1975.

Despite the many titles and records achieved with brilliance during the early years of the 90s by **Noureddine MORCELI** with an Olympic gold medal plus 3 gold medals at the world championship and **Hassiba Boulmerka** with a gold medal at the Olympic Games plus 2 gold medals at the world championship, **Benida Merah** with an Olympic medal and also **Ali Saidi-Sief** and **Abderrahmane Hammad** plus **Aissa Djabir Said-Guerni** with an Olympic medal, and finally **Toufik Makhloufi** with 3 Olympic medals. After the 2012 Summer Olympics in London, athletics is the sport that brings the most awards to Algerian athletes.

I.2 History of the 800m and 1500m races:

The races of 800 m and 1500 m are registered in the program of the first French Championships of Athletics in 1888, and in the first modern Olympic Games in 1896 in Athens, the date on which the metric system is retained and adopted by the International Olympic Committee (IOC), chaired by Pierre de Coubertin, that to the great dismay of the British who will continue, apart from the Olympic Games, to run on their distances.

I.2.1. History of the 800 m :

Until 1958, the 800m competitors all started in the same line, perpendicular to the track. Many jostles and falls prompted the International Federation to take measures: from then on the number of starters would be limited to 6, each enclosed in a lane. The number of starters would be limited to 6, each one in a lane. First, of 100m, it was changed to 300m to be able to fall back, then it was changed to 100m in 1976 in Montreal. From 1972, the tracks offered 8 lanes, which allowed finals of 8 athletes. When we look at the history of middle- distance races, we notice the dizzying progression of records in the different events.

The 800 m is characterized by its tactical dimension. Given the high average speed and the predominantly anaerobic lactic effort, mistakes in pace and movement in the pack are costly. From 1865 to 1908, the best performances were exclusively achieved over 880 yards (804.32 m) by the first great middle-distance runners, who were English and American, often specialists in the 440 yards (402.16 m) and who could even shine in the 1000 yards. It is the case of the American champion of 100, 220, and 440 yards,

Lon Myers in 1881 beat the world record of 880 yards in 1'55"3/5 in a 1000 yards race (914,70 m). The American **Melvin Sheppard** achieved 1'52"4/5, at the London Games in 1908. Four years later at the Stockholm Games, the podium of 880 yards is entirely American. 1960 sees the imprint of the New Zealand phenomenon, **Peter Snell**. At the Rome Games in 1960, he created a surprise by becoming Olympic champion of the 800 m at 22 years and beat the world record of 800 m in 1'44"3 in 1962. Despite the appearance of synthetic tracks in 1968, this performance is beaten only eleven years later by the Italian **Marcello Fiascanaro** in 1'43"7. The Montreal Games, in 1976, consecrated another phenomenon of athletics, the Cuban **Alberto Juantorena**, nicknamed "**El Caballo**" (the horse). In the final, he broke the world record for 800 m in 1'43"5. From the end of the 1970s to 1987, middle-distance running benefited from an unparalleled emulation between British athletes (**Sebastian Coé**, **Steve Ovett**). At 800 m, **Coé** became successively the first under 1'43" then under 1'42" (1'41"73) in 1981, this record will last sixteen years.

At the end of the 1980s, Kenyan runners, long confined to the longest distances, also entered the 800m races. In 1988, in Seoul, **Paul Eireg** was the Olympic champion, ahead of the Brazilian **Joachim Cruz**, the outgoing champion. At the 1992 Games (Barcelona), the Kenyan ensured his first double on the distance with **William Tanui** and **Myon Kiprotich**.

But the most talented of all was **Wilson Kipketer**. In 1995, the IAAF authorized him to run under the shirt of his adopted country, Denmark. Thus, the Kenyan "Dane" became a triple world champion: in 1995, 1997, and 1999. Although he never won an Olympic title in the distance (second in 2000 and third in 2004), **Kipketer** holds the indoor 800m record (1'42"67) and held the outdoor record (1'40"91).

From now on, it is his ex-compatriot **David Rudisha** who holds it in 1'40"91 achieved on 09-08-2012 in LONDON. The first women's 800m record was set in 1922 by a French woman, Georgette Lenoir, in 2'30"2/5. In 1928, in London, the first Olympic champion of the event, the German **Lina Radktke-Batschauer**, brings it to 2'16"4/5. **Tatiana Kazankina** won the 800m in 1'54"9. In 1983, the Czechoslovakian **Jarmila Kratochvilova** broke the world 800m record in 1'53"28. She is still the record holder of the 800m.

Let us also note the supremacy of an African, **Maria Mutola**, a Mozambican with powerful muscles. In Barcelona, in 1992, she was disqualified in the 800m series for leaving her lane before exiting the first turn. But the following year, in Stuttgart, she became world champion, then placed third in 1997 and second in 1999. In Sydney, in 2000, **Mutola** finally became Olympic champion, then she won two more world titles in 2001 (Edmonton) and 2003 (Paris).

Without forgetting the Kenyan **Pamela Jélimo** who realized a time of 1'54"99 on 01/06/2008 in Berlin.

I.2.2. History of the 1500 m:

We often find the same athletes at the top of the 800m and 1500m. Other runners have an intermediate profile between short and long-distance. The double is achieved in the 1500m and 5000m. In terms of performance, the history of the 1500m has long been linked to that of the English mile. Until 1908, outside of the Olympic events, the English and Americans knew only the mile, so the world record for the 1500m was more modest than that for the mile. In the same year, the Englishman **Harold Wilson** was the first to go under 4' (3'59"4/5). After the First World War, the middle-distance race was dominated by Scandinavian and especially Finnish athletes. At the Antwerp Games in 1924, **Paavo Nurmi** won the 1500m. He holds the world record between 1922 and 1930. But it is beaten by the French **Jules Ladoumègue**, vice Olympic champion of 1500m in London, in 1928. This one, in 1930, beat the world record of the distance in 3'47"8, after having held that of the mile in 4'07"6 in 1933.

In 1960, African athletes arrived on the international scene at the same time as a young prodigy, the American **Jim Ryn**. In 1967, he set the 1500m record at 3'33"1, during the match between the United States and the Common Wealth in Los Angeles.

At the 1968 Mexico City Games, he could not prevent the first African athlete f r o m winning the 1500m, **Kipchoge Keino**. In 1974, a young Tanzanian **Filbert Bayi**, at the Common Wealth Games, won the 1500m by leading the race from start to finish, counting up to 25m ahead of his opponents. The world record was broken in 3'32"2.

In 1979, **Sebastian Coe** broke the world record for the 1500m in 3'32"1. **Stève Ovett,** equaled it the following year, then went under 3'31" (3'30"77 in 1983). In 1500m, his runner-up and young compatriot **Stève Cram** is the first world champion of the event in 1983 in Helsinki. In 1985, another era begins, between the Moroccan **Saïd Aouita** and the English **Cram**. On July 16 in Nice, they passed under 3'30" in the 1500m (3'29"67, world record, for **Cram**). **Aouita** achieved 3'29"46 the following month in Zurich.

The Moroccan **Aouita** inspired other athletes from the Maghreb, including the Algerian **Nouréddine Morceli**. He became the triple world champion in 1500 meters (1991, 1993, and 1995). In 1992, he completely misses his Games in Barcelona but seizes the world record of

1500m in 3'28"86 in Rieti (Italy). Three years later, he raised this record to 3'27"37 in the Nikaia, where ten years earlier, **Cram** and **Aouita** passed under 3'30". Then the Moroccan **Hicham El Guerrouj**, takes over in 1995, in Gothenburg, he is the runner-up of **Morceli** at the World Championships, and at the Atlanta Games, he still rubs against **Morceli**, to the point of falling heavily in the final. But in 1997, he won the first of his four consecutive world titles over 1500m. In 1998 in Rome, he broke his first and best world record in the 1500m in 3'26". It is also worth mentioning the good performance of Kenyan **Bernart Lagat** in 3'26"34 on August 24th, 2001 in Brussels.

The first women's track and field races were included in 1928 in the program of the London Olympic Games. They only run the 100 and 800m. The Soviet Union establishes its domination in the middle distance with **Ludmila Bragina**, the first Olympic champion in 1500m. Like the 800m, the 1500m bar is very high. At the world level, we note the domination of the Chinese who hold the four best performances. In the first position, we have **Qu Yunxia** in 3'50"46 on September 11, 1993, in Beijing, in second, we have **Bo Jiang** in 3'50"98 on October 18, 1997, in Shanghai, **Yinglai Lang** comes in third in 3'51"34 on October 18, 1997, in Shanghai and, in the end, we have **Wang Junxia** in 3'51"92 on September 11, 1993.

I.3. World record for the 800m Men and Women:

Region	Type	Performance	Athlete	Date	Location
In the open air	M	**1 min 40 sec 91**	David Rudisha	August 9, 2012	London Olympics
	F	**1 min 53 s 28**	Jarmila Kratochvílová	July 26, 1983	Munich
Indoor	M	**1 min 42 sec 67**	Wilson Kipketer	March 9, 1997	Paris
	F	**1 min 55 s 82**	Jolanda Čeplak	March 3, 2002	Vienna

Table N°1: The world records of the 800m men and women.

I.4. Men's 1500m and Women's 1500m World Records:

Region	Type	Performance	Athlete	Date	Location
In the open air	M	**3 min 26 s 00**	Hicham El Guerrouj	July 14, 1998	Rome
	F	**3 min 50 s 07**	Genzebe Dibaba	July 17, 2015	Monaco
Indoor	M	**3 min 31 s 04**	Samuel Tefera	February 16, 2019	Birmingham
	F	**3 min 55 sec 17**	Genzebe Dibaba	1er February 2014	Karlsruhe

Table N°2: World records of the 1500m men and women.

I.5. Algerian records of 800m and 1500m:

- 800m Men and Women:

Type	Performance	Athlete	Date	Location
Male	1 min 42 s 61	Taoufik Makhloufi	August 16, 2016	Rio de Janeiro
Female	1 min 58 s 72	Hassiba Boulmerka	July 17, 1991	Rome

Table N°3: Algerian records of 800m men and women.

- 1500m Men and Women:

Type	Performance	Athlete	Date	Location
Male	3 min 27 s 37	Noureddine Morceli	July 12, 1995	Nice
Female	3 min 55 s 30	Hassiba Boulmerka	August 8, 1992	Barcelona

Table N°4: Algerian records of 1500m men and women.

II. The middle distance:

II. 1.Definition:

The middle distance refers to all athletics races between the sprint and the long- distance (from 800m to 3000m), which take place in a sports arena or outdoors. Only 800m and 1500m are on the program of the Olympic Games or the World Championships. The 800m is the pivotal event between the extended speed of the sprint and the endurance events. Athletes first run a quarter lap of the track in their lane, similar t o the 400m, before falling back to the rope after 100m of running. Competitors must then demonstrate, in addition to their physical ability, a tactical sense of anticipation and skill. The 1500m is a race that includes 3 and ¾ laps around a 400m track. It requires from the competitors a certain endurance, a tactical sense of race as well as an ability to accelerate and resist in the last lap.

NB: The middle-distance races are run in a pack, except for the first 100m of the 800m which are run in lanes.

II.2 The course of the middle-distance event (800m-1500m):

Middle-distance running is practiced in a stadium, in competition. It requires a significant effort over a short period, but one must know how to run correctly, which means saving energy while having the best biomechanical performance. The qualities of the strides, the acceleration, the conservation of the speed, until the end of the race, of its breath, capacities of recovery during the race, and aerobic and anaerobic are necessary skills for the runner of half-distance.

Self-control and a competitive spirit can influence the course of the event and, with proper training, allow the athlete to win.

It should be noted that in middle-distance races, competitors may not receive outside assistance. Persons not taking part in the race may not participate in the race and lead the pace for the benefit of one or more runners. Similarly, a rider who is one lap behind and is about to be overtaken may not become the "hare" of the competitors in the lead. Any rider who pushes a competitor cuts him off or hinders his progress is disqualified.

II.2.1. The departure:

The start is given by a sound signal (gunshot or electrical signal). The starter must give the signal as soon as he has checked that the competitors are stationary in the appropriate starting position. "In all international meetings, the starter's orders are given in his natural language or English or French. In reality, the starter gives his commands in the language of the organizing country. For races longer than 400m, the Starter's command is "On your marks!" inviting "without delay the runners to take up their full and final starting position immediately", one foot behind the line. "During the start, an athlete shall not touch beyond the line or with his hand(s). When all runners are stationary, the Starter shall fire a pistol or activate the approved starting apparatus. After a standing start (no starting blocks), the 800m is run in lanes for 110m, then runners are allowed to leave their lanes from the breadline. This 5cm wide curved line is drawn across the width of the track from one end to the other at the exit of the first turn. The athlete who falls back to the rope before this line is disqualified, hence the special marking of this line in major competitions. Its two ends are indicated by two flags at least 1.50m high, placed outside the track. For the 800m, small cones or prisms of 5cm by 5cm and a maximum height of 15cm may be placed at the intersection of each lane line with the break line. Two athletes may, if necessary, share the same lane. Above 800m and especially the 1500m, the starts shall be in line. Athletes are placed in a pre-determined order following the starting line curved from the rope to the outside of the track.

With the new rules where a "zero" false start has been introduced, when there is a false start, the athlete at fault is immediately disqualified and must withdraw from the race.
However, in international meets, countries may agree to use the curved start line, not the lanes for the 800 meters, depending on the number of competitors.

II.2.2. The technique of the race :

In the stride when walking, the body is always in contact with the ground, either on one foot or on both.

But in running, the periods of support on one or the other foot alternate with a period or (phase) of suspension where the body rises above the ground.

The running man progresses by jumping from one foot to the other, each jump being considered a stride.

The stride technique or running technique (succession of strides) is characterized by the way the runner:

- Receives on the ground (reception or damping).
- Leaving the ground by the push, the impulse, the clawing action is more attenuated, the middle-distance runner is distinguished especially by the frequency and the amplitude of his strides, these are, in general, of great amplitude, sometimes rather close to the values recorded in the sprint, but with frequencies of less raised supports.
- Manage your pace.

The real technical specificity of the middle-distance event appears rather at the level of race management. Indeed, the adoption of a regular pace seems to be an essential element for the most rational use of the physical potential.

This adoption assumes a good knowledge of travel speeds and the relationship between the duration and intensity of the effort.

Furthermore, running within a group (peloton) requires a skill that can be classified as one of the technical elements to be acquired.

In the end, this is the essential corollary to the ability to run at a regular pace, the athlete must develop the ability to adapt to voluntary or provoked changes in pace. The good runner is the one who knows how to adapt to all these hazards and to keep the best awareness of his possibilities as well as of his limits while being able to take charge of the running technique that is required. Experience is irreplaceable at this level. In the field of competition, this ability is essential, and often makes the difference between two athletes of the identical level.

➢ Some special aspects for the 800m and 1500m runner:

- **The effort of the 800m:** The critical phase of this race is between the 400m and the 600m in a well-conducted race (anaerobic phase 65% and aerobic phase 35%); the distribution of the effort most often adopted is the equality of the trains: first 400m is equal to the second 400m. It should be noted, however, that many runners from distances shorter than 400m prefer to run the first half of the race faster than the second (**Fiasconaro**), while runners from longer distances tend to set the record with a slower first half of the race than the second (**Ryun**).

- **The effort of the 1500m:** from the 1500m, the aerobic and anaerobic processes are balanced (50% -50%). In this discipline, there are two opposite types of runners.

On the one hand, the resistant runners with muscular qualities oriented toward work in oxygen debt such as **Ryun** and **Snell,** and, on the other hand, the enduring runners, more adapted to aerobic efforts such as **Wadoux** and **Norpoth**. The critical phase for the former will appear around 1000m, for the latter around 1200m. The distribution of effort will depend on the tactics adopted or the goal sought (victory or record). However, the former will tend to slow down the first phase of their race so that the critical phase appears later, the latter will consider the equality of the trains.

II.2.3. Arrival:

There is no specific finish for the middle-distance race that differs from other races, like these, the ranking will be done in the order judged according to the position of the torso (the chest) of the runner (excluding any other part of the body), the
The stopwatch is only started when the chest crosses the vertical plane of the inside edge of the finish line.

III. Bioenergetics of the 800 m race:

III. 1. The energy process of the 800m race:

The transformation of chemical energy into mechanical energy and heat, during muscular exercise, requires the hydrolysis of adenosine triphosphate (ATP) molecules present in the muscle.

ATP is the source of energy immediately available for muscle contraction. However, intracellular ATP reserves are low and do not allow for more than a few seconds of full activity on their own.

The resynthesis of ATP can be done by the anaerobic or an oxidative pathway (in the absence of oxygen) and aerobic or oxidative pathway (in the presence of oxygen). From the beginning of the effort, the energy comes mainly from the degradation of phosphagen reserves (ATP-CP) present in the muscle. These reserve phosphagens, which are the basis of the anaerobic mechanism galactic anaerobes exist in the body only in very limited quantities. It is considered that, at its maximum, the anaerobic alactic process is exhausted in a few seconds (5" to 10").

As the duration of maximal exercise exceeds 10seconds, the use of ATP and CP stores becomes less important in favor of anaerobic glycolysis. **W. MC. Ardle - F. Katch and V. Katch (1996)**, believe that as the duration of exercise approaches one minute, the power produced is somewhat reduced and the energy that is mostly drawn from anaerobic glycolysis will result in the production of lactic acid.

According to the same authors, as the duration of exercise increases, the intensity is further reduced, so that anaerobic sources lose their importance to make way for aerobic sources. These three energy systems (anaerobic alactic, anaerobic lactic, and aerobic) are often used at different times during the same physical activity but not in isolation. The use of one is always associated with an increase in the activity of the other two, and the importance of each depends on the intensity and duration of the exercise.

III.1.1. Contribution of energy processes in the 800 m race:

The 800 meters where you have to go as fast as possible and for as long as possible, the race is done both aerobically and anaerobically to meet the energy requirements of the event. The percentage of each of the energy production mechanisms varies during the effort. For the 800m, the percentage of energy channels used during the event can vary between 55% and 70% anaerobic, and 45% to 30% aerobic (**Phillipe Collard and Driss Maazouzi 2002**).

III.1.2. Participation in the anaerobic process:

During a physical exercise of increasing intensity such as the 800 m where the first 150 meters are very fast (essentially related to the placement problem), the muscle is forced to use anaerobic energy to contract (**J. R. Lacour 2002**).

According to **R. Flandrois and H. Monod (1977) p. 16**, "the ATP-CP reserve constitutes the source of energy immediately available at the beginning of the exercise. It does not require the presence of oxygen and is not accompanied by the formation of lactic acid (anaerobic alactic source), but it is weak and only allows the continuation of an exercise, even if it is not very intense, for about ten seconds.

According to **W. Mc. Ardle et al (1996)** believe that as the duration of exercise approaches one minute, the power produced is somewhat reduced and energy is mostly drawn from anaerobic glycolysis which results in the formation of lactic acid. The anaerobic process is characterized by two phases: the anaerobic alactic pathway requiring no lactic acid production and the presence of oxygen; the anaerobic lactic pathway with high lactic acid production.

III.1.2.1. Anaerobic alactic metabolism:

At the beginning of an effort with high intensity, the energy needs cannot be covered by the oxidative process, because of the slowness of the cardiorespiratory system which takes some time to adjust to the demand (**Hersrnan1969**).

The muscle is therefore forced to use anaerobic energy to contract. The first biochemical reaction to produce energy comes from the hydrolysis of ATP. The ATP reserves present in the muscle cell are about 6 mmol/kg of wet muscle and are only sufficient for 2" to 3" of maximal contraction according to **Keul, Doll, and Keppler (1969)** quoted by **Jürgen Weineck (1997)**. For the muscular effort to continue, ATP is renewed with great speed by another phosphate-rich compound: creatine phosphate (CP), which is also stored in the muscle. Roughly speaking, the reserve of CP is of the order of 20-30 mmol/kg of wet muscle (**Keul, Doll and, Keppler 1969**).

This immediate synthesis of ATP from CP allows a maximum effort of about 20 seconds. The reserve phosphagens (ATP-CP), which are the basis of the alactic mechanism, exist in the body only in very limited quantities; according to **Saiben**, their presence in the muscles is barely sufficient to cover a distance of 103 m.

III.1.2.2 The anaerobic lactic metabolism :

As soon as the phosphagen reserves (ATP-CP) in the muscle decrease considerably, anaerobic lactic metabolism ensures the resynthesis of ATP. The production of energy by the anaerobic lactic pathway or anaerobic glycolysis takes place in the sarcoplasm of the muscle cell. It represents the main energy supply when the effort is very intense, and the oxygen needs of the muscles are not satisfied.

The maximum power of anaerobic glycolysis is reached around the 45th second (**Jürgen-Weineck 1997**). When the muscular effort is very intense, and the oxygen supply becomes insufficient, lactic acid, which is the product of anaerobic glycolysis, appears in the blood.
This production of lactic acid progressively leads to a decrease in muscle and blood PH, thus causing a homeostatic imbalance. According to some authors, the acid-base imbalance and the drop in PH linked to high to maximum lactatemia are responsible for fatigue during short events (400 m and 800 m).

The intensity of the effort will decrease under their influence. The lactic acid thus produced becomes the main limiting factor of supercritical endurance. After an exhausting effort like the 800 m, its blood concentration is around 20mmol/l (**Jürgen Weineck 1997**).

III.1.3. Participation in the aerobic process:

The aerobic process is the energy pathway whose physiological reactions rely on oxygen brought into the muscle cells by the bloodstream. This process takes place as soon as the concentration of lactate in the blood increases considerably to ensure the resynthesis of ATP while limiting the level of lactate in the body. The aerobic pathway is characterized by oxygen consumption and this is not suspended at moderate or low-intensity exercise. During an exercise of increasing intensity, oxygen consumption increases linearly with the power developed up to a limit value that remains constant, even if the power imposed is further increased (**R. Flandrois and H. Monod 1977**).

According to **C. Dénis (2002**), (**p.22**), "the 800m fi must not be considered as an exclusively anaerobic discipline because the subject calls upon the aerobic process for approximately 50% of the total energy spent". In an 800m race, the part of the aerobic process is not negligible because according to **J.C.Vollmer**, the obligation of placement imposes a beginning of race whose rhythm is higher than the average rhythm of the race.

As a result, a significant production of lactate appears from the first 150 m. The rest of the race must be managed with this constraint. During the 800 m, the aerobic process does not intervene directly in principle in the energy production until the end of the race, when the increase in the rate of lactic acid and the rate of intramuscular acidity (decrease in PH) will lead to a decrease in the intensity of the effort. Therefore, the closer the maximum aerobic speed (MAS) is to the specific rhythm, the more its intervention will be preponderant and will spare the anaerobic process.

