Scientific Research Publishing

Open Journal of Internal Medicine, 2022, 12, 153-169
https://www.scirp.org/journal/ojim
ISSN Online: 2162-5980
ISSN Print: 2162-5972

# Evaluation of the Physical Fitness of the Type 2 Diabetic Patients: A Necessity for the Prescription of Adapted Physical Activity

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**How to cite this paper:** Bagbila, W.P.A.H., Enette, L., Sagna, Y., Victor, O.P., Kyelem, C.G., Yameogo, T.M., Ouedraogo, S.M., Drabo, Y.J. and Fagour, C. (2022) Evaluation of the Physical Fitness of the Type 2 Diabetic Patients: A Necessity for the Prescription of Adapted Physical Activity. *Open Journal of Internal Medicine*, **12**, 153-169.
https://doi.org/10.4236/ojim.2022.123018

**Received:** August 6, 2022
**Accepted:** September 17, 2022
**Published:** September 20, 2022



## Abstract

**Background:** Diabetes mellitus and physical inactivity are modifiable risk factors for stroke. Physical activity is one of the pillars of type 2 diabetes management. The aim of this study was to evaluate the physical fitness of a sample of type 2 diabetes patients at the CHU of Martinique (UHCM). **Patients and Methods:** This was a descriptive cross-sectional study, from 1st June to 30th September 2018. It consisted of the exhaustive prospective collection of data on the usual physical activity and physical fitness of type 2 diabetic patients hospitalized in the Endocrinology department of the UHCM for a short stay. The physical fitness tests of the French National Olympic and Sports Committee, validated on 13 April 2013, were used. **Results:** Thirty patients were included in the study. The mean age was 51.9 ± 11 years. The sex ratio was 1.5, and hypertension in 53% (n = 16) of patients was the most associated risk factor. The median duration of diabetes progression was 4 years with Q1 and Q2 quantiles of 2 and 10 years, respectively. The physical fitness evaluation noted a balance disorder with a risk of falling in 56.7% (n = 17) of patients, muscle stiffness in 20% (n = 6) of them, while 56.7% (n = 17) and 80% (n = 24) had a decrease in the muscular strength of the upper and lower limbs, respectively. The distance covered during the standard 6 min walking test was normal for 70% (n = 21) of the patients. **Conclusion:** The evaluation of the patient's physical fitness allows us to assess their deconditioning to physical activity and other obstacles to physical activity to plan appropriate

interventions.

## Keywords

Physical Fitness, Diabetic Patient, Physical Activity

## 1. Background

Diabetes mellitus are modifiable risk factor for stroke including hypertension, dyslipidemia, cigarette smoking, atrial fibrillation, heart disease, obesity, and physical inactivity [1]. Physical activity is any bodily movement produced by skeletal muscles that require the expense of energy [2]. Physical activity is one of the pillars of type 2 diabetes management. It has several interests in diabetics. It improves cardio-respiratory performance and stamina, improves glycemic control, reduces insulin resistance, improves lipid profile, reduces blood pressure (BP), and maintains weight loss [2] [3] [4]. All these benefits reduce cerebrovascular risk factors and justify the implementation of regular physical activity for diabetics. For the physician, the question that generally arises is not the effectiveness of the physical activity, but rather the type and intensity of physical activity appropriate for the patient [5] [6] [7]. The practice of physical activity also comes up against implementation obstacles such as physical deconditioning to the effort linked to the absence of practice and aggravated by the obesity present in this type of patient. Many diabetics stop exercising for fear of hypoglycemia [8]. In addition, advancing age, lack of interest, lack of time, Difficulty moving around and fear of injury limit his practice of the sport [6]. Indeed, a study conducted in 2021 on the evaluation of the physical condition of elderly people living in EHPAD [9] revealed a deterioration in physical condition with, in particular, 60% of EHPAD residents failing the unipodal test of the Senior Fitness Test and 46% of EHPAD residents failing at least one of the tests of the Short Physical Performance Battery (SPPB). A 3-year longitudinal study of physical fitness in children and adolescents showed deterioration in physical fitness for muscular strength, agility/coordination, and cardiorespiratory endurance in both boys and girls with a statistically significant difference [10]. There is a lack of research on physical fitness. This study was initiated to evaluate the physical fitness of diabetic patients hospitalized during a short stay in the Diabetology-Endocrinology Department of the Pierre Zobda Quitmann Hospital with a view to introducing them to the practice of an adapted physical activity.

