THE EFFECT OF INTENSE EXERCISE ON MUSCLE POWER AND FUNCTIONAL ABILITIES OF OBESE PEOPLE

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BACKGROUND: Obesity, expressed as a high body mass index (BMI), is associated with a risk of decrease in functional capacity and muscle strength, in particular in weight-bearing joints, but so far, no study has been able to show a sufficiently strong relationship between these factors. two options in conclusion.
AIM: This study was conducted to quantify the effect of intense exercise on the functional capacity and muscle power of obese individuals and the risk of knee osteoarthritis.
MATERIALS AND METHODS: The present research project is characterized as a clinical trial, cross-sectional, and uncontrolled research. All participants had a body mass index from 30.6 kg/m² to 34.9 kg/m² and reported not working out in the last 3 months prior to this experiment. Before their involvement, all participants were informed during an initial interview about the experimental procedure, the nature of the research, and the test protocols. They gave their written and signed informed consent to voluntarily participate in this research and completed two questionnaires. Participants in our study were recruited from sports centers, social clubs, and word of mouth. A total of 78 participants responded to the call articipated in our training protocol which was composed of two main parts. The first one is the «Anthropometric measurements tests» and the second one is the «Functional capacity tests» that were done in a gym. The participants were divided randomly into two experimental. After the end of every phase of the experiment, some members of each group were moved randomly to the other group.
RESULTS: The final results of the intra-class correlation coefficient measurements for a set of tests showed strong reliability among members of each examined group. For the handgrip strength tests of the right and left hands, the results were 0.850 and 0.892, respectively. For the squat jump and countermovement jump tests, the results were 0.966 and 0.932, respectively. The results were 0.896 and 0.945 for walking 6 meters with or without double tasks. Finally, for the TUG and TUP-DT tests, the results were 0.520 and 0.663, respectively. After analyzing and interpreting the data for the functional capacity tests, the following results were obtained: For the 5 sit-stand test, the result was (F (3.87)=4.22; p=0.008, ηp2=0.127). For the Time up and go test, the result was (F (3.87)=4.56; p=0.019, ηp2=0.136), and for the 6 m walk, the result was (F (3.87)=3.81; p=0.013, ηp2=0.116). Finally, the 5X sit-to-stand test at 48 hours was lower than the base value (p=0.024), while the TUG immediately after the post was lower than the base value.
CONCLUSION: In conclusion, the results of this study demonstrate the positive impact of intense exercise on muscle power and functional capacity in obese individuals. These findings suggest that high-intensity physical activity may be an effective means of improving the health and quality of life of obese individuals. Therefore, it is recommended that obese individuals include high-intensity exercise in their regular exercise program to reap these health benefits. However, it is important to emphasize the importance of consulting a healthcare professional before starting a high-intensity exercise program to avoid the risk of injury or health complications.

KEYWORDS: Obesity; exercise; functional abilities; muscle.

ABSTRACT

Obesity has become the first non-infectious “inflammatory” disease in human history. It is a real epidemic, affecting both industrialized and low-resource countries [1]. The Ob-Epi epidemiological survey found that there is a difference in the prevalence of obesity by place of living. For example, from 1997 to 2009, the prevalence of obesity increased by 82% in urban areas compared to 37.9% in rural areas [1]. The last 20 years have been marked by the appearance of a new concept called metabolic syndrome. This condition is characterized by a set of risk factors that may develop cardiovascular disease and/or type 2 diabetes and may include abdominal obesity, atherogenic dyslipidemia, high blood pressure and insulin resistance [2]. Associated with an increased risk of diabetes and cardiovascular disease, metabolic syndrome is now considered one of the most important public health problems of our time. Although multifactorial, the causes most often cited to explain the emergence of obesity/metabolic syndrome are a genetic predisposition associated with an “unsuitable” lifestyle where dietary errors occupy a major place [3].On the one hand, regular exercise has been shown to be an effective strategy in the prevention of cardiovascular risk factors related to obesity and metabolic syndrome [4].On the other hand, in the majority of clinical studies, re-entry programs in obese patients with cardiovascular risks are often associated with hygieno-dietary measures (calorie restriction, diet modification, smoking cessation) [5]. Thus, lifestyle change through the promotion of physical activity and healthy eating is an effective strategy to combat the emergence of obesity and its cardiovascular complications [6].