III.1.4. The lactate in the body:

Lactic acid, which is the end product of anaerobic glycolysis, appears in the blood whenever the oxygen supply is insufficient. The production of lactate changes according to the intensity of the effort. When the exercise is very intense, the oxygen supply becomes insufficient; and anaerobic glycolysis, by providing energy to the muscles, will be accompanied by a drop in PH and the production of lactic acid. This production of lactic acid will lead to both local and general changes in metabolic exchanges.

It is possible that the increase in lactate concentration or decrease in muscle PH also intervenes by altering the contractile processes at the level of the myofibrils, thus decreasing their ability to develop sufficient tension (**Hersman 1977**).

Jean-Paul Détrouloux (1988), believes that the acidification of muscle fibers inhibits the degradation of glycogen by modifying the enzymatic functions of glycolysis and decreases the capacity to create actin-myosin union bridges. This means that lactic acid is the primary factor preventing the continuation of exercise.

Jürgen Weineck pointed out in 1997 that after strenuous exercise, the measured intramuscular lactate concentration can exceed 25 mmol/kg, while in the blood, the concentration of lactic acid is around 20 mmol/l.

IV. The bioenergetics of the 1500-meter race:

IV.1. The energetic process of the 1500-meter race:

The physiology of muscular contraction, which is necessary for the exercise or physical work, is both highly complex and of low mechanical efficiency. In a race such as the 1500m, the body is rather energy-hungry: barely 30% of the energy expended is used mechanically to move, and the remaining 70% is evacuated in the form of heat through sweat and respiration. The only energy that the muscle can use to contract comes from the disintegration of ATP, stored in the muscle cells.

Therefore, the contraction of so-called skeletal muscles is the result of a shortening by sliding of numerous myofibrils constituting the muscle fibers. This shortening, reproduced many times, generates, by summation, the contraction of the muscle at the level of the commitment ordered by the nerve impulse. This elementary process requires each time the energy is released by the disintegration of ATP molecules.

IV.1.1. Contribution of energy processes in the 1500m race:

For the 1500m, the percentage of energy channels used in the race is 50% anaerobic and 50% aerobic (**CHARLET.S**).

According to **Alain LIGNIER**, the first 300m is often run in deceleration after the first 100m, this way of running could call on the anaerobic alactic system for energy.

The second section following the first 300m, 800m long, is very close to the average speed of the race and will challenge the aerobic system.

Finally, the acceleration gives the last 400m (last lap) will request the anaerobic lactic system

IV.1.2. Participation in the anaerobic process:

In the 1500m event, run at maximum intensities, the contribution of the anaerobic pathway is also important (**AUBERT.F, CHOFFIN.T**).

Indeed, the anaerobic alactic system is always coupled to the anaerobic lactic system: lactate is always coupled to the anaerobic lactic system: intramuscular lactate, therefore, appears from the first seconds of effort.

Although not a priority, the development of the anaerobic alactic and lactic pathway is not to be ignored in the training of the 1500m runner because having a "speed reserve" at the end of the race can be appreciable.

The anaerobic process is characterized by anaerobic alactic metabolism and anaerobic lactic metabolism.

IV.1.2.1. Anaerobic alactic metabolism:

The anaerobic alactic system, the phosphocreatine pathway, is the first to intervene in energy production. It works without oxygen (anaerobic) and lactate production (alactic). It takes over the intramuscular ATP by degrading the intramuscular reserves of phosphocreatine to run at short and intense efforts. Its high bioenergetic power can only be used in a very short time, less than 7 seconds for maximum effect, although the duration of its maximum energy production capacity is about 20 seconds.

IV.1.2.2. Anaerobic lactic metabolism:

Once the phosphocreatine reserves are exhausted, the anaerobic lactic system takes over to cover an effort that lasts between 20 and 50 seconds.

According to **Danielle Alleman** and **Philippe Dureau**, "during the 1500m, this energy channel is solicited last. It works without oxygen (anaerobic) but produces lactic acid.

Depending on the level of training, the duration of its maximum production capacity can reach 2 to 3 minutes. Since oxygen does not have time to intervene in this system, pyruvic acid is then transformed into lactic acid. The formation of lactate from pyruvate does not release energy but binds hydrogen ions to form a dissociated moderating acid. This acidity quickly disrupts the functioning of muscle contraction, leading to a significant and unavoidable decrease in running speed.

IV.1.3. The involvement of the aerobic process:

It is an energy production pathway by which the muscle uses oxygen to burn carbohydrates and lipids that will provide energy.

The aerobic system is the predominant bioenergetic pathway when it comes to sustaining an effort at a relatively high intensity. After 2 to 4 minutes, the aerobic system becomes the priority for energy supply. The oxidation of the substrates of this pathway (glucose residues, fatty acids, amino acids) requires much slower processes than those of the anaerobic pathways. The aerobic pathway has the lowest maximum power of the three energy production systems.

On the other hand, its capacity is theoretically unlimited, because the reserves of substrates degradable by oxidative processes for the supply of ATP are very large. This evidence must be taken into account in race pace strategies.

IV.1.4. The lactate in the body :

Despite all the controversy and uncertainty surrounding the lactate world, one fact remains: the level of lactate in the blood is strongly correlated with the intensity of exercise (**RIEU, 1993**).

The faster an athlete runs, the more lactate he produces. The simple fact justifies its use in the control and monitoring of training. Its legitimacy is all the greater since the performances achieved in the middle-distance running are also predictable from the lactate levels taken during training.

Many authors have shown that the lactic threshold, given the fraction of maximum oxygen consumption, corresponds to a rapid increase in the level of lactate in the blood (**Mac DOUGALL, 1977, SKINNER and MC LELLAN, 1980, SJODIN and JACOBS, 1981, BROOKS, 1985, DAVIS, 1985**).

For some of them, it is a more reliable indicator of endurance performance than oxygen consumption (**MILLER and MANFREDI, 1987**).

Objectification of the effort undergone by the body, prediction of performance: these are all characteristics that have accompanied and contributed to the development of the use of lactate in sports.

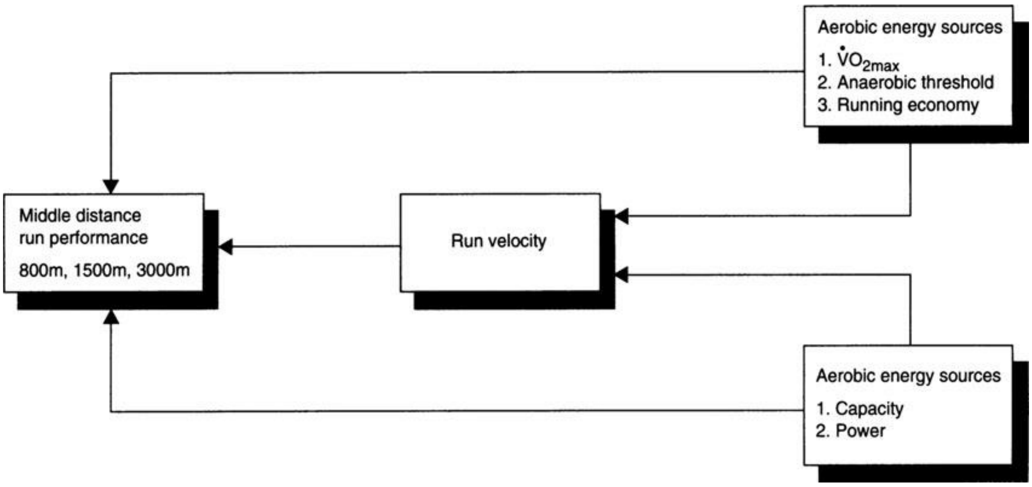


Figure N°1: Illustrates the contributions of aerobic and anaerobic variables to the performance of middle-distance running.

Chapter two : Evaluation of the physical qualities

I. Physical qualities :

I.1. Concepts:

Sports performance depends on several interacting qualities: mental, relational, technical, tactical, and physical.

Physical qualities are the expression of the constitutional factors that support human physical performance. The dictionary of physical activities and sports (APS) defines physical qualities as "characters, individual properties, on which physical performance is based".

J. Weineck asserts that physical qualities represent the basic material of coordination.

According to Manno R. (1991), the motor capacity or physical qualities constitute the presupposition or basic motor prerequisite, on which the man and the athlete constitute their technical abilities.

The physical qualities of **Cazorla** and **Dudal are quoted by Seck. K (1999),** the physical qualities represent "the most simplified dynamic expression" of the biological components of the motor action.

But it is necessary to point out that at a time when some people use the concepts of physical qualities, others speak of physical capacity. There is certainly not a big difference because the people who have defined these concepts recognize the existence of a common base which is nothing else than the physical aptitude from which a capacity or a quality develops and is expressed.

SECK, K (1991) continues by quoting **Gilewicz (1964)** who defines physical aptitude as the current possibility of carrying out motor acts requiring of us the setting inaction of the fundamental motor qualities which are the force, the speed, the address, and the endurance.
The physical qualities represent the basic material of the coordination **J.Wiencek (1992)(Weineck, Biologie du sport, Vigot, Paris, 1992).**

Traditionally, physical qualities are defined according to five terms which are: Speed, Endurance, Strength, Coordination, and Flexibility.

Figure N° 2: The different physical qualities.

II. The different families of physical qualities:

R.Manno distinguishes three (03) main types of physical qualities:

- The conditional qualities (muscle and apparatus): strength, resistance, and speed
- Coordination skills: ability to organize and regulate a movement
- Intermediate qualities: flexibility and speed of reaction

J.Weineck distinguishes only two (02) main types:

- Factors mainly dependent on physical condition (energy process): endurance, strength, and speed
- Factors that depend primarily on coordination (SN control process): flexibility and coordination capacity.

III. Classification of physical qualities:

III.1. Endurance:

Endurance is considered to be the "ability to perform any activity for a long time without a decrease in efficiency" **Zatsiorsky, V. M. (1966).**

According to **Weineck (1990)**, the "psycho-physical capacity of the athlete to resist fatigue

It is a quality that allows both the development of the cardiovascular and cardiorespiratory systems by performing actions maintained at a given intensity and for a given time in aerobic capacity, aerobic power, resistance, optimization of the VAM, or speed associated with maximum oxygen consumption (Vo2max).

Endurance is considered as the ability to perform any activity for a long time without a decrease in efficiency or as the psycho-physical ability of the athlete to resist fatigue.

Or as "the ability to express a motor skill of any intensity for the longest possible time" M.Pradet (2001).

Or "endurance refers to the notion of postponed fatigue and the time limit constantly exceeded". **G. Gacon (1998).**

III.1.1. The different forms of endurance :

There are several forms of endurance:

Figure N° 3: The different forms of endurance.

III.1.1.1. Basic endurance:

It corresponds to the basic intensity of physical training with the privileged use of lipids. It allows the use of free fatty acids and therefore maintains the blood sugar level in the blood. It is equivalent to a moderate intensity effort that will be between 60 and 70 of your maximum heart rates. During this type of training, the athlete is not out of breath and can hold a conversation during the effort (jogging). We talk about aerobic work; the oxygen brings sufficient energy to the muscles. Breathing is rapid and there is no sensation of breathlessness. The effort can therefore last in principle as long as the reserves are present.

III.1.1.2. Aerobic capacity (AC):

The aerobic capacity corresponds to the intensity from which the athlete develops his endurance qualities.

Physiologically, it allows glycolytic utilization resulting in an accumulation of lactate. Thus, the reserve of muscular glycogen will increase. CA will improve the functioning of the cardiovascular and cardiorespiratory systems with an increase in the number and surface of mitochondria, elements essential to the development of endurance and thus the oxygen reserve of the cell and blood.

Costill and Trappe (2002) showed that a 27-week training period was accompanied by a 5/week increase in the number of mitochondria and a 35/week increase in the size of mitochondria, as well as an increase in the density of capillaries (which irrigate muscle fibers) and an increase in aerobic enzymes.

III.1.1.3. Aerobic power PA:

Aerobic power corresponds to the intensity from which one will increase, and optimize one's endurance potential, and one's capacity to maintain high-intensity runs. The recommended exercises are either continuous or based on interval exercises or intermittent exercises. They are applied with variations in load and type of recovery.

Aerobic power is worked at a speed between 90 / and 120/ of the v VO 2 max or the VAM. There are three types of exercise: continuous, interval, and intermittent. The most commonly used are intermittent exercises such as short line and shuttle runs (during the season). These are exercises of type 30-30, 20-20, 15-15, 10-10, 5-25 (work time recovery time)... The intensity is defined according to the objective of the session and is applied according to the VAM and therefore according to the corresponding distance.

III.1.1.4. Active endurance:

Here the effort is more intense and the heart rate higher (80 -90 of the FC max), the athlete is no longer able to speak normally, is out of breath, and must take breaks. We speak then of work in anaerobic, that is to say, that the oxygen misses us and our body produces an important dose of lactic acid. The energy is drawn directly from the reserves of the muscles involved.

III.2. The speed:

According to **Fry (1977),** speed is the capacity that allows, based on the mobility of the processes of the neuromuscular system and of the properties that the muscles have to develop force, to accomplish motor actions in a minimum time in given conditions.

The speed of the athlete is a very diverse ability. It involves not only the capacity for rapid action and reaction, the speed of starting and running, the speed of handling the ball, sprinting, and stopping, but also the speed of analysis and exploitation of the situation at hand. (**Weineck, 1997, From training to performance).**

The speed of the sports player is a complex ability that consists of different psychophysical abilit**ies. (Bauer, 1981).**

III.2.1. The different forms of speed:

III.2.1.1. The maximum speed:

This is the maximum speed that an athlete can reach. It varies according to the individual and can be reached at distances that vary according to the position. In team sports, we consider that a player reaches his maximum speed at around 45 to 55 meters. When training with maximum speed exercises, players accumulate lactates and other metabolic waste products and therefore the recovery time will approach 48 hours.

III.2.1.2. Short speed:

It includes short distances directly influenced by the ability toreact, anticipate and act. It corresponds to the start and changes in direction. These actions are omnipresent in team sports (**Dllal** and **Keller, 2004).** During the training that includes short speed exercises, the recovery time is 24 hours. The main energy substrate, phospho-creatine (PCR), is rapidly regenerated; however, we must be careful with the number of sets and repetitions that can induce a significant rise in lactate.

III.2.1.3. Speed -coordination:

It consists of mastering actions in predictable situations (automatism), or unpredictable (adaptation), economically exercising them, and to learn quickly the movements, at a certain speed. We try to carry out actions, and technical gestures (dribble, control-pass sequence...) at an optimal speed. The recovery time is 24 hours because the main energy substrate (PCR) regenerates very quickly.

III.2.1.4. Speed-force:

The speed is directly influenced by the quality of the strength of the lower gear. The thrust during the first few meters of a start is very important and depends directly on the strength of the player **Kotzamansis** et **al, (2005)**. It is a question of performing various fast actions while being subjected to a load (parachute, elastic, terrain, mud, hill, an opponent...).

III.2.1.5. The speed-power in dimension:

Speed can be worked on by exercises on inclined slopes. During a hill session, the inclination should not exceed 10/15 to remain in a power - speed or strength - speed work. The more the angle of the hill is important, the more the concentric pushes of the quadriceps will be important. This type of hill work is also interesting to quickly increase the heart rate to 100 BPM in less than 10 seconds, which deteriorates the gestural frequency. We can consider staircase work on low steps to train the player's power, especially for the return of hamstring injuries.

III.2.1.6. Speed- Endurance:

This is the player's ability to perform repetitions of short or long sprints without losing speed (return to a better state of freshness between each sprint). This work allows the player to repeat sprints and maintain maximum speed for as long as possible, increase phosphagen reversals, be protected against lactic acidification (drop in pH, long sprints), and return to a better state of freshness before each start of the sprint. The recovery time approaches 72 hours as players accumulate lactates and other metabolic waste.

III.3. Coordination :

The Coordination is the ability of athletes to control actions in predictable or unpredictable situations, to perform them economically, and to learn the movements quickly enough." **FREY (1977).**

In a more physiological context, **Hahn (1982)** defines it as "the simultaneous action of the central nervous system and the skeletal muscle to execute a voluntary movement in such a way that there is a harmonious sequence between the different components of this movement. The ability to coordinate (synonym skill) is determined primarily by the processes of control and regulation of movement. "It allows us to master motor actions with precision and economy and to learn gestures relatively more quickly Sportsmen " **(J. WEINECK, 1992).**

Coordination skills are closely related to technical and tactical skills. They appear in three aspects of the execution of a movement:

- The course of the movement.
- Adaptation to changing conditions.
- refining the adjustment possibilities.

III.3.1. Coordination skills:

III.3.1.1. Quality of orientation:

It makes it possible to perceive and take into account the reference points and the space-time modifications " quoted by **WEINECK (1992) ".**

III.3.1.2. Quality of differentiation:

It makes it possible to control the interior and external information and to proportion, to adapt the engagement of the force or the space-time precision" quoted by **Weineck (1992) .**

III.3.1.3. Quality of reaction:

The necessary condition to recognize situations quickly and to bring appropriate motor responses " quoted by **Weineck (1992) ".**

III.3.1.4. Quality of balance:

It allows either to maintain a position or to find it quickly in difficult situations" quoted by **Weineck (1992).**

III.3.1.5. Quality of rhythm:

Ability to carry out a sequence of movements rhythmically and dynamically, or to grasp and apply a given rhythm " quoted by **Weineck (1992) ".**

III.4. Flexibility:

Synonymous with joint mobility, flexibility is considered "the ability to perform gestures with the greatest amplitude, whether actively or passively" **R. MANNO (1992).**

According to the classification of **R. MANNO (1992),** flexibility is an intermediate capacity because its limiting factors are both anatomical and neurophysiological (emulative).

It is a physical quality like any other. As such, it has the same characteristics of specificity, trainability, de-trainability, load programming, etc. It is the intrinsic property of the tissues that determines the degree of movement that can be achieved without injury to one or more joints.

III.4.1. Flexibility factors:

From an anatomical point of view, the limiting factors are:

- the type and shape of the articular surfaces.
- the extension capacity of muscles, tendons, ligaments, and joint capsules.
- are the muscles which, thanks to their relaxation regulation, are the most suitable for stretching work (and therefore for training influences).
- There are two (02) sub-categories of flexibility:
- joint flexibility, which concerns the structure of the joints (often called laxity)
- the stretching capacity which concerns muscles, tendons, ligaments, and capsular structures.

More specifically we distinguish:

Depending on the muscle mass:

- **General flexibility:** mobility of the main articular systems, scapular joint, xoxo-femoral joint, spinal column.
- **Specific flexibility: the** ability to be flexible in a specific joint. According to the mode of muscular work:
- **Active flexibility:** maximum amplitude of a joint by the contraction of the agonists and the stretching of the antagonists.
- **Passive flexibility**: maximum amplitude obtained under the effect of an external force. (Quoted by **WEINECK).**

III.5. The strength :

Muscular strength is defined as the tension that a muscle or group of muscles can apply to resistance in a single maximal effort" **FOX** and **MATTHEWS.**

For **Fox** and **MATHEWS (1981):** "strength is the ability of a muscle group to exert

maximum strength against resistance."

These two authors will later specify: Muscular strength is defined as the tension that a muscle or more precisely a group of muscles can oppose to resistance in a single maximal effort. **WEINECK (1997).**

III.5.1. Different types of strength:

1II.5.1.1. Maximum strength:

It is the force that a muscle or a group of muscles can develop during a movement.

If the resistance is insurmountable: it is the maximum isometric strength (without displacement). If the resistance is lower: it is the maximum dynamic strength (with displacement).

III.5.1.2. Speed strength:

It is the strength that characterizes the neuromuscular system to overcome a resistance with the greatest possible speed of contraction. It is a variant of the dynamic strength; we distinguish two components:

- **Explosive strength:** the ability to accelerate a movement that has already begun.
- **The starting strength:** maximum increase in strength production at the start of the movement.

If the resistance is low, the starting strength dominates, if the resistance increases, the explosive force prevails.

III.5.1.3 Strength endurance:

It is the capacity to resist fatigue in long-duration efforts with dominant force. It is based on:

- the intensity of the stimulations (% of the maximum strength).
- the amplitude of the stimulations (number of repetitions).
- the duration of the exercise.

Depending on the discipline, we can find a strength-dynamic endurance, a strength-static endurance, or a strength-speed endurance.

IV. The evaluation:

"To evaluate is to give a value to an observation or a measurement of a behavior, a criterion, a result of a performance, to decide within the context chosen by the evaluator" (**Cazorla, 1999**).

Assessment has long been a much sought-after research object that has allowed for evolution from an initial social, largely summative purpose to one of learning optimization.

According to **Cardinet. 1988** evaluation is the provision of feedback on the results of past actions, which allows the subject to adapt the continuation of his actions with his goal**.**

According to **Maccario (1986)**: "evaluation allows for the development of a training plan based on the strengths and weaknesses of the athlete, and thus for the establishment of realistic and achievable objectives and content".

IV.1 Objective of the evaluation:

The objectives of evaluations are multiple:

- To know the athlete, his or her strengths and weaknesses, and the adaptations related to training.
- Evaluating an athlete is necessary to give meaning to the training project and to know where we are starting from to reach an objective. The test must be part of a training methodology.
- Monitoring the effectiveness of the training process for regulation and remediation of any errors. It is, therefore, necessary to evaluate the progress to validate the coach's choices.
- To determine the abilities of an individual about an established and precise criterion.
- Detect possible risks of injury, particularly through the use of imbalance calculations.
- Detecting problems, especially in young athletes. Drawing up a complete profile with objective data will allow orientating the physical preparation sessions.

IV.2 When evaluated ?

The evaluation process must be continuous but in different ways depending on the parameter considered and the complexity of the evaluation. Indeed, a single evaluation in a sports season does not allow one to know an athlete. On the other hand, repeating them over time to compare them will be useful and will help to avoid interpretation errors. The placement of the evaluations in time is as follows:

- Placed at the beginning of the training cycle, the evaluation serves as a diagnosis for the construction of the training plan. It is an inventory of strengths and weaknesses.

- Carried out during the cycle, it allows for the verification of the progress made and authorizes possible corrections. It is an operational evaluation.
- At the end of the cycle, the sum of the acquired knowledge is evaluated and the level reached is indicated. This is the summative evaluation.