## 2. Methods

### 2.1. Type of Study

This was a prospectively recruited cross-sectional descriptive study of the usual physical activity and fitness of type 2 diabetic patients hospitalized in the Endocrinology Department of the UHCM over a four-month period, from June 1 to

September 30, 2018. These patients were hospitalized on a short-stay basis for therapeutic education and glycemic control.

### 2.2. Sampling Methods/Inclusion Criteria

It was an exhaustive recruitment of diabetes patients over a period of 4 months. Included were all type 2 diabetic patients hospitalized for a short stay for diabetes imbalance for therapeutic education and with none of the following contraindications to physical activity: physical disability, decompensation of diabetes mellitus, myocardial infarction, unstable angina, uncontrolled systemic hypertension, symptomatic severe aortic valve disease, progressive thrombophlebitis and/or recent pulmonary embolism, acute pericarditis, unstable asthma, decompensated chronic respiratory failure, hemodynamic instability.

### 2.3. Data Collection

The physical fitness tests of the French National Olympic and Sports Committee (FNOSC), validated on April 13, 2013, were used. Data was collected from patients' medical records and the assessment of the patient's physical condition by the practitioner using a questionnaire including the following variables:

- Socio-demographic characteristics: surname, first name, gender, age, origin.
- Personal and family history of diabetes, high blood pressure, dyslipidemia.
- Cardiovascular risk factors including age (over 50 in men and over 60 in women), heredity, smoking, high blood pressure, dyslipidemia, age of diabetes, sedentary lifestyle, obesity, metabolic syndrome.
- Characteristics of diabetes: Duration of diabetes, diabetes balance.

Microangiopathy: Diabetic retinopathy (RD), Diabetic nephropathy (NpD), Diabetic neuropathy (ND).

Macroangiopathy: Obliterating arterial diseases of the lower limbs, myocardial ischemia, Cerebral Vascular Accidents.

- Anthropometric parameters: weight, height, Body Mass Index, waist circumference.
- Hemodynamic constants: blood pressure, heart rate, respiratory rate.
- Biological parameters: Glycated hemoglobin, lipid balance (Total cholesterol, Low density lipoprotein cholesterol (LDLc), High density lipoprotein cholesterol (HDLc), Triglycerides).
- Profile: inactive, active, or very active with the Ricci and Gagnon's questionnaire, modified by Laureyns and Sene (**Appendix**).
- Variables assessing the physical condition of patients (**Appendix**):

- Static equilibrium: time of the unipodal test.
- Suppleness before standing lowest level reached by the patient's fingers.
- Gripping force: Muscular force measured by the dynamometer.
- Strength in the lower limbs, number of lifts in thirty seconds.
- Distance covered in the six-minute walk test.

Throughout the fitness test, patients were monitored in real time with a heart

rate monitor. Six items were evaluated. These were static balance, forward standing flexibility, grip strength, lower limb test, 6-minute walk test and mass index.

The six-meter (6 MWT) walk test was conducted over a 30-meter indoor, flat, rectangular, straight corridor. The half turn was visualized by a distinct mark on the ground. The starting line was marked with a colored band. During the test, a stopwatch with a timer was used. Patients were monitored with a heart rate monitor that measured the heart rate of the patients [11].

Obesity was investigated using the Quetelet body mass index (BMI), which relates weight to the square of the height. A person was declared overweight when the BMI was greater than or equal to 25 kg/m$^2$ and less than 30 kg/m$^2$, and obese when the BMI was greater than or equal to 30 kg/m$^2$.

Abdominal obesity was defined as a waist circumference greater than or equal to 94 cm in men and 80 cm in women.

The 2009 IDF criteria were used for the definition of metabolic syndrome. This included the presence of at least 3 of the following 5 criteria:

- Abdominal obesity.
- Triglyceridemia greater than or equal to 1.50 g/l (or 1.7 mmol/l) and/or taking a specific lipid-lowering treatment.
- HDL-cholesterol levels less than or equal to 0.40 g/l (1.03 mmol/l) in men and 0.50 g/l (1.29 mmol/l) in women and/or taking a specific lipid-lowering treatment.
- Hypertension, defined as blood pressure greater than or equal to 130/85 mm Hg and/or taking antihypertensive treatment.
- High fasting blood glucose levels greater than or equal to 1 g/l (5.6 mmol/l) or antidiabetic treatment.

In our study, since all of our patients were diabetic, the presence of two additional criteria out of the four remaining criteria was retained for the definition of metabolic syndrome.

## 2.4. Statistical Analysis

The data collected was recorded and analyzed on a microcomputer equipped with Epi Info software in Version 7.1.1.14 and SPSS Version 20. A descriptive analysis of the data was performed. The data were expressed in mean ± standard deviation to the mean (esm) and in frequency

## 2.5. Ethical Issues

To protect the confidentiality of the patients, the questionnaire was anonymous. The objectives and implications of the work were well explained to them. The questionnaire was completed after verbal consent was obtained from the patient.

***Scientific value of the study***: The study adds value to the research on the evaluation of the physical condition of patients in Martinique.

***Social value of the study***: This study contributes to the improvement of the management and well-being of diabetic patients. The data collection was indi-

vidual, the privacy of the patients was preserved and the results were confidential. The study had no impact on the social or moral values of the patients.

***Risks and benefits***: The patients included in the study were not at particular risk. The findings of the study could lead to the initiation of preventive measures to enable the initiation of appropriate physical activity.

## 3. Results

### 3.1. Socio-Demographic Characteristics

A total of thirty patients were included in the study. All patients were type 2 diabetic. The mean age of our patients was 51.9 ± 11 years. The extreme ages were 28 and 74 years. There were 18 males; the sex ratio (Male to Female) was 1.5. The most represented age group was 40 to 60 years, which was 60% (n = 18) of the patients. All patients in the study resided in Martinique.

### 3.2. Clinical and Paraclinical Characteristics

The clinical and paraclinical features are summarized in Table 1. The median

**Table 1.** Socio-demographic and clinical characteristics of the diabetic patients in the study.

| Variables | | Men | | Women | | Total n (%) |
|---|---|---|---|---|---|---|
| | | Number | % | Number | % | |
| Average Age (years) | | 51.3 = /−11.8 | | 52.6 = /−10.4 | | 51.9 = /−11 |
| Age groups (years) | 20 - 40 | 3 | 10.0 | 1 | 3.3 | 4 (13.3) |
| | 40 - 60 | 10 | 33.3 | 8 | 26.7 | 18 (60.0) |
| | 60 - 80 | 5 | 16.7 | 3 | 10.0 | 8 (26.7) |
| Physical activity practiced | Yes | 9 | 30.0 | 3 | 10.0 | 12 (40.0) |
| | No | 9 | 30.0 | 9 | 30.0 | 18 (60.0) |
| Cardiovascular Risk Factors | Cardiovascular heredity | 5 | 16.7 | 3 | 10.0 | 8 (26.7) |
| | Age | 8 | 26.7 | 5 | 16.7 | 13 (43.3) |
| | Sedentary lifestyle | 6 | 20.0 | 6 | 20.0 | 12 (40.0) |
| | Tabagism | 7 | 23.3 | 2 | 6.7 | 9 (30.0) |
| | Dyslipidemia | 3 | 10.0 | 4 | 13.3 | 7 (23.3) |
| | High blood pressure | 10 | 33.3 | 6 | 20.0 | 16 (53.3) |
| | Obesity Grade I | 7 | 23.3 | 3 | 10.0 | 10 (33.3) |
| | Obesity Grade II | 0 | 0.0 | 3 | 10.0 | 3 (10.0) |
| | Obesity Grade III | 0 | 0.0 | 2 | 6.7 | 2 (6.7) |
| | Metabolic Syndrome | 6 | 200 | 9 | 30.0 | 15 (50.0) |
| Diabetes Balance | ]7 - 9] | 2 | 6.7 | 3 | 10.0 | 5 (16.7) |
| | ]9 - 10] | 1 | 3.3 | 2 | 6.7 | 3 (10.0) |
| | >10 | 14 | 46.7 | 7 | 23.3 | 22 (73.3) |
| Impacts of Diabetes (Microangiopathy) | Retinopathy | 5 | 16.7 | 2 | 6.7 | 7 (23.3) |
| | Nephropathy | 4 | 13.3 | 3 | 10.0 | 7 (23.3) |
| | Neuropathy | 6 | 20.0 | 0 | 0.0 | 6 (20.0) |

duration of diabetes progression was 8 years. Physical activity was practiced in 40% (n = 12) of patients.

The modifiable cardiovascular risk factors were, in decreasing order, high blood pressure, sedentary lifestyle and smoking, with a frequency of 53.3% (n = 16), 40% (n = 12) and 30.0% (n = 9) respectively. Obesity was present in 15 patients, *i.e.* half of the cases. It was morbid in 6.7% of cases (n = 2). The metabolic syndrome was reported in 50% (n = 15) of the cases with a clear female predominance, *i.e.* 30% (n = 9).