IV.3 Evaluation criteria:

Assessments can be performed in the laboratory or the field. In the first case, the measurements are direct and therefore precise, but access to this type of test is sometimes difficult. In the second case, the implementation is easier, but the accuracy of the estimates of results by indirect measurements depends on the following requirements:

- **Objectivity**: the results must be independent of the "tester" to express the reality with accuracy.
- **Fidelity**: the test conditions must be identical each time for the results to be comparable. If the test is repeated the next day, for example, the results, within the margin of error, should be identical.
- **Validity**: this principle expresses the fact that a test must have been tested and validated to be used as a reference, such as the VAMAVAL-test for VO2max. However, a trainer can set up tests specific to his discipline that respect the stated imperatives.
- **Relevance**: the test must be related to the discipline practiced to make a coherent evaluation of the preponderant criteria. Related does not mean derived from a specific action or gesture. In our case, we are talking about the type of effort. If we want to evaluate a physical capacity, it is better than the degree of technique influencing it as little as possible.

V. Evaluation of physical qualities:

Objectivizing physical training is fundamental. This step involves evaluation sessions or even daily evaluations to determine a state of fitness. Classic evaluation sessions require some precautions to be taken so that the data recorded is reliable and reproducible. Evaluating even the simplest physical quality can have pitfalls and bias the interest.

Evaluation in physical preparation is a fundamental step to objectifying and individualizing physical training. Even if the principle of evaluation is simple, there are many pitfalls to avoid to obtain the most accurate values possible and to make the right interpretations. We will only talk about the evaluation of physical qualities. The evaluation of technical-tactical parameters, a psychological profile, of medical aspects, ... will allow us to know the athlete in the most complete way possible and thus propose adapted contents.

V.1. Evaluation of strength qualities:

V.1.1. Determination of the maximum strength:

The goal is to find the load that can be lifted only once.

V.1.1.1. By direct evaluation:

This solution is the one that best allows us to know the maximum load, called the1RM. This method should only be used by athletes who are familiar with the movements to be performed, warmed up perfectly, and using an established protocol.

V.1.1.2. By indirect evaluation: The principle is to calculate the maximum load from a sub- maximal load lifted between 2 and 10 times. This method is the one to be used by athletes who are not familiar with weight training under bars.

This estimate is possible because a quasi-linear relationship exists between percent strength and the number of reps achievable (Sale and McDougall, 1981).

V.1.2. The determination of the explosive strength:

V.1.2.1. Explosive strength of the upper limbs:

V .1.2.1.1The 3 kg medicine ball throw:

- From a sitting position, back against a wall, legs spread and stretched, throw a medicine ball in front of you (not upwards) as far as possible
- Make three consecutive attempts and note the best distance
- Measurement between the starting point of the medicine ball and the point of impact.

V.1.2.2 Explosive strength of the lower limbs:

V.1.2.2.1. The Sargent test (vertical expansion):

Beyond the interest of the vertical expansion measurement, an evaluation of the power of anaerobic alactic can be deduced, by combining the test result and the weight of the subject. AAP = (4.9)2 x weight (kg) x height (m).

Squat jump, countermovement jump, drop jump (vertical relaxation and quality of muscular elasticity) On a Bosco mat that allows you to calculate the time spent in the air between contact with the ground at the start and the time of landing.

V.2. Assessments of flexibility qualities:

The evaluations will be done on the various articulations according to different plans:

- Scapular belt (arm extension).
- Pelvic girdle (abduction, flexion).
- Knees and ankles (flexion).
- Stand with your feet together on a step and stretch your legs.
- Lower your hands to the ground and measure the positive or negative difference between your fingertips and the surface of the ground.

Or

- Facing a wall, stand aside with your feet against the wall and your legs straight and completely on the ground;
    - Measure the distance between the wall and the anterior surface of the pelvis.

V.3. Evaluation of speed and coordination qualities :

V.3.1 Evaluation of gestural speed qualities:

The aim is to measure the time covered over a very short distance (30 to 40m sprint, 15m swimming, etc.) or the number of specific gestures performed for 7-8sec (fouettés or directs au sac in French boxing, etc.).

V.3.2 Evaluation of speed endurance qualities:

The goal is to measure the ability to maintain a maximum speed (the second part of 120m for example), or the number of specific gestures performed in the last 10 seconds of a 20-second effort at maximum speed (stereotyped sequence such as front jab - back jab - front whip to the bag in French boxing, etc.).

V.3.3 Evaluation of speed resistance qualities:

The aim is to measure the ability to repeat a short effort (5 to 7sec or 30 to 40m thrown) at maximum speed with passive recovery times of about 30sec. Perform seven repetitions and record the exercise time. The difference and calculation of the percentage between the worst and the best time will indicate the ability to repeat a maximum speed effort. The overall time can also be recorded.

This principle can be realized for sprints or specific gestures.

V.3.4 Evaluation of speed and coordination (10 x 5m shuttle):

The principle is to make 10 trips at maximum speed between 2 lines spaced 5 meters apart. Only one test is performed.

- Position yourself behind the line, one foot just behind it.
- Both feet must systematically cross the line.
- The calculated time is the one taken after the 10 trips.
- Be careful not to perform the test on a slippery floor.

V.4. Evaluation of the quality of endurance :

The endurance capacity of a person is a fundamental reference for planning adequate physical training or re-training. Aerobic tests are tests to determine the physical, ventilatory and cardiac adaptations to the effort.

They must be part of a very precise methodology so that they are both reproducible but also reliable.

V.4.1. The different endurance tests :

Test	***Material needed***	***Realization of the protocol***	***Duration***	***number of evaluated at a time***	***number of evaluators***
1- Cooper	1 track + 1 stopwatch	Very easy	12 min	10 to 20 max	1
2- Shuttle race 20 m	1 flat surface 15 X 22 m 1 recorded cassette 1 video recorder	Easy and well explained	15 to 20 minutes	depends on the length of the parallel lines	1
3- Vameval	1 multiple track of 20 m 1 recorded cassette 1 tape recorder + amphitheater	Easy and well explained	10 to 20 minutes	possibility to evaluate up to 100 people	1 or more depending on the number of evaluated
4- Leger Boucher Track Race	1 multiple track of 20 m 1 recorded cassette 1 tape recorder + amphitheater	Easy and well explained, speed sometimes difficult to adjust	10 to 30 minutes	Possibility to evaluate up to 50 people	1 or more depending on the number of evaluated
5- TUB2	cardio frequency meter + samples	Easy and well explained	10 to 30 minutes	Depending on the number of heart rate monitors and the number of authorized samplers	Minimum 1
6- Race behind a cyclist	1 flat course 1 adapted bicycle 1 recording	Easy but evaluator used to pedal frequency	10 to 25 minutes	Possibility to evaluate 4 to 6 people	Minimum 2

Table N°5: The different endurance tests.

Chapter three : Sports morphology

I. Morphology:

1. Definition: Is defined as the science that studies the shape and external structure of the human being. According to Solon **Olivier** (1971), it is the study of the human form on the internal (anatomy) and external (anthropometry) levels.

Vrijens (1991) defined morphology as the result of the interaction of endogenous (hereditary) and exogenous (external) factors, including intensive high-level practice.

Biometry and anthropometry are the means used to assess human morphology. Biometry aims at the exploitation of numerical data while anthropometry refers to the technique of measuring the body.

2. Importance of morphology in sports:

According to **Lesgaft** (**1940)** (founder of functional anatomy), morphology is a fundamental science of physical education. It deals with the study of structural changes in the body of athletes under the influence of physical exercise.

Mimouni and Antipov, 1986 emphasize the fact that morphological characteristics are used as diagnostic and prognostic criteria to solve the sport selection, for the continuous control of the athlete's condition as well as for the evaluation of the efficiency of the high- level training. The genetic determination of most of the morphological parameters makes them difficult to modify by sports training. Even the most sophisticated procedures of modern training cannot overcome the limiting effects of certain morphological parameters of high genetic programming.

Hahn, 1988 also indicates that the morphological factors represent a fundamental value in any sports selection and more particularly for the detection of talents.

Bulgakova (1978) states that anthropometric data such as height, body mass, segmental ratios, and body surface area are often indispensable factors in the practice of certain sports and are an essential tool for the coach.

Olivier (1971) and Sempé (1979) consider that the relationships between the different morphological characters provide basic information for the direction of the different preparation processes.

According to **Toumanian and Martirosov (1976)**, it must be present from infancy in :

- The initial selection of children for a given sport.
- Morphological training of athletes of different specialties, whether they are beginners or confirmed athletes (the elite).
- Individual training for each athlete, taking into account morphological characteristics.
- The orientation of the inhabitants of the various ecological zones in the choice of a sports specialty and their preparation for competitions in different environments.
- Morphological criteria represent the first level of performance determining factors. They are often considered basic factors for any sports selection, as **Shürch** (1984) points out.

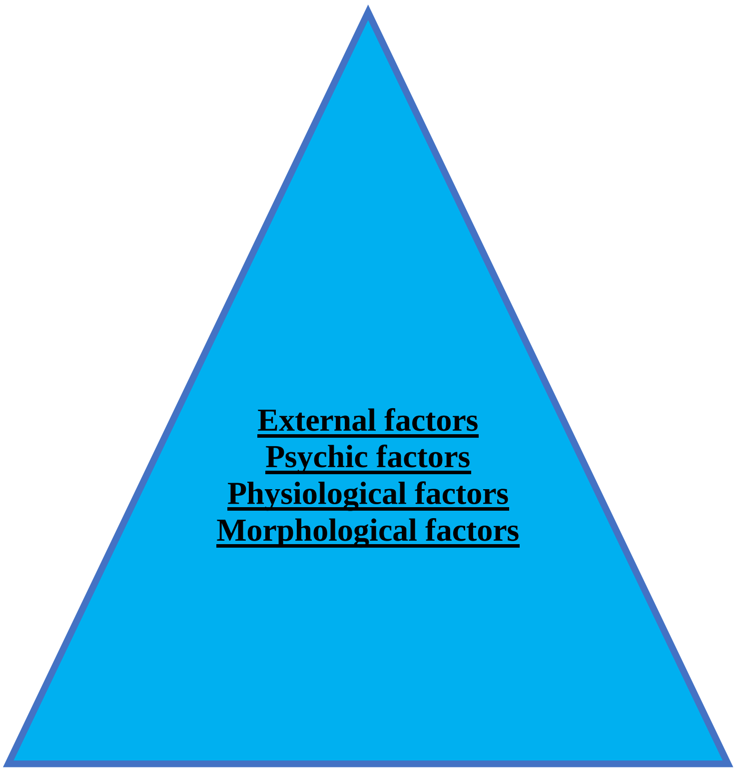


Figure N°4: Determining factors of performance according to Shürch (1984).

Many studies have been conducted to identify the anthropometric and biometric characteristics that best explain athletic success **(Carter, 1984; Vanhandel et al., 1988; Gualdi-russo and Gazani, 1993; Carter and Ackland, 1994).** The results of this research highlight the specificity of several characteristics that distinguish athletes according to the sport practiced and the level of performance achieved. The presence of an anthropometric profile well adapted to the sport practiced is an essential criterion for sports performance **(Malina et al., 1982; Gualdi-russo and Grazani, 1993).**

3. Morphology and specific aptitude of the runner:

The details that we will give below concern the form subjects. With the athletic and ground tests, and this study of the morphology, one can have an idea of the orientation to give to a junior or senior beginner who takes up athletics for the first time. **(Mambaye Diarra 1999)**

- **Sprinters :** (Up to 200 m) They are generally athletes with strong legs, torso, and arms they are, among the most muscular runners. Their sizes generally vary between 1,70 and 1,85 m, the weight from 75 to 85 kg.
- **Middle-distance runners:** They have a slimmer stature, longer legs than sprinters and a height varying between 1.70 m and 1.80 m, and a bodyweight of 65 to 75 kg.
- **Long-distance runners:** They are even less muscular than the previous ones. They are generally smaller in stature, and strength and endurance are qualities that are acquired through hard work and years of experience.
- **110m hurdlers:** They are of average height and are relatively fast light, and have a good release.
- **400m hurdlers:** Generally, these runners have the qualities of middle-distance runners and great flexibility.

4. Morphology according to Sheldon:

As with all sports activities, weight training requires that certain rules and constraints be respected, which must then be individualized according to the morphology and resistance of each person. In the middle of the 20th century, Professor Sheldon established a typology of the different existing morphologies, still used today and serving as a basis for defining the training program adapted to each individual. Sheldon's original approach, is still in use today the original approach of scientist William Herbert Sheldon (born in 1898 and died in 1977) is still a reference today. Based on the distinction made in embryology between 3 layers of tissue (the endoderm, the mesoderm, and the ectoderm), Sheldon set out to establish a typology of the different physical characteristics of an individual, by establishing a morphotype.

II. Anthropometric measurements:

For the realization of our work, we carried out anthropometric measurements according to the basic anthropometric techniques fixed in the Monaco congress of 1912.

Anthropometric measurements were taken on the whole sample: body weight, height, wingspan, length of lower and upper limbs, circumferences (arm, forearm, thigh, leg), diameters (distal arm, forearm, thigh, leg), as well as skin folds (bicipital, tricipital, subscapular, supra-iliac, belly, thigh and leg).

Body surface measurements were taken on the whole sample according to the **Izakson** (1958) formula. The body components (muscle mass, fat mass, and bone mass) were determined by a body analysis scale. Thus, the body mass index (BMI) according to WHO. And the somatotypes of the dimensions (**Carter & Heath**, 1990).

1. Weight:

The weight of an individual (P) or an object is evaluated from a weighing which is done on scale. The subject takes off his shoes, stands upright, horizontal gaze, arm in the extension of the body, and his weight is the value indicated on the dial of the scale.

2. Height :

The height is measured with the help of the toise. The unshod subject is standing on the base of the tape measure in the anatomical reference position, his heels, and occiput against the tape measure. From this tape measure, fixed by a high point that is lowered onto the top of the subject's head, the height value is obtained directly.

3. Scope:

Standing position, both arms extended to the maximum, to look for the highest point possible on the height rod located in front of the two arms.

4. Length of the upper limb: This is the distance between the acromial point and the right dactylic 3. The arm is stretched without stiffness; the palm turned inwards is placed in the extension of the forearm.

5. Lower limb length: There is no correct measurement of the total length of the lower limb. The height of the pubis, the height of the anterior superior iliac spine, or the height of the inguinal point above the ground may be chosen as an approximate length. The authors rightly reject the height of the apex of the greater trochanter, because of the difficulties in determining the landmark, the trochanter. It seems better to use the values obtained by measuring the symphyseal height or the height at the anterior superior iliac spine than to try to correct them by adding values based on stature or calculated once and for all (Twiesselmann, 1952).

6. Transverse measurements or body diameters:

On the frontal plane, the measurements are taken with the upper arm of the anthropometer by the straight or curved rulers and with the caliper or slide caliper. The pressure of the branches on the soft tissues must be regular. The small caliper with olive tips is used to measure diameters or the distance between two points in a transverse plane. The large calipers are used to measure the large transverse and sagittal diameters of the body.

6.1. The large diameters of the body:

6.1.1 Bi-acromial Diameter: This is the distance between the highest protruding points of the acromion apophysis which is located on the spine of the scapula.

6.1.2 Bicretal Diameter: This is the distance measured between the most prominent points of the iliac crests on the external part of the iliac bone.

6.1.3 Bi-trochanteric diameter: This is the distance between the highest points of the greater trochanter and the femur.

6.1.4 Transverse diameter of the thorax: This is the distance between the two thoracic- lateral points.

6.1.5 Anteroposterior diameter of the thorax: This is the distance between the meso- sternal and thoracic-spinal points (sagittal plane).

6.2. The small diameters are:

6.2.1 Distal arm diameter: This is the distance between the epitrochlea and the epicondyle of the humerus.

6.2.2 Distal forearm diameter: This is the most horizontal distance between the radial and ulnar styloid processes.

6.2.3 Hand diameter: This is the distance between the radial metacarpal and metacarpal ulnar points. Measure on the dorsal surface of the hand when fully extended.

6.2.4 Distal thigh diameter: This is the maximum horizontal distance between the medial and lateral femoral condyles.

6.2.5 Distal leg diameter: This is the distance between the medial and lateral malleoli.

6.2.6 Foot diameter: This is the distance from the medial metatarsal to the lateral metatarsal. The subject rests on the right foot; the left leg rests only on the ball of the foot.

7. Measurement of Body Circumferences:

The dimensions of the body circumferences are made with a tape measure. During the measurement, it is necessary that the tape measure is put horizontally and the measurement must be on the facial level of the subject. The tape measure must be slightly tight to the measured part of the body; deformation of the body by the tape measure is forbidden; after removing the tape measure, the traces of the tape measure must not be seen (Twiesselmann, 1952).

The circumferences retained in our study as well as the methodical indications to be observed are the following:

7.1.Chest circumference in resting position: The tape measure is placed in such a way that it passes under the lower angles of the shoulder blades, then between the body and the arms, and then closes under the lower segments of the nipples.

7.2.Chest circumference in the maximum inspiration position: During the measurement, the shoulders must not be too low or too high.

7.3.Chest circumference in the exhalation position: The measurement is also done in the same way, but the maximum exhalation position.

7.4.Circumference of the arm in resting position: Is measured on a horizontal plane at the point where the volume of the biceps is greatest, with the arm at the side of the body.

7.5.Circumference of the arm in a stretched position: This is done in the same way, but the muscles of the front of the arm are contracted.

7.6.Median circumference of the forearm: Is measured on a horizontal plane at the point where the volume of the muscles is greatest. The position of the arm must be alongside the body.

7.7.Distal forearm circumference: Taken in the same way, towards the lower part of the forearm, above the styloid processes.

7.8.Thigh circumference: Is measured similarly, the tape measure is placed on the buttock crease and closes at the front of the thigh.

7.9.Leg circumference: The tape measure is placed horizontally at the point on the leg where the triceps is most developed.

8. Skinfold measurement:

The measurement of skin folds, and more specifically that of the adipose panicles, is carried out with the folding forceps. For our research, we used folding forceps. Regarding the measurement procedures, it must be ensured that the pressure of the feet of the device does not exceed 10g/mm 2 of the skin surface. The folds measured in our study are:

8.1.Subscapular fold: In the region of the back under the lower angle of the right shoulder blade.

8.2.Suprailia fold: On the anterior aspect of the abdomen at the level of the iliac spine, on the anteroposterior part.

8.3.Bicipital fold: Above the biceps, approximately in the middle of the arm.

8.4.Tricipital fold: At the level of the triceps, approximately in the middle of the arm.

8.5.Belly fold: the line that connects the iliospinal point to the anterior border of the axilla and a horizontal line marked at the iliocristal point.

8.6.Thigh fold: Above the rectus abdominis.

8.7.Leg fold: Close to the posterior aspect of the right leg at the level of the gastrocnemius muscle.

9. Body Mass Index:

The BMI or body mass index is an indicator used to estimate the corpulence of a person. Formerly called the Quételet index, after its inventor, Lambert Adolphe Jacques Quételet (1796-1874), a Belgian scientist, it was renamed the body mass index in 1972 and accepted in 1997 as a standard by the WHO (World Health Organization) to assess the risks of being overweight in adults.

BMI is calculated from weight and height. It is obtained by dividing the weight of the individual by the square of his height:

BMI = weight (kg) / height2 (m).

10. Body Mass Composition:

Body composition is the analysis of the human body in compartments (Barbe and Ritz, 2005). It is also of great importance for scientific researchers in the field of sport and physical education, especially because of the relationship between body composition and performance. For the determination of the components of the body mass we used a body analysis scale for the following measurements:

10.1. Muscle mass: The skeletal muscle is formed by a set of muscle fibers joined by elastic connective tissue, and crossed by numerous blood capillaries, nerves, and nerve endings. **(BRIKCI.A, 1995, p. 195)** confirms that the result of the sport can only increase with the size, water, and muscle components.

10.2. Bone mass: Bone tissue is a living tissue whose cellular function depends on chemical factors (hormones and cytokines) and mechanical factors (muscle stress, gravity, and impact). The acquisition of bone mass is influenced by several factors: hormonal, nutritional, mechanical, environmental, and genetic factors. Regular physical activity influences the amount of bone mass that will contribute to bone status in adult life. Exercise stimulates bone formation independently of the formation processes associated with puberty. Thus, bone structures undergo deformational stresses that vary in amplitude and orientation **(Bemben et al., 2004 Egan et al., 2006). (Praagh. V, 2007, p. 143)** which notes that a large bone mass results in a noticeable difference in potential power.

10.3. Fat mass: This corresponds to the total amount of fat distributed in the body. Some fats are constitutive of the organism and only melt under conditions of abnormal dietary restrictions, such as those that can be observed in the very poor countries of the world. Under normal living conditions, this fat will never be mobilized: fat around organs in the abdomen,fat between muscle planes, etc.). The rest of the fat is mobilizable and corresponds to what is called fat mass.**(Monod. H, 2004, p. 457)** indicates that large body fat will automatically reduce sports performance.**(Reilly.T , Williams.M ,Nevili.A and Franks. A, 2000, pp. 695-702)** consider that "lean mass and fat mass is more sensitive to development through training and nutritional monitoring"

10.4. The water mass: The water mass refers to all liquids contained in the body expressed as a percentage of the total mass. It takes into account the water contained in the cells and tissues. Water is the major component of the human body, so water mass is the largest part of your body weight. **(BRIKCI.A, 1995, p. 195)** confirms that sports performance can only increase with height, water, and muscle components.

11 Body surface:

The body surface is defined by calculation according to the total measurements of the body stature and body mass. We have calculated the body surface according to the formula **of Izakson (**1958). This index informs us about the state of physical development. The bigger this index is, the better the physical development is.

$$Sa = \frac{(100 + W + (Height - 160)}{100}$$

Sa: Body surface expressed in m². W: Body mass in kg.

11. Anthropometric instruments:

Only a good instrument allows for accurate results and the possibility to compare them. Research must be done with standardized and verified instruments. Anthropometric instruments include:

- **A tape measure:** (0 - 2000 mm). We use it to measure the perimeters of the body (circumferences) and its segments and to measure the wingspan.
- **A caliper:** Used to measure diameters (the distance between two points).
- **Electronic skinfold forceps (Comed):** Used for measuring panicles with an accuracy of (10 g /mm2).
- **A body analysis scale (Renpho):** Used to determine Body Weight, BMI, body fat percentage, water percentage, skeletal muscle, fat-free body weight, muscle mass, bone mass, protein, basal metabolic rate, body age, subcutaneous fat, and visceral fat.
- **A metal measuring rod**: Graduated in centimeters for the measurement of the height.