Patients with glycated hemoglobin greater than 10% were predominant with a frequency of 73.3% (n = 22).

The distribution of microangiopathy in our patients was as follows: diabetic retinopathy and diabetic neuropathy 30.0% (n = 9) each and diabetic nephropathy 26.7% (n = 8).

### 3.3. Score by Rici and Gagnon (Appendix)

The mean score for Rici and Gagnon was 19.4 ± 8.7 with extremes of 8 and 32. Patients were active in 53.3% of cases.

### 3.4. Evaluation of the Physical Fitness of Diabetic Patients

Table 2 summarizes the fitness assessment of patients with type 2 diabetes.

Table 2. Results of CNOSF fitness tests in diabetics monitored in the Endocrinology Department, University Hospital Center of Martinique.

| Items | Score | Number | Percentage (%) |
|---|---|---|---|
| **Equilibre (Static equilibrium test)** | 1 Very Bad | 15 | 50 |
| | 2 Bad | 2 | 3.7 |
| | 3 Normal | 1 | 3.3 |
| | 4 Good | 12 | 40.0 |
| **Flexibility (Flexible front standing)** | 1 Very bad | 9 | 30.0 |
| | 2 Bad | 6 | 20.0 |
| | 3 Normal | 5 | 16.7 |
| | 4 Good | 8 | 26.7 |
| | 5 Very good | 2 | 6.7 |
| **Muscular strength** | | | |
| **(Gripping force test)** | 1 Very bad | 11 | 36.7 |
| | 2 Bad | 6 | 20.0 |
| | 3 Normal | 2 | 6.7 |
| | 4 Good | 3 | 10.0 |
| | 5 Very Good | 8 | 26.7 |
| **(Test standing seated)** | 1 Very Bad | 19 | 63.3 |
| | 2 Bad | 5 | 16.7 |

**Continued**

| | | | |
|---|---|---|---|
| | 3 Normal | 2 | 6.7 |
| | 4 Good | 3 | 10.0 |
| | 5 Very Good | 1 | 3.3 |
| **Endurance (TDM6)** | 1 Very Bad | 4 | 16.7 |
| | 2 Bad | 2 | 6.7 |
| | 3 Normal | 6 | 20.0 |
| | 4 Good | 4 | 13.3 |
| | 5 Very good | 13 | 43.3 |
| **BMI** | Underweight | 0 | 0.0 |
| | Normal | 7 | 23.3 |
| | Good shape | 2 | 6.7 |
| | Overweight | 8 | 26.7 |
| | Obese | 15 | 50.0 |

Abbreviations: TDM6: 6-minute walk test; BMI: Body Mass Index.

### 3.5. Static Balance

The mean value of the duration of single-modal support in the static equilibrium test was 40.2 seconds +/− 21.5 seconds with extremes of 4 seconds and 60 seconds. Patients with balance disorder with risk of falling accounted for 56.7% of patients (n = 17), with 6.7% (n = 2) at moderate risk and 50% (n = 15) at high risk. A good state of equilibrium was reported in the remaining of 43.3% (n = 13) of patients.

### 3.6. Flexibility before Standing

A flexibility disorder was present in 15 patients (50.0%). Of these, very poor flexibility was noted in 30% (n = 9) of patients, while flexibility was rated poor in the remaining of 20% (n = 6) of patients.

### 3.7. Grip Strength

The average value of the gripping force was 37.3 Kg +/− 13.7 Kg with extremes of 18.3 kg and 63.9 kg. A decrease in grip strength was noted in 56.7% of patients (n = 17). It was bad in 20% (n = 6) of patients and very bad in 36.7% (n = 11) of patients.

### 3.8. Lower Extremity Muscle Strength

The mean value of the sit-up test was 12.5 +/− 6.0 sit-ups; the extremes were 0 and 24 sit-ups. Lower limb muscle strength was decreased in 80.0% of patients (n = 24). It was bad in 16.7% of patients (n = 5) and very bad in 63.3% (n = 19) of patients. Lower limb muscle strength was normal in 20.0% (n = 6) of patients.

### 3.9. Six Min Walking Test (Endurance Test)

The mean value of the distance travelled in the standard 6-minute walk test was 664.3 ± 104.1 m with extremes of 375 m and 855 m. The ]600 - 800 m range] was the most represented with 22 patients or 73.3%; 70.0% of the patients (n = 21) had a walking distance greater than the theoretical distance in the gait test.

### 3.10. Body Mass Index

Overweight was noted in 76.7% of patients (n = 23). Overweight was noted in 30% of patients (n = 9) and obesity in 50.0% of patients (n = 15). Weight was normal in 23.3% (n = 7) of patients.

## 4. Discussion

Our study is unique in that it provides practitioners with an objective idea of the physical fitness of diabetic patients prior to prescribing physical activity. The limitations of our study are the small size of our study population and the non-random sampling, which means that the results cannot be extrapolated to the general population. Our work shows that our type 2 diabetic patients had a mean age of 52 years, a more represented [40 - 60] age range, and a clear male predominance. The physical condition of the patients was marked by a disturbance of balance and flexibility present in more than half of the cases with 56.7% and 66.7% respectively. There was also a decrease in limb muscular strength more marked in the lower limbs (80%) than in the upper limbs (56.7%). Seventy percent of the patients had a walking distance greater than the theoretical distance during the gait test.

According to the National Institute of Statistics and Economic Studies [12], the population of Martinique is predominantly female with an age range [45 - 59] predominating in 2017. This difference in the sex ratio would be due to a selection bias. The age group is in line with the same logic as our study. Moreover, the high average age may be due to the increase in life expectancy at age 60, but above all to the decrease in the fertility rate. This leads to an aging population which explains the high number of elderly patients in our series. Type 2 diabetes is mainly a chronic disease in subjects over 40 years of age. The following risk factors including high blood pressure, physical inactivity, smoking, dyslipidemia, and obesity deserve special attention. Their association with diabetes increases the cardiovascular risk to a high level, a risk correlated with the occurrence of a cardiovascular event [13] [14]. In addition, obesity plays a major role in reducing the physical condition of patients by reducing physical activity both in terms of the number of steps per day and the duration of physical activity [15].

The imbalance of diabetes in all our patients was related to the chronic hyperglycemic imbalance that motivated hospitalization. Microangiopathy was present in 46.7% of patients. The UKPDS study [16] of 3867 patients, with an average follow-up of 10 years in type 2 diabetes showed that, regardless of the therapeutic means used, improving average glycemic control can reduce the frequency or

slow the progression of microangiopathic complications.

A disturbance of balance was objectified in 56.7% of cases. It is commonly accepted that advanced age is associated with a risk of falling. This risk of falling is high when associated with a balance disorder or polyneuropathy. This is of paramount importance because falls are responsible for consequences such as fractures, subdural hematomas, and tissue contusions leading to dependency in these subjects [17] [18] [19] [20]. This evaluation has a capital interest because it allows for preventing them [21].

Flexibility disorders and decreased muscle strength in the limbs cause compensatory muscle recruitment, resulting in unusual stress on the musculature that causes muscle tears [22].

The six-minute walk test is a practical, simple and inexpensive test that is considered the first choice among several modalities for the objective assessment of exercise tolerance. In our study, this tolerance was noted in 30% of cases. This test is of paramount importance as it not only allows the detection of a possible tolerance disorder, but more importantly, it allows the planning and monitoring of the effectiveness of physical rehabilitation programs [23] [24] [25] [26].

The physician's assessment of physical fitness allows the prescription of physical activity for the efficient achievement of goals for each patient. Thus, it allows for a choice to be made [5] [6] [27]:

- The type of physical activity: an endurance physical activity alone for patients with no decrease in muscle strength +/− a resistance physical activity; an endurance physical activity associated with a counter-resistance physical activity (muscle strengthening).
- Physical activity intensity: a moderate intensity of physical activity for active patients so well tolerated with a progressive increase, that of low intensity for inactive patients with a progressive increase towards a moderate intensity.

Physical activity allows not only to highlight the difficulties of practicing sports but also to monitor the evolution and benefits of physical activity on the patient. Patients practice physical activity better if it is prescribed to each medical practitioner [27]. These are all pitfalls that justify supervised management of the practice of physical activity by healthcare personnel.

## 5. Conclusion

The beneficial effects of physical activity are known. Assessing patients' physical fitness allows the evaluation of patient deconditioning and other barriers to physical activity in order to plan future interventions. It also allows for monitoring improvement and improving adherence to sport participation.

## What Is Already Known on This Topic

- Physical activity is an integral part of the management of diabetes mellitus.
- The benefits of physical activity on health status range from improved cardiorespiratory performance and endurance, to improved glycemic control and

lipid profile, to blood pressure (BP) regulation and weight loss maintenance.
- The physical activity prescription must be adapted to the patient's health condition.