III. The somatotype:

Is a taxonomy developed in the 1940s by **William Herbert Sheldon** to categorize the human physique according to the relative contribution of three basic elements that he called "somatotypes", classified by him as "ectomorphic", "mesomorphic" and "endomorphic". He named them after the three germ layers of embryonic development:

- The endoderm: develops in the digestive tract.
- The mesoderm: becomes muscle, heart, and blood vessels.
- The ectoderm: forms the skin and nervous system.

Later variations of the method, developed by his original research assistant Barbara Heath and later Lindsay Carter are still in occasional academic use.

1. The "somatotypes" according to Sheldon:

Sheldon's "somatotypes" and their associated physical and psychological traits have been characterized as follows:

- **Ectomorph**: characterized as lean, weak, and generally tall with low testosterone levels; described as intelligent, gentle, and calm, but shy, introverted, and anxious.

- **Mesomorphic**: characterized as naturally hard and strong with even weight distribution, muscular with bodybuilding, thick-skinned, and as having good posture with a narrow waist; described as competitive, outgoing, and tough.

- **Endomorph**: characterized by fatness, usually short, and having difficulty losing weight; described as outgoing, friendly, happy, and relaxed, but also lazy and selfish.

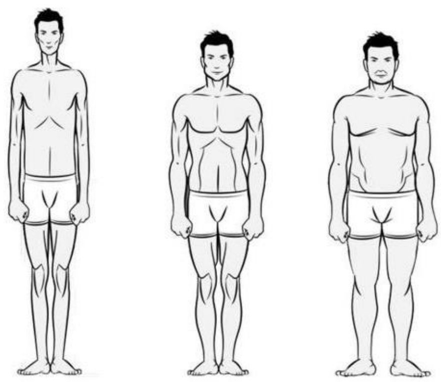


Figure N° 5: The three types of bodies.

2. Heath and Carter's somatotype:

Sheldon's physical taxonomy is still used, specifically the **Heath-Carter** variant of the methodology. This formulaic approach uses weight (kg), height (cm), arm circumference (cm), maximum calf circumference (cm), femur width (cm), humerus width (cm), triceps skinfold (mm), subscapular skinfold (mm), supra-spinal skinfold (mm), and medial calf skinfold (mm), and remains popular in anthropomorphic research, as for **Rob Rempel** "With modifications by Parnell in the late 1950s, and by **Heath and Carter** in the mid-1960s the somatotype has remained the best qualifier of total body shape.

This variant uses the following set of equations to assess a subject's traits in relation to each of the three somatotypes, each rated on a seven-point scale, with 0 indicating no correlation and a very strong 7:

Endomorphism = -0.7182 + 0.1451 (X) - 0.00068 (X2) + 0.0000014 (X3)

X = (sum of tricipital, subscapular and suprailiac skinfolds) multiplied by (170.18/height in cm)

Mesomorphy = (0.858 DDB + 0.601 DDC + 0.188 CBC + 0.161 CJC) - (0.131 T) + 4.5

DDB: distal arm diameter

DDC : distal thigh diameter

CBC: circumference of the contracted arm - (triceps skin fold/10)

LCC: leg circumference - (leg skin fold/10)

T : size in cm

Ectomorphy: there are three equations for calculating ectomorphy based on weight, height ratio (WHR):

If ROP 40.75 Ectomorphy = 0.732 ROP - 28.58

If 38.25 < RDP < 40.75 Ectomorphy = 0.463 RDP - 17.63

If ROP < 38.25 Ectomorphy =0.1

RDP: height in cm / cube root of weight in kg.

Heath and Carter characterize the somatotype by three components:

- **Endomorphy:** Characterizes the roundness of the body. The endomorphic subjects present a predominance of the abdomen compared to the thorax, square, and high shoulders, the whole body presents rounded curves without muscular relief.

- **Mesomorphy:** Characterizes a square stature and predominant muscles. Usually, the bone structure of the legs, trunk, and arms is massive, and the forearms, wrists, and hands are large.

- **Ectomorphy:** Refers to slenderness. The bones are small and the muscles are not very thick. Drooping shoulders are very common in ectomorphic subjects, with relatively long limbs, small trunk, and flat abdomen.

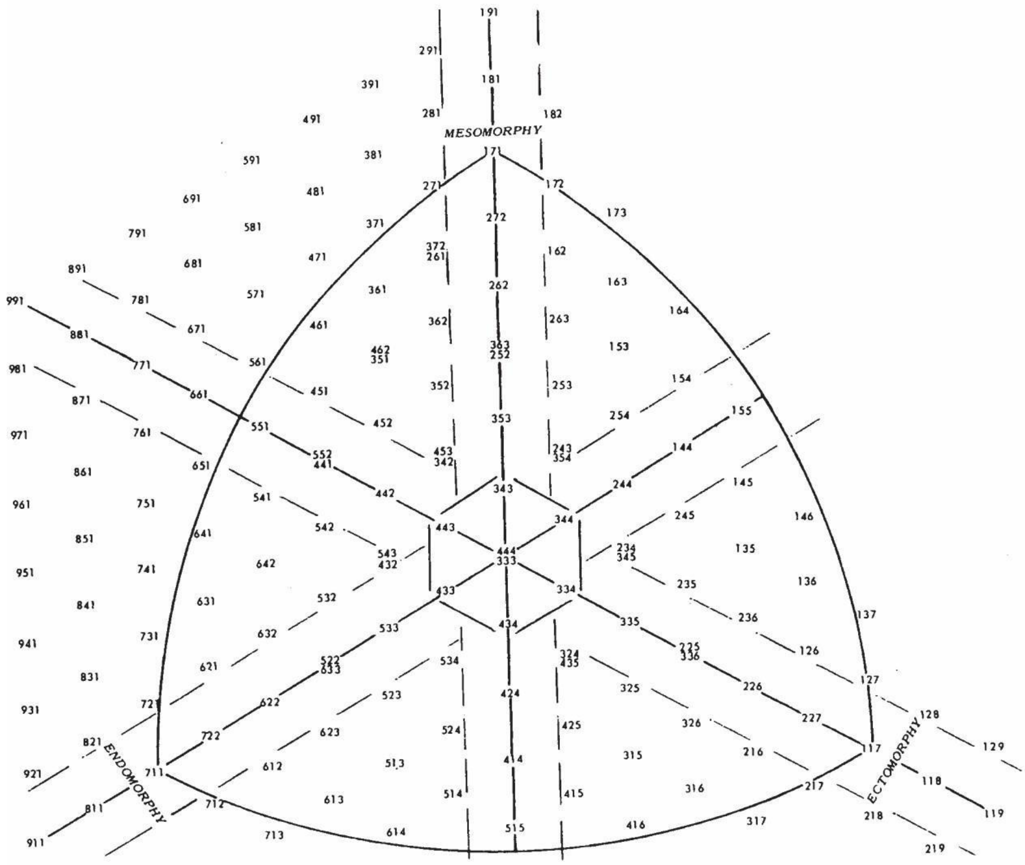


Figure N° 6: Heath and Carter's somatocard.

3. Somatotype and sports performance:

The relationship between morphology and athletic performance is an area of research that has long received attention. The nature and level of performance are influenced by the anthropometric profile of athletes **(Tanner, 1964; Orvanova, 1987; Carter and Ackland, 1994)**. In high-level adult athletes, this research has shown the great variability of the somatotype depending on the sports specialty practiced. In contrast, individuals involved in the same sports discipline present a more homogeneous somatotype profile. However, the presence of certain intra-sport variations suggests the possibility of a variety of related profiles (**Watson, 1988**).

This nuance is important insofar as it refutes the idea of the existence of a unique physique per sports discipline. Although athletic performance is a multifactorial phenomenon, a well-adapted body shape for a particular performance seems to be a determining factor in athletic success (**Carter, 1984**).

4. Somatotype of middle-distance runners:

Vucetic, Matkovic, and Sentija (2008) found that the mesomorphic component is dominant in Croatian runners in all disciplines, the ectomorphic component is less dominant, while the endomorphic component is less pronounced.

The somatotype of African middle and long-distance runners (currently the best in the world) is 1.4-3.2-4.2 and 1.6-2.9-4.3, showing that they have very weak endomorphic features with an accentuated ectomorphic component (**Ridder et al., 2000**).

Sedeaud et al (op. cit.) highlighted the relationship between anthropometry and performance overall distances in track and field. They found a positive correlation between weight and height, essential factors in determining the components of the somatotype, with speed. Weight and height thus appear to play an important role in the selection processes of world sport.

Part two : Practical part

Chapter One : Research Methodology

1. Hypothesis:

- The military athletes selected for the national team have physical qualities that make them perform better.
- The military athletes selected for the national team have morphological profiles that meet international standards
- The military athletes selected for the national team have physical qualities and morphological profiles that make them more efficient.

2. Research Objective:

- To determine the morphological profile of middle-distance athletes selected for the Algerian national military team.
- To determine the physical profile of middle-distance athletes selected for the Algerian national military team.
- Develop a battery of reliable, adaptable tests capable of measuring the main dimensions of physical fitness.
- To analyze the indices of body development (body surface, corpulence indices) through the methods of calculation of the different indices.
- Analyze the components of body weight.
- Adipose components.
- Muscle component.
- Bone components.
- Water component.
- To establish the somatotype of the middle-distance athletes selected in the national military team of Algeria according to the method (HEATH and CARTER, 1990).

3. Research Task:

To answer our problem, we set ourselves the following tasks:

- Carry out the various anthropometric measurements (weight, height, wingspan, length of lower and upper limbs, circumference, skin folds, distal diameters, BMI, body surface).
- Evaluation of physical qualities and anthropometric parameters of middle-distance athletes selected for the Algerian national military team.

- The bibliographic analysis related to our theme (keywords).
- Analysis, interpretation, and discussion of the results obtained.
- And finally, draw the necessary conclusions.

4. Means and methods of research:

4.1. Sample:

Our research was carried out on a sample of 15 middle-distance athletes of the Algerian military national team Senior men. These athletes represent an average age (24.26±3.67 years) and average weight (70.93±3.41 kg) and height (181.6±3.54 cm).

Our study is spread out 15 days counting from the 06th month of December until the 21st of December 2021 in Bejaia (Souk el Tenine athletics stadium) during the period of preparation (training course of preparation) of the middle-distance athletes selected in the national military team of Algeria. The measures are carried out in the athletics stadium (Olympic track and medicine cabinet which is part of the stadium).

4. 2. The method:

In our research, we used the descriptive method to conduct our research.

4.2.1. The descriptive method:

The descriptive method consists in describing and characterizing a phenomenon, a situation, or an event to understand and explain it. To achieve our research objective above, we proceeded with different tests that will allow us to affirm or deny the hypotheses.

5. Protocol:

The protocol set up for the research proposed two types of data collection: anthropometric measurements and the evaluation of physical qualities.

- Before starting the evaluation of the middle-distance athletes selected for the Algerian national military team, the subjects were informed of the experimental protocol. The physical tests were carried out in an athletics field, in the best possible conditions, with the necessary equipment for the different events.

- The tests were carried out during the preparation period (national team training course). Before the start of the tests, the subjects were asked to warm up with sufficient recovery time. The study of the morphological and physical profile of middle-distance athletes requires an evaluation using reliable and validated tests. Among the multitude of tests for the evaluation of athletes used in the field of scientific research (Eurofit, 1992), the latter proposes a battery of 6 tests and has been the subject of validation and reliability tests, and has also been used in different contexts, clinical and research in more than 10 European countries (several of these countries have reference standards).

I. Physical tests:

1. Test coordination speed: 10 x 5 m shuttle:

To evaluate this physical quality, we choose the 10x5 meter shuttle race. The event takes place on a flat surface two meters wide and 5 meters long. The surface must not be slippery (G. Cazorla, 1986).

The principle is to make 10 trips at maximum speed between 2 lines spaced 5 meters apart. Only one test is performed.

- Position yourself behind the line, one foot just behind it.
- Both feet must systematically cross the line.
- The calculated time is the one taken after the 10 trips.
- Be careful not to perform the test on a slippery floor.

Figure N°7: 10× 5 m shuttle test.

2. Test speed of 50 m:

To evaluate this quality, we use the 50-meter standing start. The subject stands in the starting position for the run.

The timekeeper stands on either side of the runner but 15 meters from the race track. From the moment the timekeeper raises his arm to indicate that he is ready, the runner can start whenever he wants.

The stopwatch is started when the runner's back foot leaves the ground, it is stopped when the runner passes the stake marking the finish.

The test is repeated twice at 5-minute intervals.

Figure N°8: Speed test on 50 meters.

3. Explosive strength test of the lower limbs (Sargent-test):

To evaluate this physical quality, let us choose the vertical relaxation test (**Cazorla et al. 1986**). This test requires a flat surface, a wall calibrated vertically from 1.5 to 3.5 meters from the ground and a record sheet for the results.

The test consists of two measures:

Measure1: The subject is positioned in profile to the wall, with his feet flat. The arm on the side of the wall is raised to a maximum extension of the shoulder. The height reached is noted with the fingertips.

Measure 2: (Sargent test) the subject places the feet slightly apart, the foot closest to the wall is 30 centimeters from it. Without prior bounce, he prepares his jump by lowering his arms and bending his legs; he jumps as high as possible with an outstretched arm, marking the wall with the tips of his chalk-coated fingers. The subject repeats this test three times and only the best jump is taken into account. The performance is the difference between the first and second measurements. It is expressed in centimeters and corresponds to the vertical relaxation of the subject. In 1921, D.A. Sargent proposed the first field method for estimating this vertical displacement of the center of mass by the difference in height of the prints left by the outstretched hand between the climax of the jump and the standing position. The jump height thus estimated was proposed as a measure of muscle power by a namesake, L.W. Sargent, in 1924 (Sargent, 1924).

Figure n°9: Vertical relaxation test

4.Explosive strength test of the upper train:

To evaluate this physical quality, we used the two-handed football throw test.

The subject throws the ball forward with both hands over the head, like a soccer throw-in, with the feet staggered in the axis of the throw, one in front of the other. During the throw, the front foot must not leave the ground.

The back foot may accompany the movement and extend beyond the line of the throw. The performance is the distance achieved measured in centimeters to the top or bottom 25cm closest to where the ball fell.

The best of the three trials is recorded. Three consecutive trials are planned.

The evaluator stands on the throwing surface, offset from the axis of the throw, with a regulation senior football, a 30 m double decameter calibrated at 50 cm intervals, and a result recording sheet.

Figure 10: Two-handed football throw.

5. flexibility test (trunk flexion in standing position) :

It is a flexibility test that can easily be performed at home, on a sports field, or at the doctor's office. Carried out rigorously, respecting a simple protocol, it has the advantage of being reproducible, to evaluate the progress made. (**Jacques Le Guyader, 1987)**.

Often wrongly considered as a reflection of the flexibility of the hamstring muscles, this exercise is a test of the flexibility of the whole posterior chain of the lower limbs and the trunk.

The improvement in flexibility is reflected by bringing the fingers as close to the ground as possible, thus shortening the measured finger-to-ground distance.

Figure n°11: Trunk flexion in standing position.

6. VAMEVAL test:

This test is mainly intended for specialists in long-distance sports (middle-distance and long-distance runners) as well as for athletes who want to know their VMA.

This test is an improvement of the Leger-Boucher track test. The speed increment is indeed 0.5km/h against 1km/h by steps for the Luc-Léger, and the duration of the steps is one minute against 2 for the latter. This results in greater precision in the VMA obtained.

Test Objectives:

Evaluate the VAM and VO2Max (by extrapolation).

Materials and set-up:

- A track of at least 200m or multiple of 20 meters (220,240,260 etc..). - Markers are placed every 20m with a decameter or double decameter to place them.
- The VAMEVAL cassette.
- A calibrated tape recorder or MP3 player.
- A whistle and/or an amplifier (if the track is long distance).

Figure 12: VAMEVAL test.

The course of the test:

- For the same reasons as for the 2 previous tests, it is not necessary to warm up.
- The speed of the race is regulated by utilizing a soundtrack (VAMEVAL cassette) that emits sounds at regular intervals.
- At each beep, the athlete must be at the level of one of the markers placed on the track (an accuracy of one or two meters is sufficient for the validity of the test).

- In the beginning, the athlete will certainly have a bit of a head start (or even a delay, but this is rare). The first stages will thus serve to calibrate his speed according to that dictated by the cassette.
- Once the athlete is regular, he must respect the pace imposed by the speed for as long as possible.
- The athlete will stop the test as soon as it is impossible to finish the current level or if he/she thinks he/she cannot run faster.

Bearings	*VAM(Km/h)*	*VO2max (ml/mn/kg)*	*Bearings*	*VAM(Km/h)*	*VO2max (ml/mn/kg)*
1	8.5 / 8	29.75	**18**	17 / 16.5	59.5
2	9 / 8.5	31.5	**19**	17.5 / 17	61.25
3	9.5 / 9	33.25	**20**	18 / 17.5	63
4	10 / 9.5	35	**21**	18.5 / 18	64.75
5	10.5 / 10	36.75	**22**	19 / 18.5	66.5
6	11 / 10.5	38.5	**23**	19.5 / 19	68.25
7	11.5 / 11	40.25	**24**	20 / 19.5	70
8	12 / 11.5	42	**25**	20.5 / 20	71.75
9	12.5 / 12	43.75	**26**	21 / 20.5	73.5
10	13 / 12.5	45.5	**27**	21.5 / 21	75.25
11	13.5 / 13	47.25	**28**	22 / 21.5	77
12	14 / 13.5	49	**29**	22.5 / 22	78.75
13	14.5 / 14	50.75	**30**	23 / 22.5	80.5
14	15 / 14.5	52.5	**31**	23.5 / 23	82.39
15	15.5 / 15	54.25	**32**	24 / 23.5	84
16	16 / 15.5	56	**33**	24.5 / 24	85.75
17	16.5 / 16	57.75	**34**	25 / 24.5	89.25

Table N°6 : VAMEVAl test levels.

*** Instruments used for physical testing:**

Tests	*Materials*
Vertical rebound test (cm)	-A calibrated wall -A decameter -A chisel
Shuttle coordination test 10x5 m	-A stopwatch -Plots
Soccer Throwing Test	-A football - A tape measure
Speed test 50m	-A stopwatch - A whistle
Standing Trunk Flexion Test	-A ruler (30cm)
VAMEVAL test	-A stopwatch -Poles -A whistle -The VAMEVAL tape -A double decameter -An MP3 player -Plates

Table N°7: Instruments used for the physical tests.

II. Anthropometric measurements :

1. Weight:

The weight of an individual or an object is evaluated from a weighing which is done on scale. The subject takes off his shoes, stands upright, horizontal gaze, arm in the extension of the body, and his weight is the value indicated on the dial of the scale.
It also allows to calculate the body mass index (**J.C.PINEAU and ARABI, 1996**).
BMI = Weight (kg) / Height2 (in cm).

2. Height :

The height is measured with the help of the toise. The unshod subject is standing on the base of the tape measure in the anatomical reference position, with his heels and occiput against the tape measure. From this tape measure, fixed by a high point that is lowered onto the top of the subject's head, the height value is obtained directly.

3. Scope:

Standing position, both arms extended to the maximum, to look for the highest point possible on the height rod located in front of the two arms.

Figure N°13: Illustration showing the measurement of the span.

4. The length of the upper limbs: it is the distance between the acromial point and the 3 right dactylics.

5. The lower limb length: It seems better to use the values obtained by measuring the symphyseal height or the height at the anterior superior iliac spine than to try to correct them by adding values based on stature or calculated once and for all (Twiesselmann, 1952).

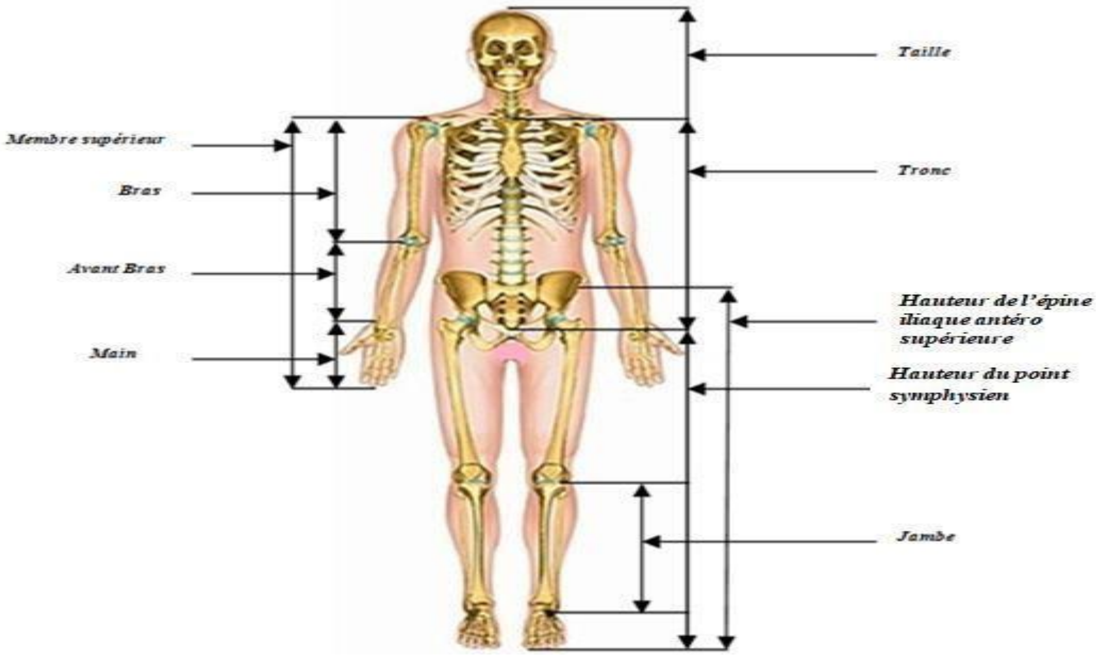


Figure N°14: Body length.

6. Circumference measurement:

All measurements relating to body circumferences are determined with a tape measure (graduated in cm). As an indication, during the measurements, it is necessary to take the following precautions:

- The measurer should face the subject and place the tape measure horizontally to the body part to be measured.
- The tape measure should wrap around the measured part without causing any deformation.
- Once the measurement is done, there should be no marks from the tape measure on the skin. The circumferences retained in our study as well as the methodical indications to be observed are the following:

6.1 Arm circumference:

Is measured on a horizontal plane at the point where the volume of the biceps is greatest, with the arm at the side of the body.

6.2 Forearm circumference:

Is measured on a horizontal plane at the point where the volume of the muscles is greatest. The position of the arm must be alongside the body.

6.3 Circumference of the thigh:

If measured similarly, the tape measure is placed on the buttock crease and closes at the anterior thigh.

6.4. Leg circumference:

The tape measure is placed horizontally at the point on the leg where the triceps is most developed.

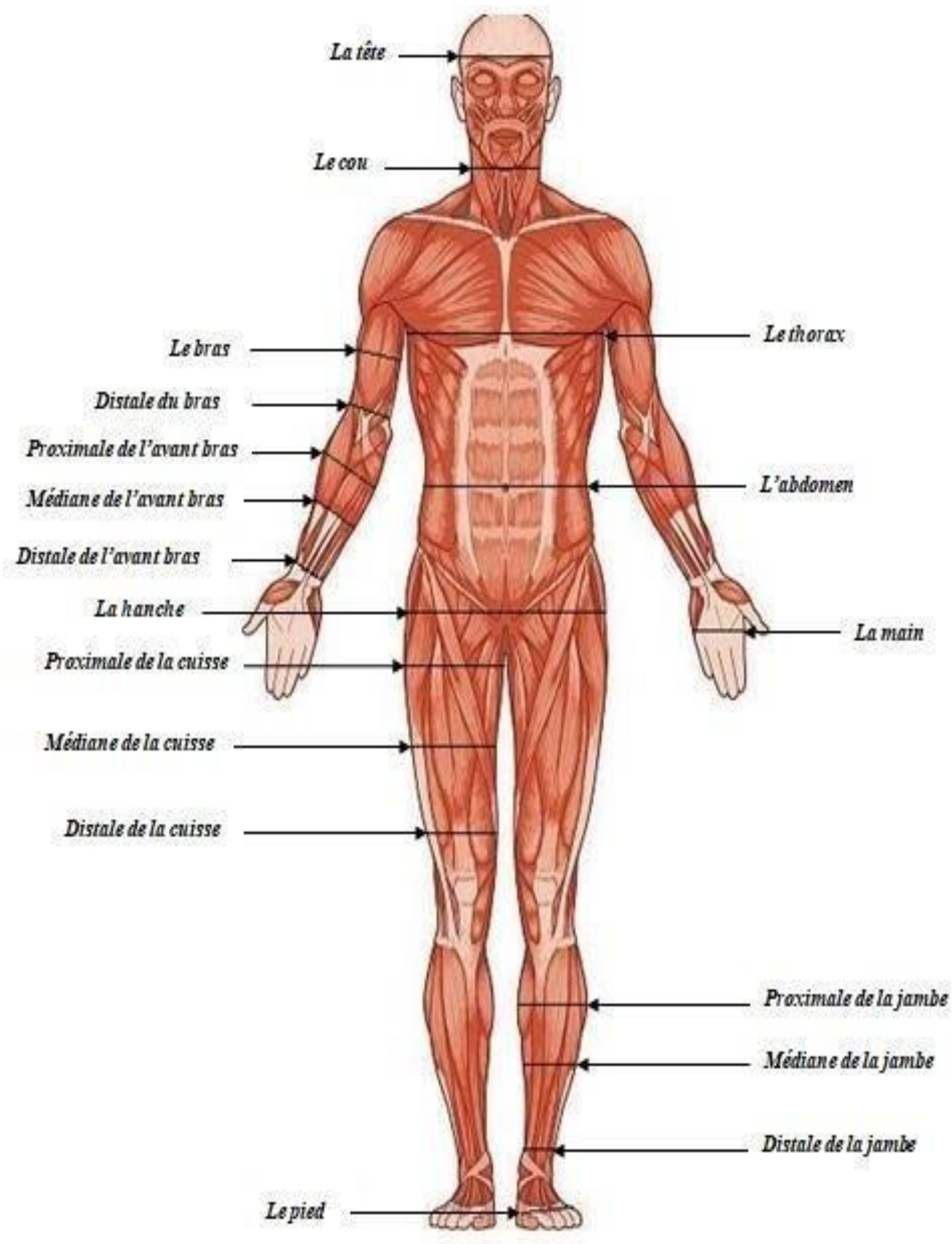


Figure N°15: The body circumferences.

7. Skin folds:

The measurement of skin folds, and more specifically that of the adipose panicles, is carried out with the folding forceps. For our research, we used folding forceps. As far as the measurement procedures are concerned, it must be ensured that the pressure of the feet of the device does not exceed 10g/mm 2 of the skin surface. The folds measured in our study are:

7.1 Subscapular fold: In the back region under the lower angle of the right scapula.

7.2 Supra-iliac fold: On the anterior side of the abdomen at the level of the iliac spine, on the anteroposterior part.

7.3 Bicipital fold: Above the biceps, approximately in the middle of the arm.

7.4 Tricipital fold: At the level of the triceps, approximately in the middle of the arm.

7.5 Belly fold: the line that connects the iliospinal point to the anterior edge of the axilla and a horizontal line marked at the iliocristal point.

7.6 Thigh fold: Above the rectus abdominis.

7.7 Leg fold: Near the posterior aspect of the right leg at the level of the gastrocnemius muscle.

8. Measurement of diameters: Measurements are taken with the upper limb of the anthropometry by the straight or curved rulers and with the caliper or caliper. The pressure of the branches on the soft tissue must be regular. The small caliper with olive tips is used to measure diameters or the distance between two points in a transverse plane. Large transverse and sagittal body diameters are measured with the large caliper. The body diameters measured in our study are as follows:

8.1 Distal arm diameter: this is the distance between the epi trochlea and the epicondyle of the humerus.

8.2 Distal forearm diameter: this is the most horizontal distance between the radial and ulnar styloid processes.

8.3 Distal thigh diameter: this is the maximum horizontal distance between the medial and lateral femoral condyles.

8.4 Distal leg diameter: this is the distance between the two medial and lateral malleoli.

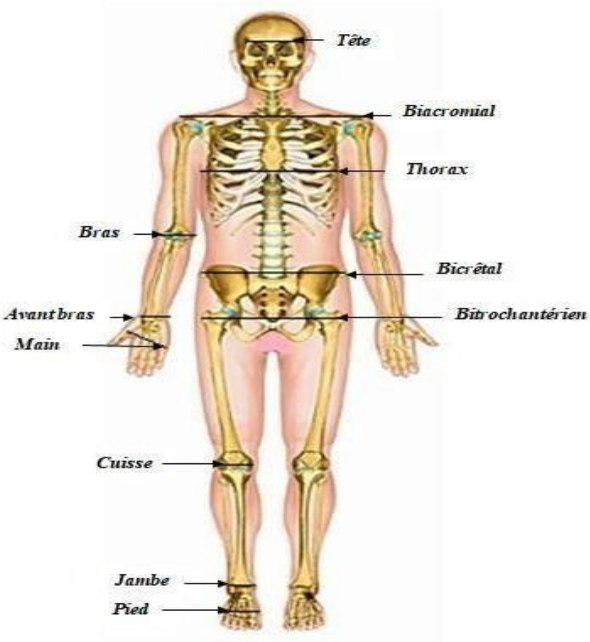


Figure N°16: Measurement of body diameters.

9. The body composition:

In the field of physiology, nutrition, and morphology, the evaluation of body composition takes a very important place, serving as an indirect indicator of the energy balance of the body. It is also of great importance for scientific researchers in the field of sports and physical education, especially because of the relationship between this composition and performance. For the determination of the components of the body mass, we used a body analysis scale (RENPHO scale, Bluetooth connected scale impedance meter, scale impedance meter with 13 body data**).**

For the following measures:

- Muscle mass - Water mass - Fat mass - Bone mass.

* Anthropometric instruments used:

A tape measure: (0 - 2000 mm). We use it to measure the perimeters of the body (circumferences) and its segments and to measure the

wingspan.

Figure N°17: A tape measure

A caliper: Used to measure diameters (the distance between two points).

Figure n°18: A caliper

Electronic skinfold forceps: Used to measure panicles with an accuracy of (10 g /mm2).

Figure N°19: Electronic skinfold forceps (Comed).

A body analysis scale: Used to determine body weight, BMI, body fat percentage, water percentage, skeletal muscle, fat-free body weight, muscle mass, bone mass, protein, basal metabolic rate, body age, subcutaneous fat, and visceral fat.

Figure N°20: A body analysis scale (RENPHO).

A metal measuring rod: Graduated in centimeters for the measurement of the height.

Figure N°21: A metal measuring rod

III. Calculations used:

1. Body surface area calculations:

We calculated the body surface according to the formula of Izakson (1958)

$$Sa = \frac{(100 + W + (Height - 160)}{100}$$

Sa: surface of the body in square meters (m²)

W: weight in kilograms (kg)

2. Calculate BMI:

BMI is calculated from weight and height. It is obtained by dividing the weight of the individual by the square of his height:

BMI = weight (kg) / height (m²)

3. somatotype calculations:

Concerning the somatotype, it was determined using the method of **Carter and Heath** (1990). The values of the somatotypic components of endomorphic, mesomorphic and ectomorphic of our sample, were thus calculated according to the following formulas:

Endomorphism = -0.7182 + 0.1451 (X) - 0.00068 (X2) + 0.0000014 (X3)

X = (sum of tricipital, subscapular and suprailiac skinfolds) multiplied by (170.18/height in cm)

Mesomorphic = (0.858 DDB + 0.601 DDC + 0.188 CBC + 0.161 CJC) - (0.131 T) + 4.5

DDB: distal arm diameter

DDC : distal thigh diameter

CBC: circumference of the contracted arm - (triceps skin fold/10)

LCC: leg circumference - (leg skin fold/10)

T : size in cm

Ectomorphic: there are three equations for calculating ectomorphic based on weight, height ratio (WHR):

If ROP 40.75 Ectomorphic = 0.732 ROP - 28.58

If 38.25<RDP<40.75 Ectomorphic = 0.463 RDP - 17.63

If ROP <38.25 Ectomorphic =0.1

RDP: height in cm / cube root of weight in kg.

4. Statistical calculation methods :

4.1 Arithmetic means: It represents the sum of the measured values divided by their number, it determines the average value of a series of calculations.

$$\bar{x} = \frac{x_1 + x_2 + ... + x_n}{n} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

4.2. Standard deviation:

Is considered a measure of the dispersion of values from the mean.

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \overline{x})^2}$$

4.3. Coefficient of variation:

Is defined as the ratio of the standard deviation to the mean.

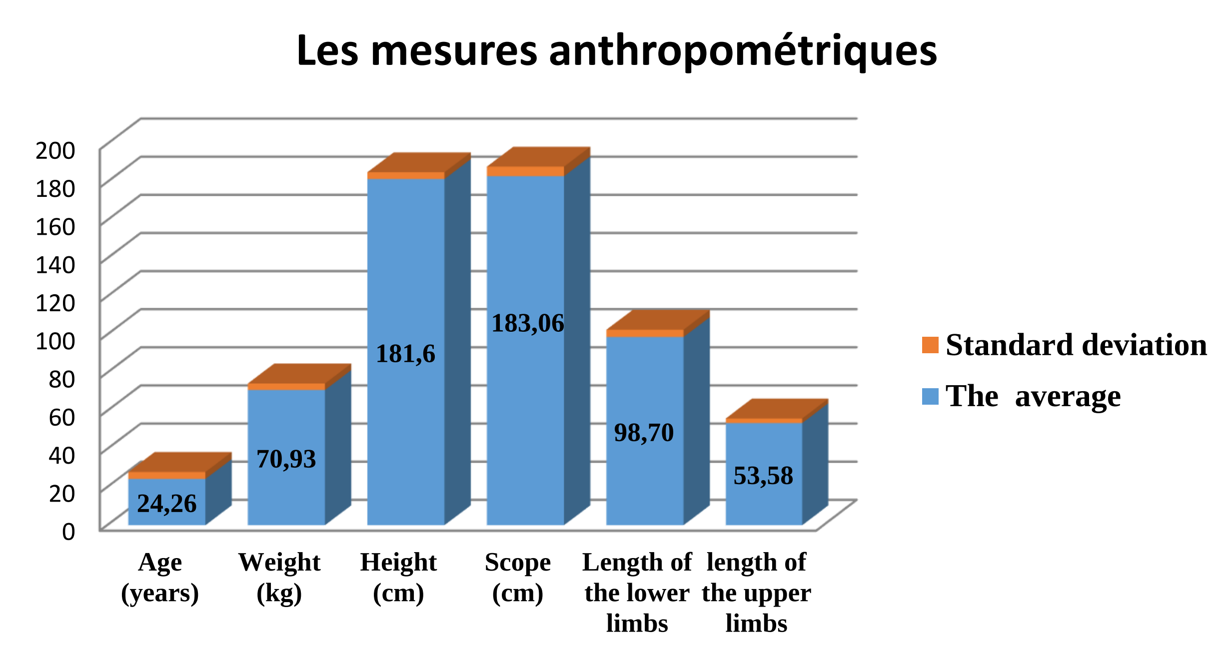
$$Cv = \frac{\text{Standard deviation}.100\%.}{\text{Average}}$$

Chapter two: Interpretation and Discussion Results

I. Anthropometric measurements:

Athletes	*Age (years)*	*Weight (kg)*	*Height (cm)*	*Scope (cm)*	*Length of the lower limbs*	*length of the upper limbs*
1	**30**	**70**	**183**	**182**	**97**	**52,3**
2	**25**	**76**	**187**	**187**	**101**	**52**
3	**26**	**72**	**182**	**191**	**104**	**51,5**
4	**26**	**65**	**176**	**184**	**99,8**	**56**
5	**21**	**72**	**184**	**183**	**99**	**52,8**
6	**30**	**76**	**183**	**187**	**103**	**53,8**
7	**27**	**68**	**176**	**170**	**91**	**49,5**
8	**28**	**70**	**188**	**182**	**105**	**53**
9	**19**	**70**	**180**	**180**	**99,4**	**54**
10	**23**	**73**	**179**	**181**	**93**	**56,5**
11	**20**	**71**	**181**	**186**	**97**	**51,3**
12	**21**	**72**	**183**	**181**	**98,4**	**57**
13	**22**	**71**	**180**	**186**	**98**	**58**
14	**26**	**64**	**178**	**178**	**95,2**	**54,3**
15	**20**	**74**	**184**	**188**	**99,8**	**51,7**
Average	**24,26**	**70,93**	**181,6**	**183,06**	**98,70**	**53,58**
Standard deviation	**3,67**	**3,41**	**3,54**	**5,02**	**3,82**	**2,40**
CV %.	**15,13%**	**4,80%**	**1,95%**	**2,74%**	**3,87%**	**4,49%**

Table n°8: Presents the anthropometric values obtained by all our subjects.



Graph n°1: Presents the anthropometric measurements of middle-distance athletes**.**

1. Descriptive analysis and interpretation of the results (anthropometric measurements) :

For a better appreciation of our results, we refer to the classification table of the human species and the study of Cazorla and Coll. on anthropometric measurements and physical tests, a study that allowed the development of scales of the physical value of young people from 12 to 18 years and more.

The age of our population ranges from **19 to 30 years**. Our population has an average age of **24.26 years**, with a standard deviation of **3.67 years**. This shows us that the middle- distance athletes selected for the Algerian national military team are young compared to their average age. The coefficient of variation is **15.13%** which shows the heterogeneity of the sample for this parameter.

The height of our population is between **176cm** and **188cm**. We have a mean of **181.6cm** with a standard deviation of **3.54cm**. The coefficient of variation is **1.95% which** shows the homogeneity of the sample for this parameter.

Values in(cm)	Appreciations
174,9 à 176,5	Small
178,0 à 179,4	Average
180,8 à 182,2	Quite large
183,6 à 185,0	Great
186,4 à 187,8	Very large
189,2 à 192,0	Extremely large

Table n°9: Values and appreciation of height in men according to Cazorla and Coll. 1998.

From the data collected, we can say that the middle-distance athletes selected for the national military team of Algeria are quite tall according to the classification table of the human species. This is what he says (**Bulgakova. J, 1978, p. 125**) that anthropometric data such as height, body mass, segmental ratios, and body surface area are often indispensable factors in the practice of certain sports and are an essential tool for the coach. Similarly (**Vladimir. N, 1984, p. 56**) testifies that "Height is a parameter that helps to detect athletes, as it allows the achievement of sports performance."

The weight of our population ranges from **64 to 76 kg**. Our population has a mean of **70.93 kg**, with a standard deviation of **3.41kg**. The coefficient of variation is **4.80%** which shows the heterogeneity of the sample for this parameter too.

Values in kg	Appreciations
64,7 à 66,3	Low mass
68,0 à 69,8	Average weight
71,7 à 73,5	Fairly large mass
75,3 à 77,1	Large mass
79,0 à 80,8	Very large mass
82,6 à 86,3	Excellent mass

Table 10: Values and assessments of weight in men according to Cazorla and al.

From the data obtained, we can say that the middle-distance athletes selected for the Algerian national military team have a fairly large mass according to the classification table of the human species (see Table N°). According to **Cazorla (1991)**, weight is one of the first indicators of the state of form or misformity of the athlete.

The scope of our population is between **170 and 191 cm**. Our population has a mean of **183.06 cm**, with a standard deviation of **5.02 cm**. The coefficient of variation is **2.74%** which shows the homogeneity of the sample for this parameter.

Values in cm	Appreciations
179,1 à 181,1	Small scope
183,0 à 184,7	Medium scope
186,4 à 188,1	Fairly good scope
189,8 à 191,5	Good scope
193,2 à 194,9	Very good scope
196,6 à 200,0	Excellent scope

Table 11: Value and appreciation of stature in men according to Cazorla and al. 1998.

By these values, we will say that the middle-distance athletes selected for the national military team of Algeria have an average size (183.6 cm average). This is what he says (**Bulgakova. J, 1978, p. 125**) that anthropometric data such as height, body mass, segmental ratios, and body surface area are often indispensable factors for the practice of certain sports and are an essential tool for the coach.

From the results obtained concerning anthropometric measurements we can say that:

- For the size, our subjects have a rather large size.
- For the weight, our subjects have a rather important mass.
- For the wingspan, our subjects have a medium scope.

II. Descriptive analysis of the performances realized in the different tests of physical qualities :

1. Descriptive analysis and interpretation of the performance in the 10 x 5 m coordination test:

For the 10 x 5 m shuttle race, the values obtained vary between **14''56 sec** and **17''39 sec**. We have an average of 16**''29 sec** with a standard deviation of **0''81 sec**.

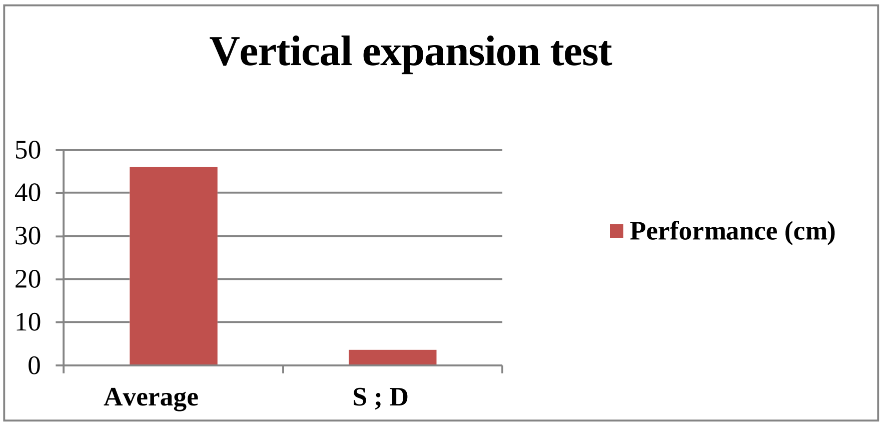
Values in sec	Appreciations
18"55 à 18"39	Low speed - coordination
18"24 à 18"09	Medium speed - coordination
17"93 à 17"77	Fairly good speed - coordination
17"60 à 17"42	Good speed - coordination
17"21 à 16"97	Very good speed -coordination
16"68 à 14"67	Excellent speed-coordination

Table 12: Values and assessments of coordination speed in men according to Cazorla and al.

From these values, we notice that our middle-distance athletes selected for the national military team of Algeria are on the interval of excellence (**16''68 to 14''67**) with an average of (16"29 sec). (**Weinneck. J,1983, p. 267**) indicates that "The qualities of coordination are determined, above all, by the processes of control and regulation of movement. This allows the athlete to master motor actions with precision and economy".

2. Descriptive analysis and interpretation of the performance achieved in the vertical expansion test:

The values obtained in the vertical expansion by the middle-distance athletes selected in the national military team of Algeria are between **41 cm** and **52.6 cm**. we have an average of **45.96cm** with a standard deviation of **3.57cm**.



Graph n°2: Shows the mean and standard deviation of the values obtained in the vertical expansion test.

Values in cm	Appreciations
38 à 39	Low expansion
40 à 41	Average expansion
42 à 43	A quite good expansion
45 à 46	Good expansion
47 à 49	Very good expansion
51 à 63	Excellent expansion

Table 13: Values and assessments of the explosive strength of the lower limbs in men according to Cazorla et al (G. Cazorla, P. Housseaux and G. Millet, 1986).

We will say that the middle-distance athletes selected for the military national team of Algeria have good explosive strength in the lower limbs (vertical relaxation) of average (**45.96**). (**Balsalobre Fernandez et al., 2015; Bachero-Mena B et al., 2017**) indicates factors such as vertical jump performance and personal record over (800m-3000m-5000m) have a significant correlation, suggesting a better running economy.

3. Descriptive analysis and interpretation of performance on the football throwing test:

The values obtained in the football throw by the middle-distance athletes selected in the national military team of Algeria are between **16.01m** and **19.02m.** We have an average of **17.31m** with a standard deviation of **0.83m**.