## What This Study Adds

- This study offers a reproducible evaluation of the physical condition of diabetic patients.
- It highlights the difficulties encountered in the implementation of regular physical activity.
- It proposes solutions to the prescription of physical activity of the patient in the function of the evaluation of the physical condition.

## Authors' Contributions

BWPAH and FC conceptualized, collected, analyzed, and interpreted the data and wrote the manuscript; EL collected and analyzed the data, and revised and approved the manuscript. VPO, YS, CGK, YTM, OSM, and DYJ interpreted the data, revised, and approved the manuscript. All authors read and approved the final version of the manuscript.

## Conflicts of Interest

The authors have no conflicts of interest to declare. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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## Appendix

Fitness Assessment Test for the "Feel Sport Days" and Ricci and Gagnon's questionnaire, modified by Laureyns and Séné

**Fitness Assessment Test for the "Feel Sport Days".**

**First test:** Balance on one leg (static balance)

| | |
|---|---|
| **Purpose** | To measure the effectiveness of posture control on a reduced surface area. |
| **Material** | A stopwatch. |
| **Instructions** | The subject stands on one leg, eyes open, the heel of the opposite foot placed on the inside of the knee of the supporting leg, arms relaxed on each side of the body. The subject chooses the side that suits him/her best. 2 trials can be performed. |
| **Measurements** | The evaluator starts timing as soon as the subject has a correct position. He stops the stopwatch as soon as the subject loses balance (if he starts to move) or as soon as the foot is no longer in contact with the knee. The result is noted in seconds, the maximum duration of the test is 60 seconds. |

Where do you stand?

| | 21 - 30 years | 31 - 40 years | 41 - 50 years | 51 - 60 years | 61 years and + | Indice |
|---|---|---|---|---|---|---|
| **Men** | - | - | - | - | - | 4 |
| **Women** | - | - | - | - | 60 sec | |
| **Men** | - | - | - | - | - | 3 |
| **Women** | - | - | - | - | 35 - 59 sec | |
| **Men** | 60 sec | 60 sec | 60 sec | 60 sec | 60 sec | 2 |
| **Women** | 60 sec | 60 sec | 60 sec | 60 sec | 18 - 35 sec | |
| **Men** | <60 sec | <60 sec | <60 sec | <35 sec | <35 sec | 1 |
| **Women** | <60 sec | <60 sec | <60 sec | <35 sec | <18 sec | |

Source: HEPA (translate in English). Practical summary in the current state of knowledge.

**Second test:** Forward bending of the trunk (standing forward flexibility)

| | |
|---|---|
| **Purpose** | To measure the flexibility of the trunk and the posterior chain of the lower limbs. |
| **Material** | None. |
| **Instructions** | Standing, legs straight, bend the trunk by bringing your hands as low as possible (without bending the legs) with a progressive and jerk-free forward rocking movement of the bust. |
| **Measurements** | See table below. |

Where do you stand?

| | | |
|---|---|---|
| **Men** | **You touch the floor with closed fingers** | **5** |
| | Fingertips touch the ground | 4 |
| | Fingertips reach the neck of the foot | 3 |
| | Fingertips reach down to the lower shins | 2 |
| | Fingertips reach the middle of the shins | 1 |

| | | |
|---|---|---|
| **Women** | **The palms of the hands touch the ground** | **5** |
| | You touch the floor with closed fingers | 4 |
| | Fingertips touch ground | 3 |
| | Fingertips reach down to the lower shins | 2 |
| | Fingertips reach the neck of the foot | 1 |

Source: HEPA (translate in English).

**Third test:** Measurement of the isometric strength of the hand and forearm muscles (grip strength)

| | |
|---|---|
| **Purpose** | To measure the maximum grip force. |
| **Material** | A dynamometer, a chair. |
| **Instructions** | The subject is seated on a chair, with the forearm on the side being tested resting on the thigh, palm of the hand facing up, arm and elbow in contact with the body. At the evaluator's signal, the subject should squeeze the dynamometer as hard as possible. |
| **Measurements** | The subject should alternately perform two trials on each hand; record the better of the two trials on each hand and then add them together and average them. (Results to the nearest 0.5 kilos). |
| **Namely** | This test is not necessarily necessary if you only want to measure the shape. |

Where do you stand?

Calculate your shape index (average of the right and left sides in kg)

| | 21 - 30 years | 31 - 40 years | 41 - 50 years | 51 - 60 years | 61 years and + | Indice |
|---|---|---|---|---|---|---|
| **Men** | ≥57 | ≥57 | ≥53 | ≥50 | ≥46 | 5 |
| **Women** | ≥34 | ≥34 | ≥33 | ≥30 | ≥27 | |
| **Men** | 52 - 56 kg | 51 - 56 | 50 - 52 | 47 - 49 | 41 - 45 | 4 |
| **Women** | 31 - 33 | 31 - 33 | 30 - 32 | 27 - 29 | 25 - 26 | |
| **Men** | 48 - 51 | 46 - 50 | 47 - 59 | 44 - 46 | 38 - 41 | 3 |
| **Women** | 29 - 30 | 28 - 30 | 27 - 29 | 24 - 26 | 22 - 24 | |
| **Men** | 45 - 47 kg | 44 - 46 | 41 - 46 | 40 - 43 | 34 - 37 | 2 |
| **Women** | 25 - 28 | 25 - 27 | 24 - 26 | 21 - 23 | 20 - 21 | |
| **Men** | ≤44 | ≤43 | ≤40 | ≤38 | ≤33 | 1 |
| **Women** | ≤29 | ≤24 | ≤23 | ≤20 | ≤19 | |

Source: HEPA.

**Fourth test:** Standing-sitting test 30 seconds (lower limb strength)

| | |
|---|---|
| **Caution** | For this test, make sure that the person does not have balance problems due to dizziness and that he or she is never the victim of a loss of consciousness. It is recommended to be very vigilant (a person must be ready to intervene) if loss of balance occurs. |
| **Purpose** | To measure the strength of the lower limbs and the ability of the muscles to contract to produce movement. |
| **Material** | A chair with a backrest without armrests placed against a wall or in such a way as to keep it immobile. |
| **Directions** | Do sit-stand squats for a period of 30 seconds, arms cross over the chest (Standing means standing upright and knees straight). |
| **Measurements** | Count the number of lifts. |

Where do you stand?

| | 20 - 29 years | 30 - 39 Years | 40 - 49 years | 50 - 59 years | 60 years and + | Indice |
|---|---|---|---|---|---|---|
| **Men** | 32.8 | 34.2 | 24.9 | 21 | 19 | 5 |
| **Women** | 33.8 | 26.4 | 27.5 | 18 | 17 | |
| **Men** | 30 | 33 | 20.25 | 18 | 17 | 4 |
| **Women** | 32 | 21.75 | 22 | 16 | 15 | |
| **Men** | 24.5 | 31 | 19 | 15 | 15 | 3 |
| **Women** | 27 | 19.5 | 18.5 | 14 | 13 | |
| **Men** | 19 | 21 | 18.75 | 13 | 13 | 2 |
| **Women** | 21 | 17.5 | 16.5 | 12 | 11 | |
| **Men** | 17.1 | 20.4 | 17.4 | 11 | 9 | 1 |
| **Women** | 19.2 | 15.9 | 14.5 | 10 | 10 | |

Source: FFEPMM Sport pour tous.

**Fifth test**: 6-minute walk test (allows an evaluation of endurance ability)

| | |
|---|---|
| **Goal** | To evaluate cardiovascular endurance and mobility. |
| **Equipment:** | A flat course that was calibrated using blocks, a stopwatch, a heart rate monitor. |
| **Equipment** | After a warm-up, the subject must walk as many meters as possible in 6 minutes. |
| **Measurements** | Length covered and number of heartbeats is measured at the end of the test? |
| **Directions** | Count the number of lifts. |

**Continued**

| | |
|---|---|
| **Reference equations for healthy adults: Men:** | DM6M = (7.57 × taillecm) − (5.02 × âge) − (1.76 × poidskg) − 309 m.<br>Equation alternative utilisant l'IMC*:<br>DM6M = 1.140 m − (5.61 × BMI) − (6.94 × age).<br>Whatever the equation used, subtract 153 m to obtain the LBN |
| **Reference equations for healthy adults: Men:** | DM6M = (2.11 × heightcm) − (2.29 × weightskg) − (5.78 × age) + 667 m.<br>Alternative equation using BMI:<br>DM6M = 1.017 m − (6.24 × BMI) − (5.83 × age).<br>Whatever the equation used, subtract 139 m to obtain the LBN |

**Definition of abbreviations:** BMI = Body Mass Index; DM6M = Total Walking Distance in 6 Minutes; LBN: Low Normal Limit (of the range). *BMI in kg/m$^2$. The simplest and quickest technique is to enter the equations into an Excel table (one table for men and one for women) where you integrate height, age and weight. Once you have the result, you refer to the table.