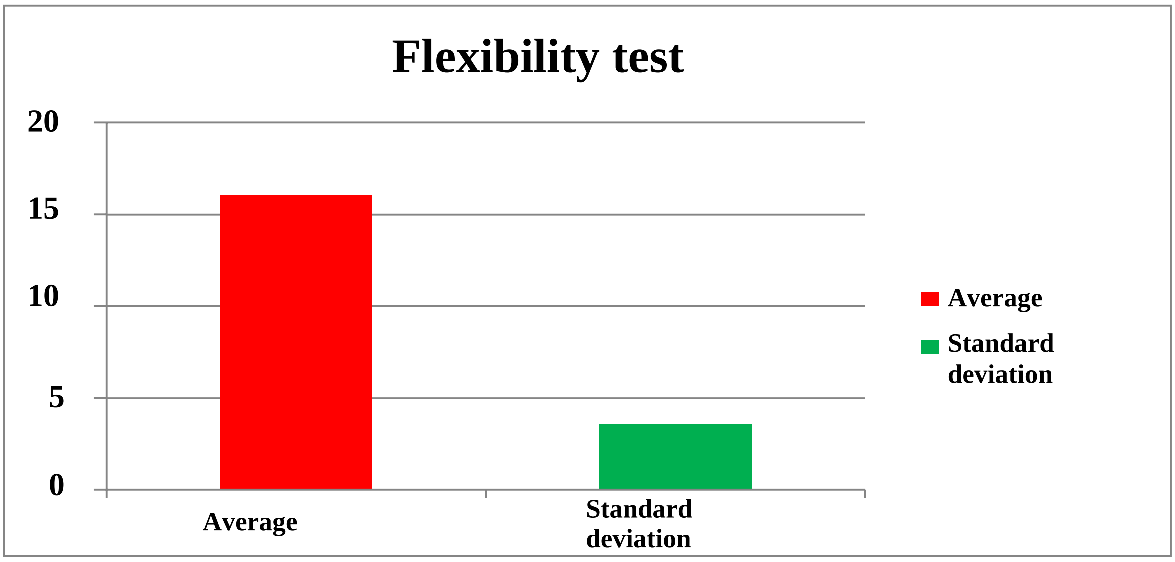
Values in m	Appreciations
13,68 à 13,97	Low strength - explosive
14,25 à 14,53	Medium strength - explosive
14,82 à 14,90	Fairly good strength - explosive
15,43 à 15,77	Good strength - explosive
16,14 à 16,58	Very good strength -explosive
17,13 à 20, 82	Excellent strength - explosive

Table 14: Values and assessments of the explosive force of the upper train in men according to Cazorla and al.

From these values, we can say that the middle-distance athletes selected for the Algerian national military team have excellent explosive strength at the level of the upper train with an average of (17.31m). (**Jung, 2003 ;Legaz-Arrèse et al., 2005**) indicate that strength training has been proposed as an important complementary training to increase performance in endurance events by improving other factors, such as running economy.

4. Descriptive analysis and interpretation of the performance on the flexibility test:

For **the flexion of the trunk in a standing position,** the values obtained by the middle-distance athletes selected for the national military team of Algeria are between **13cm** and **22.50cm.** We have an average of **16.06cm** with a standard deviation of **3.58cm**.



Graph 3: Shows the mean and standard deviation of the values obtained in the flexibility test.

Referring to **J.D.M. Howard et al. (1988)** who say that any measurement below the bench is positive, we will say that the middle-distance athletes selected in the national military team of Algeria have good flexibility at the level of the trunk because all the measurements were taken below the bench, in other words, from the fingertips to the bench.

5. Descriptive analysis and interpretation of the performances achieved in the 50 m speed test:

The performances obtained in **the 50m sprint race** by the middle-distance athletes selected for the Algerian national military team are between **6''36** sec and **6''88** sec. We have an average of **6''65** sec and a standard deviation of **0.18 sec.**

Values in sec	Appreciations
7"41 à 7"34	Low speed
7"28 à 7"22	Medium speed
7"16 à 7"10	Fairly good speed
7"03 à 6"96	Good speed
6"88 à 6"78	Very good speed
6"66 à 5"87	Excellent speed

Table 15: Values and assessments of the speed of the 50 m race in men according to Cazorla and Coll. 1986.

From these values, we can say that the middle-distance athletes selected for the Algerian national military team have an **excellent** average **speed** of **(6''65).**

In middle-distance running, primary speed is seen through the fact that anaerobic threshold speed, ventilatory threshold speed, and VO2max have been identified as predictors of middle-distance running performance in novice and elite athletes **(Zacharogiannis and Farrally 1993; Abe et al. 1998**).

6. Descriptive Analysis and Interpretation of VAMEVAL Test Performance:

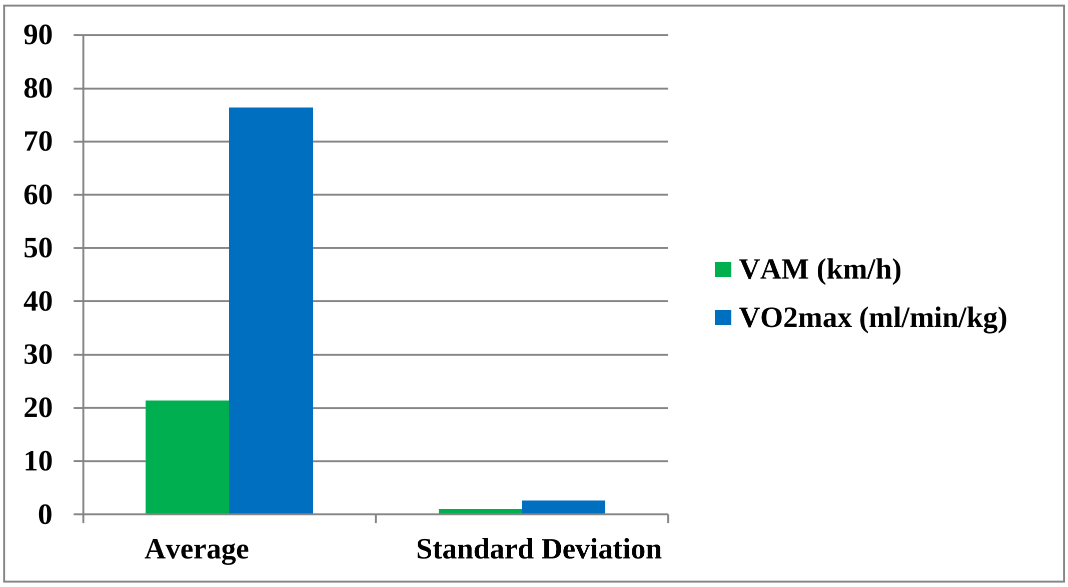
The performances obtained in the **VAMEVAL test** (**G. CAZORLA**) by the middle- distance athletes selected for the Algerian national military team are as follows

For the VAM are between **20,5 km/h** and **23,5km/h** with an average of **21,83 km/h** and with standard deviation of **01,04 km/h** .

For VO2max are between **71.75 ml/min/kg** and **82.39 ml/min/kg** with a mean of **77 ml/min/kg** with standard deviation of **2.80 ml/min/kg** .

Athletes	*Bearing*	*VAM (km/h)*	*VO2max (ml/min/kg)*
1	**31**	**23,5**	**82.39**
2	**27**	**21,5**	**75.25**
3	**28**	**22**	**77**
4	**27**	**21**	**73,5**
5	**30**	**23**	**80,5**
6	**30**	**23**	**80,5**
7	**26**	**21**	**73,5**
8	**26**	**21**	**73.5**
9	**28**	**22**	**77**
10	**27**	**21,5**	**75,25**
11	**25**	**20,5**	**71.75**
12	**25**	**20,5**	**71.75**
13	**31**	**23,5**	**82.39**
14	**29**	**22,5**	**78,75**
15	**26**	**21**	**73.5**
	The average	**21,83**	**77**
	Standard deviation	**1,04**	**2,80**

Table n°16: Represents the performances realized in the VAMEVAL test.



Graph n°4: Shows the average and standard deviation of the values obtained in VMA and VO2max.

VAM km -h-1	VO2 max	POTENTIAL PERFORMANCE (h: min: s) according to different running distances (m)										
		800	1000	1500	2000	3000	5000	10000	15000	20000	30000	42195
14	49.0	2:59	3:56	6:30	9:05	14:28	25:20	56:15	1:27:23	1:59:22	3:15:43	4:54:07
15	52.5	2:46	3:38	5:59	8:20	13:16	23:11	50:47	1:18:46	1:47:29	2:53:20	4:17:48
16	56.0	2:35	3:24	5:32	7:43	12:15	21:23	46:17	1:11:42	1:37:45	2:35:33	3:49:28
17	59.5	2:26	3:11	5:09	7:10	11:23	19:50	42:30	1:05:47	1:29:38	2:21:05	3:26:44
18	63.0	2:17	2:59	4:50	6:42	12:38	18:30	39:18	1:00:47	1:22:46	2:09:06	3:08:06
19	66.5	2:10	2:49	4:32	6:17	9:58	17:20	36:33	56:29	1:16:52	1:59:57	2:52:34
20	70.0	2:03	2:40	4:17	5:56	9:23	16:18	34:10	52:45	1:11:45	1:50:18	2:39:23
21	73.5	1:57	2:32	4:03	5:36	8:52	15:23	32:04	49:29	1:07:17	1:42:49	2:28:05
22	77.0	1:51	2:25	3:50	5:19	8:24	14:34	30:12	46:36	1:03:20	1:36:17	2:18:16
23	80.5	1:46	2:18	3:39	5:07	7:59	13:50	28:33	44:01	59:30	1:30:32	2:09:41
24	84.0	1:42	2:12	3:29	4:49	7:36	13:10	27:04	41:43	56:41	1:25:26	2:02:06
25	87.5	1:37	2:06	3:20	4:36	7:15	12:34	25:44	39:39	53:51	1:20:53	1:55:21

Table n°17: Presents the regressions calculated by Mercier and Léger 1982 (From the knowledge of the VAM it is possible to extrapolate VO2max to predict the running performances likely to be reached).

Of these values, we will say that the athletes of middle-distance selected in the military national team of Algeria can claim potential performances in the events of the 800 m until the 3000m:

Athletes **1 and 13** have a VO2max of **82.39 ml/min/kg** and a VAM of **23.5km/h.** They can achieve (with a possible margin of error of 5 to 7% more or less) the following performances: **1 min 44 sec** in the 800m; **2 min 14** sec in the 1000m; **3 min 33 sec** in the 1500m; **4 min 58 sec** in the 2000m; **7 min 42** sec in the 3000m.

Athletes **5 and 6 and 14** have a VO2max of **80.5 ml/min/kg** and a VAM of **23km/h** they can achieve (with a possible margin of error of 5 to 7% more or less) the following performances: **1 min 46 sec** in the 800m; **2 min 18** sec in the 1000m; **3 min 39 sec** in the 1500m; **5 min 07 sec** in the 2000m; **7min 59** sec in the 3000m.

Athletes **3 and 9** have a VO2max of **77 ml/min/kg** and a VAM of **22km/h** and can achieve (with a possible margin of error of 5 to 7% more or less) the following performances: **1 min 51 sec** in the 800m; **2 min 25 sec** in the 1000m; **3 min 50 sec** in the 1500m; **5 min 19 sec** in the 2000m; **8min 24 sec** in the 3000m.

Other athletes had a VO2max of **75.25 ml/min/kg** and an VAM of **21.5km/h** for (athletes 2 and 10) and a VO2max of **73.5 ml/min/kg** and an VAM of **21km/h** for (athletes 4 and 7 and 8 and 15) and also a VO2max of **71.75 ml/min/kg** and an VAM of **20.5km/h** for (athletes 11 and 12).

According to **BERG et al. 1980, KENNY and HODGSON 1985**, Vo2max is a success factor for middle-distance athletes, particularly for 1500m and 3000m runners, and is related to the athlete's specialty, age, and sex.

Aerobic capacity is an important aspect of the middle-distance runner, especially with increasing distance **(Mytton et al., 2015; Thomson MA, 2017).**

In summary, we can say that the middle-distance athletes selected for the Algerian national military team have:

Good explosive strength in the lower limbs (vertical expansion test).

Excellent speed and coordination (10 x 5 m shuttle coordination test).

Excellent explosive strength in the upper extremity (soccer throwing test)

Excellent speed (50m speed test).

Good flexibility at the level of the trunk (the flexion of the trunk in a standing position). Excellent maximum aerobic speed and VO2max (VAMEVAL test).

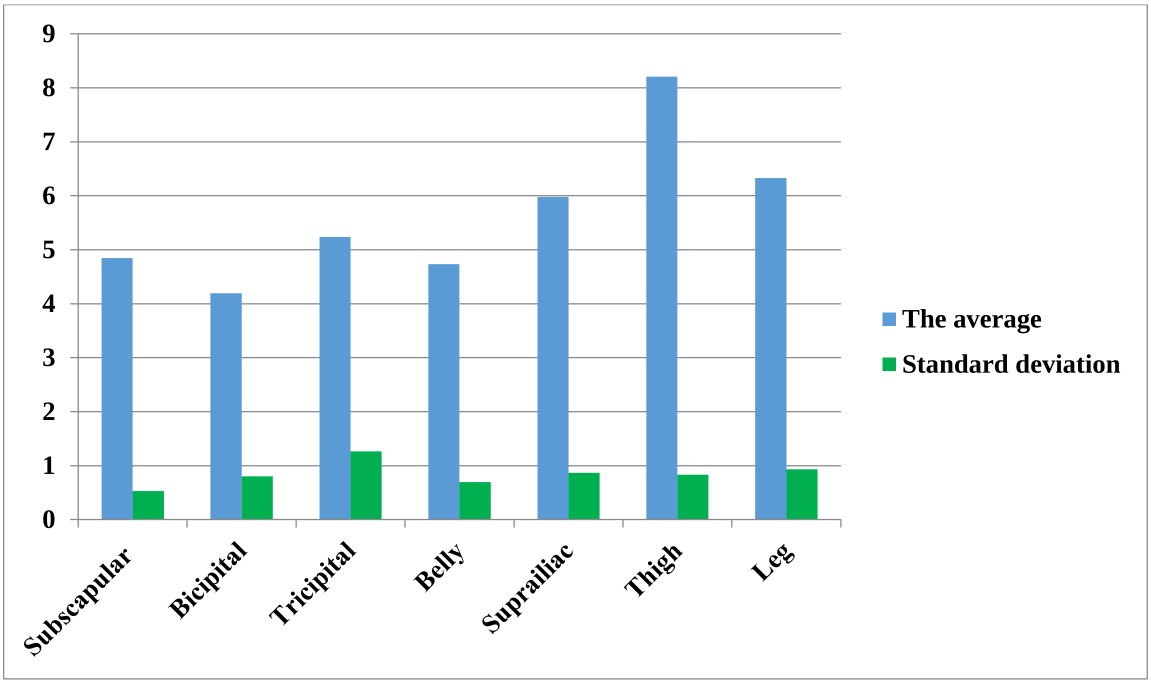
Tests	Average	Standard deviation
Vertical expansion test (cm)	45,96	3,57
Shuttle coordination test 10x5 m (sec)	16,29	0,81
Soccer Throwing Test (m)	17,31	0,83
Speed test 50m (sec)	6,65	0,18
Flexibility test trunk flexion in standing position (cm)	16,06	3,58
VAMEVAL test. VAM in (km/h); VO2max in (ml/min/kg)	VAM :21,83 VO2max :77	VAM: 1.04 VO2max :2,80

Table n°18: Represents averages and standard deviations of the performances realized in the different physical tests.

II. Descriptive analysis and interpretation of the results of the measured skin folds:

Skin folds	Subscapular	Bicipital	Tricipital	Belly	Suprailiac	Thigh	Legs
Average	4,84	4,19	5,24	4,73	5,98	8,20	6,32
Standard deviation	0,52	0,80	1,26	0,69	0,86	0,83	0,93

Table n°19: Represents the averages and the standard deviation of the measured skin folds.



Graph 5: Shows the mean and standard deviation of skin folds.

The analysis of anthropometric parameters of skin folds of middle-distance athletes selected for the Algerian national military team gave the following results: Subscapular (4.80±0.52), bicipital (4.19±0.80), tricipital (5.24±1.26), belly (4.73±0.69), suprailiac (5.98±0.86), thigh (8.20±0.83) folds, and lastly the average of the leg is (6.32±0.93).

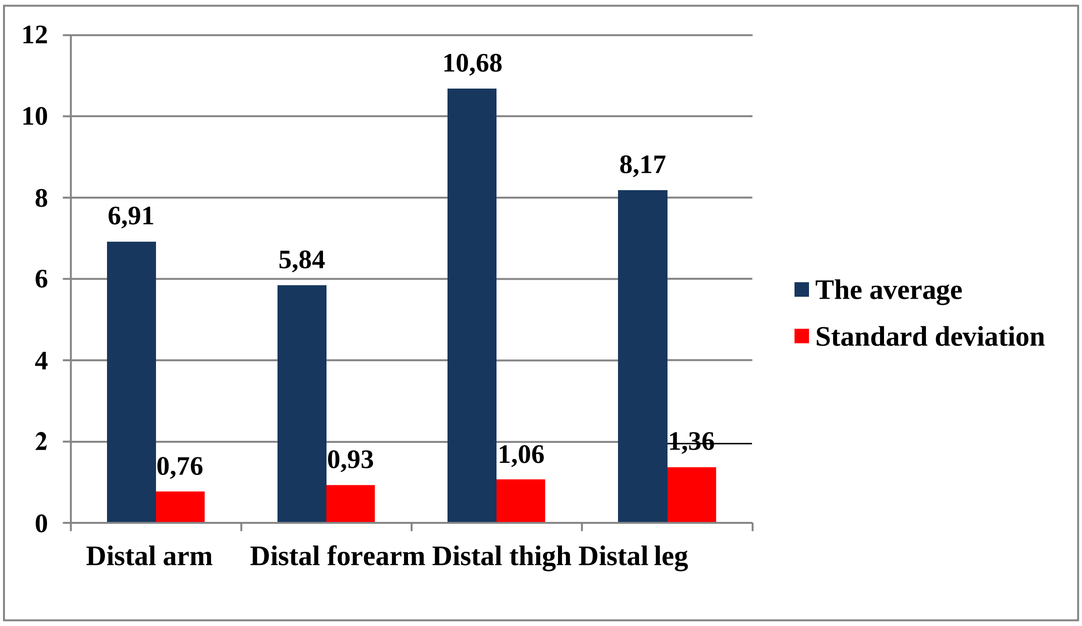
According to **Cazorla (1991)**, weight is one of the first indicators of the athlete's state of fitness or lack of fitness, together with the measurement of the skin fold, it is used to monitor training and to assess the balance of energy intake and expenditure related to diet and training.

III. Descriptive analysis and interpretation of results of measured body diameters:

Distal diameters	Distal Arm	Distal forearm	Distal thigh	Distal leg
The average	**6,91**	**5,84**	**10,68**	**8,17**
Standard deviation	**0,76**	**0,93**	**1,06**	**1,36**

Table n°20: Represents the means and the standard deviation of the distal diameters.

The values of the anthropometric parameters of the diameters of the middle-distance athletes selected for the national military team of Algeria gave the following results: the distal arm (6,91±0,76), distal forearm (5,84±0,93), thigh (10,68±1,06), lastly the leg with an average of (8,17±1,36). (**Sempe.M, 1979, p. 101**) which emphasizes that the relationships between the different morphological characters provide elementary information for the direction of the different preparation processes.



Graph n°6: Shows the mean and standard deviation of the distal diameters.

IV. Descriptive analysis and interpretation of body mass component results (%) :

Athletes	Mass fat(%)	Water mass(%)	Muscle mass(%)	Bone mass(%)
1	4,3	69,2	47,6	3,3
2	4,7	69,3	47,9	3,3
3	5,1	68,8	48,1	3,4
4	2,8	71,4	48,3	3,4
5	3,9	69,6	51,1	3,7
6	5,2	65,7	45,7	3,1
7	2,8	70,8	50,5	3,6
8	1,8	72,9	45	3,1
9	5,2	68,7	48,2	3,4

10	**5,7**	**68,1**	**50,1**	**3,6**
11	**4,5**	**69,6**	**47,4**	**3,3**
12	**4,3**	**69,8**	**48,1**	**3,4**
13	**4**	**70,1**	**48,4**	**3,4**
14	**1,3**	**73,1**	**47,8**	**3,3**
15	**3,8**	**70,3**	**47,7**	**3,3**
Average	**3,96**	**69,82**	**48,12**	**3,37**
Standard deviation	**1,27**	**1,83**	**1,58**	**0,16**

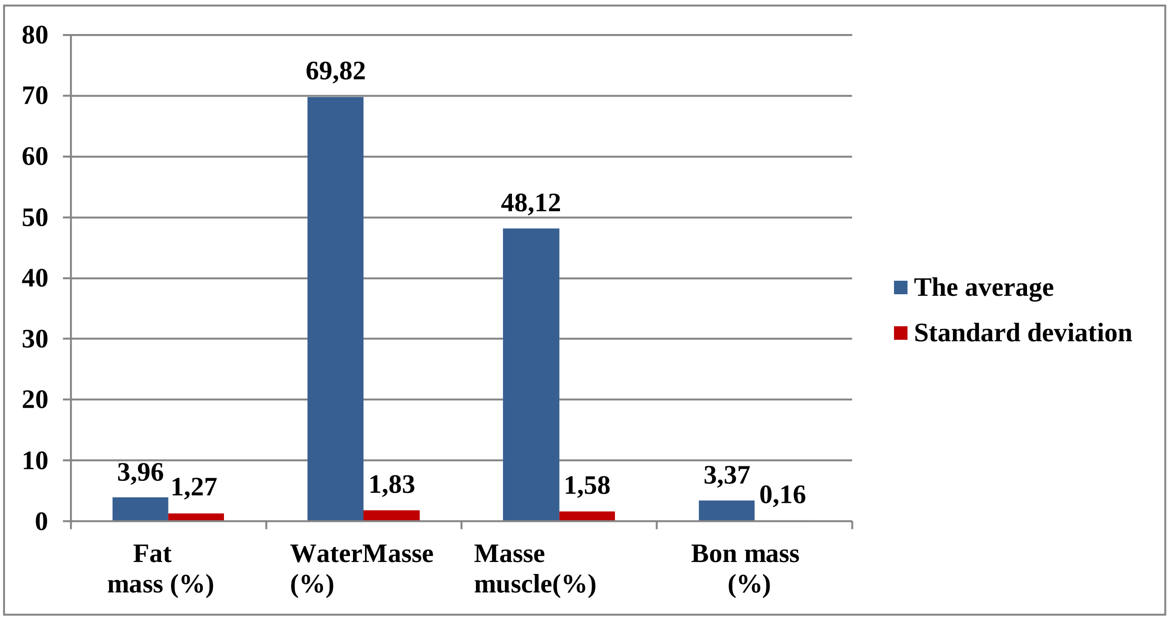
Table 21: Represents the different components of the body mass of the middle-distance athletes of the military national team.

We found, through our results, that middle-distance athletes selected for the national military team of Algeria had the highest percentage of water mass **(69.82%±1.83)**, **(BRIKCI.A, 1995, p. 195)** confirming that the result of the sport can only increase with the size, the fat and muscle components

And a percentage of **(48, 12%± 1.58) of** muscle mass. **(Poortmans.R and Boisseau .N, 2001, p. 487)** that emphasize that the muscle mass can increase more, with the exercise, the diet, or both.