Where do you stand? For example, you might say:

You are a man measuring 1.80 m for a weight of 65 kg (BMI = 20.06). You are a woman measuring 1.70 m for a weight of 58 kg (BMI = 20.06). Here is the table:

| | 20 - 29 years | 30 - 39 years | 40 - 49 years | 50 - 59 years | 60 years and + | Indice |
|---|---|---|---|---|---|---|
| **Men** | 839 m | 789 m | 738 m | 689 m | 638 m | 5 |
| **Women** | 777 m | 719 m | 661 m | 603 m | 546 m | |
| **Men** | 801 m | 751 m | 700 m | 651 m | 600 m | 4 |
| **Women** | 742 m | 684 m | 626 m | 568 m | 511 m | |
| **Men** | 763 m | 713 m | 662 m | 613 m | 562 m | 3 |
| **Women** | 707 m | 649 m | 591 m | 533 m | 476 m | |
| **Men** | 725 m | 675 m | 624 m | 575 m | 524 m | 2 |
| **Women** | 672 m | 614 m | 556 m | 498 m | 441 m | |
| **Men** | 686 m | 636 m | 585 m | 535 m | 485 m | 1 |
| **Women** | 638 m | 580 m | 522 m | 464 m | 407 m | |

Source: PAUL L.ENRICHT and DUANE L.SHERILL.

**Sixth Test:** Body Mass Index

Calculate your Body Mass Index (BMI) BMI = Weight/Height in metres squared

| **BMI** | |
|---|---|
| **<18.5** | **Underweight** |
| **Between 18.5 and 25** | **Normal** |
| **Between 19 - 22** | **Good shape** |
| **Between 25 and 30** | **Overweight** |
| **>30** | **Obese** |

**Ricci and Gagnon's questionnaire, modified by Laureyns and Séné**

This self-assessment questionnaire allows you to determine your profile: inactive, active or very active.

Calculate it by adding the number of points (1 to 5) corresponding to the checkbox of each item.

| | Points | | | | | Scores |
|---|---|---|---|---|---|---|
| **A)Sedentary behaviors** | 1 | 2 | 3 | 4 | 5 | |
| Combien de temps passez vous en position assise par jour? (loisirs, télé, Ordinateur, Travail) | more than 5 hours ☐ | 4 to 5 hours ☐ | 3 to 4 hours ☐ | 2 to 3 hours ☐ | less than 2 hours ☐ | 1 |
| | | | | | Total (A) | |
| **B) Leisure physical activities (including sport)** | 1 | 2 | 3 | 4 | 5 | Scores |
| How often do you do all of these physical activities? | No ☐ | | | | Yes ☐ | |
| On average, how many minutes do you spend per physical activity session? | 1 to 2 times a month ☐ | 1 time per week ☐ | 2 time per week ☐ | 3 time per week ☐ | 4 time per week ☐ | |
| On average, how many minutes do you spend on each physical activity session? | Less than 16 min ☐ | 16 to 30 min ☐ | 31 to 45 min ☐ | 46 to 60 min ☐ | More than 60 min ☐ | |
| How do you usually perceive your effort? The number 1 represents a very easy effort and the number 5 represents a difficult effort. | 1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | 5 ☐ | |
| | | | | | Total (B) | |
| **C)Daily physical activities** | 1 | 2 | 3 | 4 | 5 | Scores |
| How much physical activity does your job require? | Light ☐ | Average ☐ | Moderates ☐ | Intense ☐ | Very intense ☐ | |
| Apart from your regular job, how many hours per week do you spend on light work: DIY, gardening, cleaning, etc...? | Less than 2 h ☐ | 3 to 4 h ☐ | 5 to 6 h ☐ | 7 to 9 h ☐ | More than 10 h ☐ | |
| How many minutes a day do you spend walking? | Less than 16 min ☐ | 16 to 30 min ☐ | 31 to 45 min ☐ | 46 to 60 min ☐ | More than 60 min ☐ | |
| How many floors on average do you walk up each day? | Less than 2 ☐ | 3 to 5 ☐ | 6 to 10 ☐ | 11 to 15 ☐ | More than 16 ☐ | |
| | | | | | Total (C) | |
| | Total (A + B + C) | | | | | |

**Results:** Less than 18: Inactive; Between 18 and 35: Active; More than 35: Very active; Based on the questionnaire of Ricci and Gagnon, University of Montreal, modified by Laureyns and Séné.