And a percentage of **(3, 96%± 1.27)** fat mass. **(Reilly.T, Williams.M, Nevili.A and Franks. A, 2000, pp. 695-702)** consider that "lean mass and fat mass is more sensitive to development by training and nutritional monitoring". And a lower percentage of bone mass **(3.37%± 0.16)**. **(Praagh. V, 2007, p. 143)** which notes that a large bone mass results in a significant difference in power potential.

Also, **(Poortmans. R and Boisseau . N, 2001, p. 487)** mentions that body fat can increase further, with exercise, diet, or both. **(Monod. H, 2004, p. 457)** indicates that large body fat will automatically reduce sports performance.



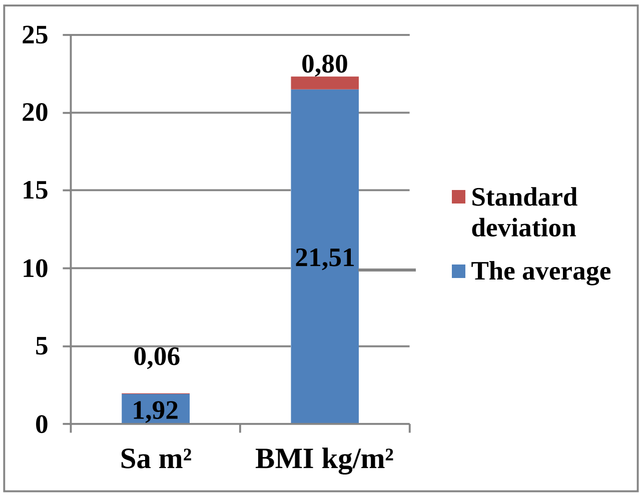
Graph 7: Shows the mean and standard deviation of the different components of the body mass of the middle-distance athletes of the military national team.

IV-1. Body Surface Area and Body Mass Index (BMI) :

Athletes	BMI (kg/m²)	Sa (m²)
1	20,9	1,93
2	21,7	2,03
3	21,7	1,94
4	21	1,81
5	21,3	1,96
6	22,7	1,99
7	22	1,84
8	19,8	1,98
9	21,6	1,9
10	22,8	1,92
11	21,7	1,92
12	21,5	1,95
13	21,9	1,91
14	20,2	1,82
15	21,9	1,98
Average	21.51 kg/m².	1,92 m²
Standard deviation	0.80 kg/m².	0,06 m²

Table 22: Represents the body mass index (BMI) and body surface area (SA) of middle-distance athletes of the military national team.

The values of anthropometric parameters of BMI (kg/m²) and Sa (m²) of middle-distance athletes selected for the national military team of Algeria have given the following results: For the body mass index (BMI) an average of **21.51 kg/m²** and a standard deviation of **0.80 kg/m²**. For the body surface an average of **1.92 m²** with a standard deviation of **0.06 m².**



Graph N° 8: Shows the mean and standard deviation of the body mass index (BMI) and body surface area (SA).

BMI (kg/m2)	Classification according to the WHO
<18,5	Underweight
18,5 à 24,9	Normal weight
25 à 29,9	Overweight
30 à 34,9	Moderate or class I obesity
35 à 39,9	Severe or class II obesity
>40	Morbid or class III obesity

Table n°23: Represents BMI classification according to WHO (source: WHO).

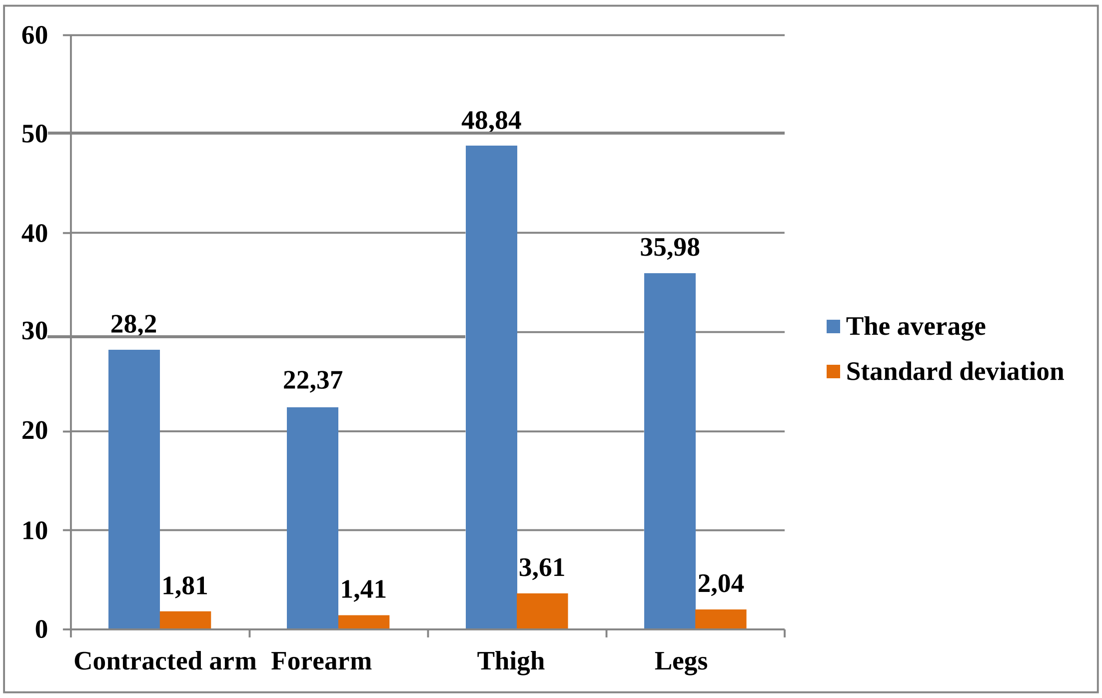
From these values, we can say that the middle-distance athletes selected for the Algerian national military team have a **normal body weight** with an average of **21.51 kg/m²**.

V. Descriptive analysis and interpretation for body limb circumferences:

Circumferences	Contracted arm	Forearm	Thigh	Legs
Average	**28,2**	**22,37**	**48,84**	**35,98**
Standard deviation	**1,81**	**1,41**	**3,61**	**2,04**

Table n°24: The means and standard deviations of the circumferences of the body members.

The average values of anthropometric circumference parameters of middle-distance athletes selected for the Algerian national military team yielded the following results: contracted arm (28.2±1.81), forearm (22.37±1.41), thigh (48.84±3.61), leg (35.98±2.04). (**Reilly & Gilbourne, 2003, p. 555**) explain that the dimensions form part of the differences in endurance performance and sprint repetition abilities.



Graph n°9: Shows the mean and standard deviation of the different circumferences of the body members.

VI. Descriptive analysis and interpretation for somatotype according to (Heath and Carter,1990):

Somatotyping	Endomorph	Mesomorphic	Ectomorph
Average	**1,37**	**3.94**	**3,51**
Standard deviation	**0,26**	**1.77**	**0.48**

Table n°25: Presentation of the mean and the standard deviation of the somatotype.

The study of the somatotype according (**HEATH and CARTER, 1990**), revealed to us that the middle-distance athletes selected in the national military team of Algeria are of mesomorphic type, we can say that on average, our sample is mesomorphic since the highest value is that of the degree of meso-morphism which is equal to **3.94 ± 1.77** followed by the degree of ectomorphic with a value of **3.51±0.48** and finally the value of the degree of endomorphism which is equal to **1.37±0,26**.

X= ecto - endo

Y= 2meso - (ecto + endo)

	Endomorph	*Mesomorph*	*Ectomorph*	*X*	*Y*
1	**1,44**	**5,02**	**3.92**	**2,48**	**4,68**
2	**1,57**	**5.27**	**3.77**	**2,2**	**5,2**
3	**1,15**	**3.92**	**3.44**	**2,29**	**3,25**
4	**1,21**	**3.84**	**3.46**	**2,25**	**3,01**
5	**1,53**	**4.23**	**3.79**	**2,26**	**3,14**
6	**1,65**	**5.97**	**3.08**	**1,43**	**7,21**
7	**1,62**	**6.87**	**2.99**	**1,37**	**9,13**
8	**0,84**	**0.41**	**4.82**	**3,82**	**-5,66**
9	**1,39**	**3.34**	**3.39**	**2**	**1,9**
10	**1.45**	**6.02**	**2.83**	**1,38**	**7,28**
11	**1.04**	**4.15**	**3.41**	**2,37**	**3,85**
12	**0.90**	**2.79**	**3.62**	**2,72**	**1,06**
13	**0.99**	**2.69**	**3.24**	**2,25**	**1,15**
14	**0.74**	**1.20**	**3.99**	**3,25**	**-2,33**
15	**1.28**	**3.42**	**3.03**	**1,75**	**2,53**
Average	**1,37**	**3.94**	**3,51**	**2,25**	**3,02**
Standard deviation	**0,26**	**1.77**	**0.48**	**0,66**	**3,72**

Table N°26: Represents somatotype for the middle-distance athletes selected for the national military team of Algeria.

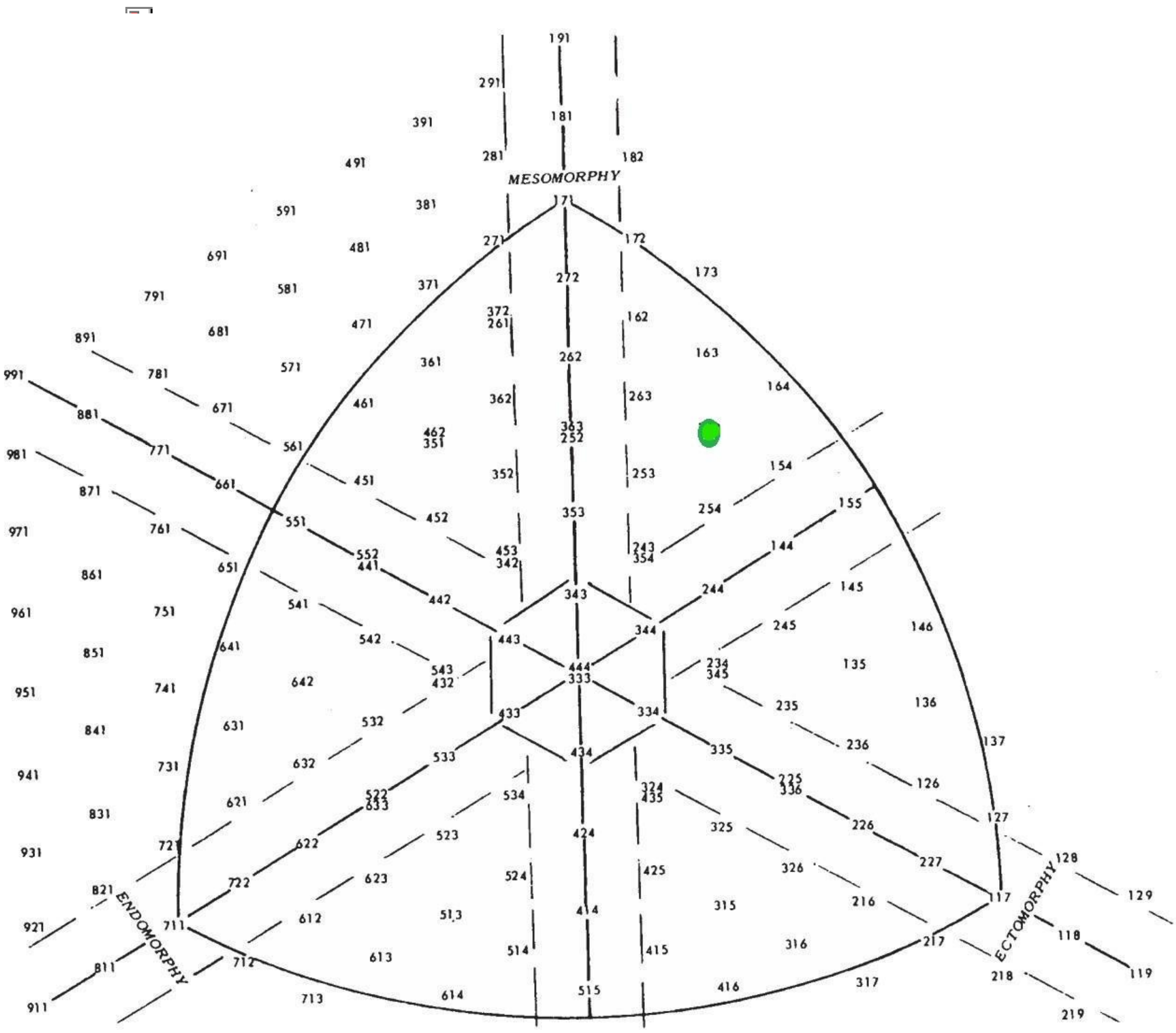


Figure N°22: Graphical representation of the results of the somatotype of middle-distance athletes selected for the Algerian national military team on the somatocard.

Discussion:

Our research is aimed at evaluating the physical qualities and morphological profile of middle-distance athletes selected for the senior men's Algerian military national team, their body composition as well as determining their somatotypes in the middle-distance event. Our research was carried out on a sample of 15 middle-distance athletes (800m, 1500m) representing an average age of (24.26±3.67 years).

The middle-distance athletes selected for the national military team of Algeria senior man were subjected to physical tests to assess their speed, strength, coordination, flexibility, and endurance. And anthropometric measurements (weight, height, scope, length of lower and upper body, skin folds, distal diameters, circumferences of body members). As well as the percentages of fat, water, bone, and muscle mass, to determine the somatotype in the middle-distance test following the method of Heath and Carter.

I. Physical tests:

1. Coordination test (10 x 5 m shuttle):

For the 10 x 5 m shuttle race, the values obtained vary between **14''56 sec** and **17''39 sec**, with an average of **(16''29 sec±0''81)**.

Referring to the classification tables of the human species and the study of **Cazorla and Coll, 1986** on anthropometric measurements and physical tests, the study allowed the elaboration of scales of the physical value of young people from 12 to 18 years and more, according to the results indicate that the middle-distance athletes selected in the military national team of Algeria have an excellent speed-coordination.

The results obtained are in agreement with our theoretical analysis, (**Dierks and Davis, 2007; Hreljac, Marshall, & Hume, 2000**), which argues that expert runners have a lower risk of injury due to a running mode that mitigates the consequences of ground impacts by an adapted pre-positioning of the lower limb or by active muscular resistance to impact. Also (**Weineck. J, 1992, p. 383**) indicates that coordination allows the athlete to master motor actions with precision and economy, in determined situations, which can be foreseen (stereotypes), or unforeseen (adaptation), and to learn relatively more quickly the sports gestures.

Referring to the different statements of the authors we can conclude that coordination is necessary to acquire a better body balance, an essential rhythm quality, and great control during the race (800m-1500m-3000m), and considering the dynamics within the race.

2. Vertical expansion test:

The values obtained in the vertical expansion test from **41 cm** to **52.6 cm**, with an average of**(45.96cm±3.57)**.

According to the study by **Cazorla et al. 1986,** middle-distance athletes selected for the Algerian national military team have good explosive strength in the lower limbs.

These results are in agreement with the scientific data (**Balsalobre Fernandez et al., 2015; Bachero-Mena B et al., 2017**) which indicates factors such as vertical jump performance and personal best over (800m-3000m-5000m) have a significant correlation, suggesting a better running economy.

On their side (**Cormie et al., 2009 Jiménez-Reyes et al., 2014**) point out that vertical jump tests have been widely proposed as an effective and immediate assessment tool of lower limb explosive strength.

Therefore, it can be concluded that the explosive strength of the lower limbs is one of the criteria determining the performance in middle-distance running.

3. Soccer Throwing Test:

The values obtained in the football toss ranged from **16.01m** to **19.02m**, with a mean of (**17.31m±0.83**)**.**

According to the classification tables of the human species and the study of **Cazorla and Coll, 1986,** we will say that the middle-distance athletes selected for the national military team of Algeria have excellent explosive strength at the level of the upper train.

Our study coincides with the scientific data of (**Jung, 2003; Legaz-Arrèse et al., 2005**) which indicate that strength training has been proposed as an important complementary training to increase performance in endurance events by improving other factors, such as running economy.

We can conclude that the strength of the upper limbs is one of the criteria determining the performance. For middle-distance runners, upper limb strength is one of the key factors that make them perform better.

4. Flexibility test (trunk flexion in standing position):

For trunk flexion in the standing position**,** the values obtained ranged from **13cm** to **22.50cm** with an average of **(16.06cm±3.58).**

J.D.M.Howard et al. (1988) confirm our results indicating that any measurement below the bench is positive. We would say that the middle-distance athletes selected for the Algerian national military team have good flexibility at the trunk level because all measurements were taken below the bench, in other words, from the fingertips to the bench.

Jenkins and Beazell. (2010), shows that a runner with less flexibility consumes less oxygen over the same distance than one who is more flexible.

Therefore, we can say that a good articular amplitude has become one of the determining criteria in sports performance. Therefore, to reach the top level (elite), athletes must have good joint flexibility. Flexibility is one of the physical qualities that make athletes perform better.

5. Speed test (50 meters):

The performances obtained in **the 50m speed race** ranged from **6''36** sec to **6''88** sec with an average of **(6''65sc ±0''18).**

According to the study **by Cazorla et al. 1986**, middle-distance athletes selected for the Algerian national military team have excellent speed.

The different statements of the authors give more scientific rigor to our research results (**Maffulli et al. 1991; Zacharogiannis et Farrelly 1993 Abe et al. 1998**), which emphasize the importance of speed can be seen in the fact that speed at the anaerobic threshold, ventilatory threshold, and VO_{2max} has been identified as a predictor of middle-distance running performance in novice and elite athletes.

On their side (**Lacour et al. 1990**), indicates the maximum speed that can be maintained under aerobic conditions has been identified as significantly correlated with the performance of middle-distance running.

This allows us to say that speed is one of the determining criteria in sports performance. Also, we can retain that the speed allows us to take the advantage in the phase of acceleration and more on the last 10 to 20 meters of a race of middle distance. So, speed is an essential element of performance in elite runners, which can place them on the international scene.

6. Endurance test (VAMEVAL):

The results obtained in the VAMEVAL test ranged from **20.5km/h** to **23.5km/h** with an average of **(21.83km/h±1.04)** for VAM. And for VO2max are between **71.75 ml/min/kg** and **82.39 ml/min/kg** with an average of **(77ml/min/kg±2.80).**

Referring to **Mercier and Léger 1982** (From the knowledge of the VAM it is possible to extrapolate VO2max to predict the performances of race likely to be reached), the athletes of middle-distance selected in the military national team of Algeria can claim potential performances, from **1 min 44sec** for the 800m**,** from **3 min 33 sec** for the 1500m, and from **7min 42 sec** for the 3000m.

According to **Berg et al 1980, and Kenny and Hodgson 1985**, Vo2max is a success factor for middle-distance athletes, especially for 1500m and 3000m runners.

The average values obtained in our study are comparable to high-level athletes such as **AOUITA** (**83.4 ml/min/kg**) and **OVETT** (**79.3 ml/min/kg**), and higher than the results of the study performed by (**Mohamed, S., Mohamed, A., Mokthar, C., & Feki, Y. 2005**), the VAM with an average of (**20.38km/h±1.45**), and the VO2max with an average of (**64.76ml/min/kg±7 .68**). (**Lacour et Col., 1989)** quotes the value of **22.9km/h** for French athletes, which demonstrates the power of this parameter in our population concerning the latter.

The different statements of the authors give more scientific rigor to our research results in the image of (**Mytton et al., 2015; Thomson MA, 2017**) who emphasize aerobic capacity is an important aspect of performance in middle-distance runners, especially when distance increases. Also (**Foster et al. 1978; Boileau et al. 1982; Camus 1992**) motion VO2max was found to be more strongly correlated with running performance in middle-distance runners than in long-distance runners.

Using the arguments, we have given, based on the exploitation of the results obtained, we can say that the VAM and VO2max processes are of great importance in middle-distance events, and are one of the important elements of sports performance.

II. Anthropometric measurements:

1. Size, weight, scope:

Our population has a mean of (**181.6cm±3.54**) for height and a mean of **(70.93kg±3.54)** for weight, and finally a mean of **(183.6cm±5.02)** for wingspan.

According to the classification table of the human species by **Cazorla et al. 1998**, the middle-distance athletes selected for the national military team of Algeria are quite tall and have a medium wingspan and a fairly large mass.

This average is comparable to that of the elite (180cm 70kg), and to that of the winners of the Tokyo 2020 Olympic Games in the middle-distance events.

This agrees with our theoretical analysis confirmed by (**Reilly T, Secher N, Snell P, and Williams C., 1990**) who indicate that "in middle-distance runners, it seems that a moderate height and lightweight accompanied by a low body fat content constitute the predominant morphological profile".

(**Fall and Pirnay 1988 and Coll 1990, Carter 1982**) indicates that the height of the athletes is generally an average of 170 to 185cm.

So, we can conclude that the weight index and height are one of the factors that must be taken into consideration as determining criteria in the sports performance in the middle distance.

2. Upper and lower limb length:

Our population has a mean of (**98.70cm±3.82**) for lower limb length and a mean of **(53.58cm±2.40)** for upper limb length.

The results confirm that is what most specialists say in our theoretical analysis like (**Bulgakova. N.S, 1978, p. 37**) which states that anthropometric data such as height, body mass, segmental ratios, and body surface area are often indispensable factors in the practice of certain sports and are an essential tool for the coach.This agrees with the data of (**Sempe.M, 1979, p. 78**) who emphasize that the relationships between the different morphological characters provide elementary information for the direction of the different processes of preparation.

For these reasons, it is possible to emphasize the measurements of the body segments (length of the lower and upper limbs) in terms of determining factors of performance in the middle-distance race.

3. Circumference measurement:

The average values of the anthropometric parameters of the circumferences of the middle-distance athletes selected in the national military team of Algeria gave the following results: contracted arm (28.2±1.81), forearm (22.37±1.41), thigh (48.84±3.61), leg (35.98±2.04).

The results of our research agree with our theoretical analysis, especially in the usefulness of body measurements, where all the authors have the same line of thought (**Malina.M and Bouchard. C, 1991, p. 123**) who emphasize that muscle circumferences, weight, height, and body composition are among the most frequently measured anthropometric indicators. Also (**Reilly & Gilbourne, 2003, p. 555**) explains that dimensions form part of the differences in endurance performance and sprint repetition capabilities.

So, we can say that circumferences became one of the determining criteria in sports performances, it allowed to have power at the level of the inferior and superior train.

4. Skin folds measurement:

The analysis of anthropometric parameters of skin folds of middle-distance athletes selected for the Algerian national military team gave the following results: Subscapular (4.80±0.52), bicipital (4.19±0.80), tricipital (5.24±1.26), belly (4.73±0.69), suprailiac (5.98±0.86), thigh (8.20±0.83), and lastly the average of the leg is (6.32±0.93).

The mean values obtained in our study are comparable to the study (**Arrese, A. L., Badillo, J. G., & Ostáriz, E. S. 2005**), and the study (**Bosch, A. N., Goslin, B. R., Noakes, T. D., & Dennis, S. C. 1990).**

(**Arrese, A.L.; Ostáriz, E.S. 2006**) also reported that the thickness of the skin fold of the lower limbs in men was directly related to the time of running on 1500 m and 10,000 m. Also, **Cazorla (1991)**, indicates that the weight is one of the very first indicators of the state of form or misformity of the athlete, accompanied by the measurement of the skin fold, it enters the monitoring of training and allows to account for the balance of energy intake and expenditure related to the diet and training.

Taking into account the recommendations and according to the results obtained by our sample, we can say that the measurement of skinfolds is one of the essential body dimensions for athletes and consider them as a factor that makes them perform better in the middle-distance race.

5. Diameter measurement:

The values of the anthropometric parameters of the diameters of the middle-distance athletes selected for the national military team of Algeria gave the following results: distal arm (6.91±0.76), distal forearm (5.84±0.93), thigh (10.68±1.06), lastly the leg with an average of (8.17±1.36).

Our results are in agreement with the scientific data of (**Abraham, G. 2010),** and also of (**Tesanovic, G., Jakovljevic, V., Pavlović, R., Dabovic, M., & Bosnjak, G. 2017).**
It can be said that it is possible to underline that the measurement of the body diameter provides elementary information for the direction of the different processes of preparation in the middle-distance race.

6. Body composition:

Regarding body composition, our population had the highest percentage of water mass **(69.82%±1.83)**, a percentage of **(48, 12%± 1.58)** muscle mass, and a percentage of **(3, 96%± 1.27)** fat mass, and a lower percentage of bone mass **(3.37%± 0.16)**.

A collection of anthropometric measurements carried out during the Olympic Games of Montreal 1976 allowed us to retain that the athletes who possess the lowest percentage of fat mass are the middle-distance and long-distance runners (< %6), which makes the granting of our results. what is confirmed by (**Brooks and Fahey.1984**), which indicates that the athletes performing in the sports of endurance have generally a low-fat mass.

The results of our research agree about water mass and muscle mass, as confirmed by (**Brikci. A, 1995, p. 278**), which indicates that the result of the sport can only increase with the size, fat, and muscle components. Also **(Praagh. V, 2007, p. 143)** mentions that a large bone mass results in a notable difference in potential power.

The results of our research confirm the importance of an objective evaluation based on measurements of the body component which allows for a good diagnosis ensuring a better follow-up of the development of sports performance.

7. Somatotype:

According to the study (**Heath and Carter, 1990**), middle-distance athletes selected for the Algerian national military team are of **the mesomorphic** type with an average of (**3.94 ± 1.77**). Our results are comparable with the scientific data **(Carter, J. L. 1984) who** found that male Olympic runners were defined as ecto-mesomorphic (a score of 1.5-4.3-3.6 for middle- distance athletes), with no significant differences between Olympic runners participating in different events.

The results of our research agreement with the results of a similar study by (**Vučetić, V., R Matković, B., & Šentija, D. 2008**) who found that the mesomorphic component is the dominant feature in all groups of athletes (sprinters, endurance runners, middle-distance runners, and long-distance runners), while the ectomorphic component is the least marked.
High-level athletes have a somatotype, body composition, and proportionality profiles determined, which leads us to link the success in a given sport to a defined morphological prototype and not to the other, without forgetting the other factors that intervene in the sports performance (**Mansilla et al, 2000**).

So, we can draw the following conclusion that somatotype is an essential factor in the determination of high performance, the determination of morphotype would be essential for middle-distance runners when it comes to sports performance.

8. Body Mass Index (BMI):

For the body mass index (BMI), the middle-distance athletes selected for the Algerian national military team have an average of **21.51 kg/m²**. According to the BMI classification table according to the WHO, our population has a normal body weight.

The average values obtained in our study are comparable to those reported by (**Knechtle, B., Knechtle, P., Andonie, J. L., & Kohler, G. 2007),** who found an average of **20.6 kg/m²** for the best Scandinavian runners. And superior to the results of the study carried out by(**Vernillo, G., Schena, F., Berardelli, C., Rosa, G., Galvani, C., Maggioni, M., La Torre, A. 2013**),which found the body mass index of Kenyan runners is 19.2 kg/ m².

The interest of different authors in the analysis of morphological and physical parameters of high-level athletes, and through this study, we have found that:

- The middle-distance athletes selected for the Algerian national military team have physical qualities that make them more efficient.
- The middle-distance athletes selected for the Algerian national military team have morphological profiles that meet international standards.
- The middle-distance athletes selected for the Algerian national military team have physical qualities and morphological profiles that make them more efficient.

Conclusion

In today's high-performance sport, physical qualities need to be improved for a good planning of training programs (short and long term). Also, a good recovery and a good diet put the athlete at the top of his physical form at the time of the competition.

As in any other sport, performance in athletics is the result of a set of factors (biological, physical, physiological, technical, etc.) among which physical qualities (strength, speed, endurance, coordination, flexibility) and morphological characteristics (height, body composition, diameters, circumference, skin folds and lengths of the body's limbs) which are considered as one of the most important parameters in sport and are often indispensable factors for the practice of certain sports. Achieving a sporting performance is above all the result of a serious follow-up of adapted and structured training.

It is in this context that we started research on the physical qualities and morphological characteristics of the Algerian runners selected in the senior military national team in the discipline of middle-distance, intending to determine the physical and morphological characteristics for this athletic specialty, as well as comparing them to international standards.

This research allowed us, in a well-elaborated framework, to have an overview of the physical and morphological profile of these athletes because in the light of the results obtained

For physical tests

For the 10 x 5 m shuttle race, given the results obtained and compared to the classification tables of the human species and the study of **Cazorla et al, 1986,** the results indicate that our athletes fit within the average values of the times achieved by high-level athletes.

It is the same for the Vertical expansion test the values obtained **were 41 cm** to **52.6 cm**, with an average of**(45.96cm±3.57)**. These results are in agreement with the scientific data (**Balsalobre Fernandez et al., 2015; Bachero-Mena B et al., 2017**) which indicate that factors such as vertical jump performance and personal best over (800m-3000m-5000m) have a significant correlation, suggesting a better running economy.

Also, the values obtained in the football throw are between 16**.01m** and **19.02m**, with an average of **(17.31m±0.83)**. Compared to the study by **Cazorla et al. 1986,** we can say that middle-distance athletes selected for the Algerian national military team have high explosive strength in the upper body.

It should also be noted that for the flexibility test the trunk flexion in the standing position the values obtained ranged from **13cm** to **22.50cm** and referring to the work of (**16.06cm±3.58) J.D.M.Howard et al. (1988)** confirm our results, similarly, **Jenkins and Beazell, (2010)**, show that a runner with less flexibility consumes less oxygen over the same distance than one who is more flexible.

This is also what we can see in the performances obtained in **the 50m speed race** between **6''36** sec and **6''88,** according to the study by **Cazorla et al, 1986,** so our athletes are within the times required for a better performance

The results obtained in the VAMEVAL test ranged from 20**.5 km/h** to **23.5km/h** for the VAM. And for VO2max are between **71.75 ml/min/kg** and **82.39 ml/min/kg,** according to **Berg et al 1980, Kenny and Hodgson 1985**, the Vo2max is a success factor for middle-distance athletes, particularly for 1500m and 3000m runners.

The average values obtained in our study are comparable to high-level athletes such as AOUITA (**83.4 ml/min/kg**) and **OVETT** (**79.3 ml/min/kg**)

In conclusion, about the physical qualities of the group selected in the national military team, we can say or advance that they can claim a place at the level of the international arena especially as they have very good support.

In terms of **anthropometric measurements,** our athletes have an average height of (**181.6cm±3.54**), an average weight of **(70.93kg±3.54)**, and an average scope of **(183.6cm±5.02),** comparing them to the classification table of the human species by **Cazorla et al, 1998**, these athletes have a fairly large average wingspan and mass and also compared to the average of the elite (180cm 70kg), and that of the winners of the Tokyo 2020 Olympic Games in the middle-distance events.

The average values of the middle-distance athletes selected for the Algerian national military team gave the following results: contracted arm (28.2±1.81), forearm (22.37±1.41), thigh (48.84±3.61), leg (35.98±2.04). This is consistent with the work of (**Malina.M and Bouchard . C, 1991, p. 123**) who point out that muscle circumference, weight, height, as well as body composition are among the most frequently measured anthropometric indicators. This validates our research objective.

The same applies to skin folds and body composition.
The total folds, subscapular fold (4.80±0.52), bicipital (4.19±0.80), tricipital (5.24±1.26), belly (4.73±0.69), suprailiac (5.98±0.86), thigh (8.20±0.83), and lastly the average of the leg is (6.32±0.93). The average values obtained in our study are comparable to the study of (**Arrese, A. L., Badillo, J. G., and Ostáriz, E. S. 2005**),

For body composition, given the results obtained the highest percentage of water mass **(69.82%±1.83)**, a percentage of **(48, 12%± 1.58) of** muscle mass, and a percentage of **(3, 96%± 1.27) of** fat mass, and a lower percentage of bone mass **(3.37%± 0.16)** these are consistent with the work of (**Brooks and Fahey.1984)**, which indicate that athletes performing well in endurance sports generally have a low-fat mass.
From this, we can say that the result of the sport can only increase concerning the size, fat, and muscle components (**Brikci. A, 1995, p. 278**)

Finally, for the somatotype, the results of our research agree with the results of a similar study by (**Vučetić, V., R Matković, B., & Šentija, D. 2008**) who found that the mesomorphic component is the dominant feature in all groups of athletes (sprinters, endurance runners, middle-distance runners, and long-distance runners), while the ectomorphic component is the least marked.

We will say that high-level athletes present a somatotype, a body composition, and determined proportionality profiles, which leads us to link the success in a given sport to a defined morphological prototype and not to the other, without forgetting the other factors that intervene in the sport performance (**Mansilla et al, 2000**).

We conclude that the athletes of the national military team in the specialty of the middle distance are called to have better results in the next world championships or at the time of the Olympic games considering the various physical qualities of which they have and especially considering their profits and the means placed at their disposal.

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Annex

Topic Overview:

Athletes	Age (years)	Weight (kg)	Hight (cm)	Specialty
Hethat Yassine	30	70	183	1500/800m
Hamada fouad	25	76	187	1500/800m
Hamouni Anes	26	72	182	400/800m
Hamouni A/Rahmane	26	65	176	1500/800m
Drabli Amine	21	72	184	1500/800m
Belferar Amine	30	76	183	800m
Benchahda Hachemi	27	68	176	1500/800m
Aleghrissi Yacine	28	70	188	800m
Benarbia Marwen	19	70	180	800m
Ouanis Sami	23	73	179	400/800m
Meghaouri a/rahmane	20	71	181	800m
Hetack Oussama	21	72	183	1500/800m
Sedjati Djamel	22	71	180	1500/800m
Hedjelaoui Hamza	26	64	178	1500/3000m
Zergui Mohamed	20	74	184	1500/ 3000m
Average	24,26	70,93	181,6	
Standard deviation	3,67	3,41	3,54	
CV %.	15,13	4,80	1,95	

Physical test results:

Athletes	Vertical rebound test (cm)	Soccer throw test (m)	Flexibility test (cm)	Coordination test 10 x 5 m (sec)	Speed test 50 m (sec)
Hethat Yassine	42	18,22	22	15,48	6,39
Hamada fouad	43,2	17,1	18,3	16,01	6,83
Hamouni anes	40	16,1	16	17,19	6,9
Hamouni A/Rahmane	40,8	17,3	15	17,39	6,87
Drabli amine	34	17,2	14,4	16,78	6,78
Belferar amine	43	19,02	21,5	14,98	6,44
benchahda Hashemi	45,4	17,08	14	16,02	6,58
aleghrissi Yacine	48	18,12	13	16,72	6,72
Benarbia Marwan	37	17,36	18,3	16,4	6,48
Ouanis Sami	42	17,6	12,5	16,67	6,54
meghaouri a/rahmane	37	17,22	15	15,8	6,8
hetack Oussama	33,5	16,9	13	16,65	6,65
Sedjati djamel	52,6	18,15	22,5	14,56	6,36
Hedjelaoui hamza	34	15,8	12,2	16,71	6,63
zergui Mohamed	46	16,6	13,3	17,06	6,88
The average	41,23	17,3	16,06	16,29	6,65
Standard deviation	5,51	0,83	3,58	0,81	0,18

VAMEVAL test results:

Athletes	Bearing	VAM (km/h)	VO2max (ml/min/kg)
Hethat Yassine	31	23,5	82.39
Hamada fouad	27	21,5	75.25
Hamouni anes	28	22	77
Hamouni A/Rahmane	27	21	73,5
Drabli amine	30	23	80,5
Belferar amine	30	23	80,5
benchahda hachemi	26	21	73,5
aleghrissi yacine	26	21	73.5
Benarbia marwen	28	22	77
Ouanis sami	27	21,5	75,25
meghaouri a/rahmane	25	20,5	71.75
hetack Oussama	25	20,5	71.75
Sedjati djamel	31	23,5	82.39
Hedjelaoui hamza	29	22,5	78,75
zergui mohamed	26	21	73.5
	The average	21,83	77
	Standard deviation	1,04	2,80

Body composition:

Athletes	Fat mass(%)	Water mass(%)	Muscle mass(%)	Bone mass(%)
Hethat yassine	4,3	69,2	47,6	3,3
Hamada fouad	4,7	69,3	47,9	3,3
Hamouni anes	5,1	68,8	48,1	3,4
Hamouni A/Rahmane	2,8	71,4	48,3	3,4
Drabli amine	3,9	69,6	51,1	3,7
Belferar amine	5,2	65,7	45,7	3,1
benchahda hachemi	2,8	70,8	50,5	3,6
aleghrissi yacine	1,8	72,9	45	3,1
Benarbia marwen	5,2	68,7	48,2	3,4
Ouanis sami	5,7	68,1	50,1	3,6
meghaouri a/rahmane	4,5	69,6	47,4	3,3
hetack oussama	4,3	69,8	48,1	3,4
Sedjati djamel	4	70,1	48,4	3,4
Hedjelaoui hamza	1,3	73,1	47,8	3,3
zergui mohamed	3,8	70,3	47,7	3,3
The average	3,96	69,82	48,12	3,37
Standard deviation	1,27	1,83	1,58	0,16

The scope, and length of the lower and upper limbs:

Athletes	Scope (cm)	Length of the lower limbs	length of the upper limbs
Hethat Yassine	182	97	52,3
Hamada fouad	187	101	52
Hamouni anes	191	104	51,5
Hamouni A/Rahmane	184	99,8	56
Drabli amine	183	99	52,8
Belferar amine	187	103	53,8
benchahda Hashemi	170	91	49,5
aleghrissi Yacine	182	105	53
Benarbia Marwan	180	99,4	54
Ouanis Sami	181	93	56,5
meghaouri a/rahmane	186	97	51,3
hetack Oussama	181	98,4	57
Sedjati djamel	186	98	58
Hedjelaoui hamza	178	95,2	54,3
zergui Mohamed	188	99,8	51,7
The average	183,06	98,70	53,58
Standard deviation	5,02	3,82	2,40
CV %.	2,72	3,87	4,49

Circumferences:

Athletes	Contracted arm	Forearm	Thigh	Legs
Hethat Yassine	30	22,5	51,3	36,5
Hamada fouad	28,5	24	52,2	38,1
Hamouni anes	28,2	25	47,2	35,8
Hamouni A/Rahmane	26,3	23	50,1	33,8
Drabli amine	28	22,3	47,3	38
Belferar amine	31	21,8	54,2	36
benchahda Hashemi	31,4	22,4	52,3	38,3
aleghrissi Yacine	26	19,3	44,8	31,8
Benarbia Marwan	27,8	22	49,1	35,4
Ouanis Sami	29,5	23,3	52,7	38,5
meghaouri a/rahmane	26,2	22,5	51	36,2
hetack Oussama	27,2	20,8	47	34,4
Sedjati djamel	29	21,7	43,9	36
Hedjelaoui hamza	25,3	21	41,5	33
zergui Mohamed	28,6	24	48	37,9
The average	28,2	22,37	48,84	35,98
Standard deviation	1,81	1,41	3,61	2,04

Diameters:

Athletes	Distal Arm	Distal forearm	Distal thigh	Distal leg
Hethat Yassine	7,2	6,8	11,7	9,5
Hamada fouad	8	7,1	11,9	9,7
Hamouni anes	7	5,8	10,6	7,6
Hamouni A/Rahmane	6,4	5,2	11,2	9,1
Drabli amine	7,5	6,4	10,4	8
Belferar amine	8	7,2	12	10,2
benchahda Hashemi	7,8	6,9	11,5	9,3
aleghrissi Yacine	6	4,6	9,2	6,6
Benarbia Marwan	6,3	5,3	10,5	7,3
Ouanis Sami	7,7	6,4	11,4	9
meghaouri a/rahmane	6,7	6	11,7	9,3
hetack Oussama	6,6	5,3	10,2	7,4
Sedjati djamel	6,1	5	9,1	6,6
Hedjelaoui hamza	5,6	4,2	8,8	5,6
zergui Mohamed	6,8	5,5	10	7,4
The average	6,91	5,84	10,68	8,17
Standard deviation	0,76	0,93	1,06	1,36

Skin folds:

Athletes	Subscapular	Bicipital	Tricipital	Belly	Suprailiac	Thigh	Legs
Hethat Yassine	5	4,8	6,3	5	6,6	8,6	6,8
Hamada fouad	5,4	5	6,7	5,5	7,1	9	7
Hamouni anes	4,7	4,6	5	4,6	5,6	7,4	5,3
Hamouni A/Rahmane	4,6	4	5,4	4,8	5,3	8,6	6,5
Drabli amine	5,4	5	6,4	5,3	6,8	8,5	7
Belferar amine	5,6	5,3	6,8	5,8	7,2	10	8
benchahda Hashemi	5,6	5,1	6	5,4	7	8,8	7
aleghrissi Yacine	4,5	3	3	3,8	4,6	7,3	5
Benarbia Marwan	4,8	4,2	6	4,4	6,3	8	6,2
Ouanis Sami	5,2	4,5	6,2	5	6	8,5	7,2
meghaouri a/rahmane	4,4	3,3	4,1	4,6	5,8	7	5,7
hetack Oussama	4,4	3,6	4	4,6	5	7,3	5,4
Sedjati djamel	4,3	3,5	4	4,4	5,6	8,2	6
Hedjelaoui hamza	3,8	2,8	3,3	3	4,6	7,2	4,8
zergui Mohamed	5	4,2	5,4	4,8	6,2	8,7	7
The average	4,84	4,19	5,24	4,73	5,98	8,20	6,32
Standard deviation	0,528	0,80	1,26	0,69	0,86	0,83	0,93

Body surface area (Sa) and body mass index (BMI):

Athletes	Sa m²	BMI kg/m2
Hethat yassine	1,93	20,9
Hamada fouad	2,03	21,7
Hamouni anes	1,94	21,7
Hamouni A/Rahmane	1,81	21
Drabli amine	1,96	21,3
Belferar amine	1,99	22,7
benchahda hachemi	1,84	22
aleghrissi yacine	1,98	19,8
Benarbia marwen	1,9	21,6
Ouanis sami	1,92	22,8
meghaouri a/rahmane	1,92	21,7
hetack oussama	1,95	21,5
Sedjati djamel	1,91	21,9
Hedjelaoui hamza	1,82	20,2
zergui mohamed	1,98	21,9
The average	1,92	21,51
Standard deviation	0,06	0,80

Somatotype:

Athletes	Endo	Meso	ECTO	X	Y
Hethat Yassine	1,44	5,02	3.92	2,48	4,68
Hamada fouad	1,57	5.27	3.77	2,2	5,2
Hamouni anes	1,15	3.92	3.44	2,29	3,25
Hamouni A/Rahmane	1,21	3.84	3.46	2,25	3,01
Drabli amine	1,53	4.23	3.79	2,26	3,14
Belferar amine	1,65	5.97	3.08	1,43	7,21
benchahda Hashemi	1,62	6.87	2.99	1,37	9,13
aleghrissi Yacine	0,84	0.41	4.82	3,82	-5,66
Benarbia Marwan	1,39	3.34	3.39	2	1,9
Ouanis Sami	1.45	6.02	2.83	1,38	7,28
meghaouri a/rahmane	1.04	4.15	3.41	2,37	3,85
hetack Oussama	0.90	2.79	3.62	2,72	1,06
Sedjati djamel	0.99	2.69	3.24	2,25	1,15
Hedjelaoui hamza	0.74	1.20	3.99	3,25	-2,33
zergui Mohamed	1.28	3.42	3.03	1,75	2,53
The average	1,37	3.94	3,51	2,25	3,02
Standard deviation	0,26	1.77	0.48	0,66	3,72

Abstract

The middle distance has always been considered the most spectacular queen event in all athletics meetings. Indeed, the national records are significant compared to the world records like the athletes Morceli and Boulmerka. Military sport, due to the means put in place and the new policy of the Ministry of Defense to be present at all international events, has taken on another dimension in the selection of athletes.

It is in this context that our study is interested in the physical qualities and the morphological characteristics of the Algerian runners selected for the senior men's national military team in the discipline of middle distance and this to determine the physical and morphological characteristics of this athletic specialty, thus comparing them to international standards.

Keywords : middle-distance, physical qualities, Morphotype.

Résumé

Le demi-fond a toujours été considéré comme l'épreuve la plus spectaculaire reine dans toutes les réunions d'athlétisme. En effet, les records nationaux sont significatifs par-rapport aux records mondiaux à l'image des athlètes Morceli et Boulmerka. Le sport militaire, de part les moyens mis en place et la nouvelle politique du ministère de la défense d'être présent à toutes les manifestations internationales, a pris une autre dimension dans la sélection des athlètes.

C'est dans ce contexte que notre étude s'intéresse aux qualités physiques et les caractéristiques morphologiques des coureurs algériens sélectionnés en équipe national militaire senior homme dans la discipline de demi-fond et ce dans le but de déterminer les caractéristiques physiques et morphologiques pour cette spécialité athlétique, ainsi les comparer aux normes internationales.

Mots clés : Demi-fond, qualités physiques, Morphotype.

Evaluation of the physical qualities and morphological profile of the middle-distance athletes of the national military team of Algeria.

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