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Sedentary living is characterized by activities whose energy expenditure is close to that of rest or basic metabolism [7]. These activities include, for example, sitting, reading, lying on a couch, driving a car or working on a computer [8]. Physical inactivity leads to the accumulation of visceral fat and therefore the activation of a network of pathways of inflammation. This promotes the development of atherosclerosis, neurodegeneration and tumor growth. Moderate physical activity helps maintain body weight. Thus, walking or cycling, to go to work, is inversely associated with weight gain after several years, because its effect on weight loss in this case, is modest. To be effective, it must be combined with dietary measures [9].

On a diet alone, the loss of lean mass is in the order of 25% compared to only 12% if physical activity is associated. Since energy expenditure depends mainly on lean mass, it can promote a subsequent recovery of weight. To maintain weight after initial weight loss, the Dietary guidelines suggest that physical activity should be carried out between 60 and 90 minutes a day. This can lead to better adherence to dietary recommendations as it improves self-esteem and well-being [10].

As part of the overall management of obese patients, physical activity participates through both physiological and psychological mechanisms in the initial weight loss. It reduces cardiovascular risk, partly independent of weight variations, and is associated with an increase in quality of life [11].

In Morocco, several clinical observations have shown that lifestyle changes including regular physical activity and the adoption of a healthy diet are effective strategy to combat obesity and its cardiovascular complications.

AIM OF THE STUDY

This study was conducted to quantify the effect of intense exercise on the functional capacity and muscle power of obese individuals and the risk of knee osteoarthritis.

MATERIALS AND METHODS

Site and time of the study

Study site.

This is a cross-sectional descriptive research study that was conducted on a representative sample of obese individuals in the Fes-Meknes region. This means that the study aimed to describe the characteristics of the sample of obese individuals in the region at a specific point in time.

Time of the study.

The study took place from September 06 to November 11, 2021.

Study populations:

Inclusion criteria: Our study focused on obese individuals aged 18 to 40 years.

Exclusion criteria: In our study, participants with uncontrolled cardiovascular diseases, endocrine dysfunction, musculoskeletal impairment preventing them from continuing their training, as well as those with diabetes and/or osteoarticular disorders were excluded. This allowed us to focus on the effect of intense exercise on functional capacity and muscle power among obese individuals without these conditions

Sampling method from the study population

All participants were randomly selected from different sports clubs and sportive institutions.

Study design

Prospective one-sample comparative.

Description of medical intervention

Our group was subjected to randomization in order to divide it into two distinct groups in a random manner. The first group was designated as Group 1 and the second group was named Group 2. This random allocation method ensures that participants were assigned to each group impartially, without external influence or bias. This helps to minimize potential biases that could affect the study's results.

Our study is structured as follows: the first day (D_0) of medical examination, to establish first contact with the participants, apply the questionnaires and carry out anthropometric measurements; a week (W_1) of familiarization with the tools and the evaluation procedure, in order to ensure good reproducibility of the measures and to free the effects of learning that can occur with the repetition of the test sessions [12]. Each participant went through three familiarization sessions (D_1, D_2, and D_3). The sessions began with a standardized dynamic warm-up (15 minutes of lower and upper limb mobility with a stick), followed by familiarization with one of the physical and functional tests, and ended with familiarization with the ground-raised exercises**,** front slot and horizontal pull with an elastic band. Following the familiarization week, the participants performed a week (W_2) of pre-tests. The objective was to assess the basic condition of the participants. The pre-tests were carried out over three days (D_4, D_5 and D_6), separated by 48 hours of recovery. The jump and load tests were performed on days D_4 and D_5, to confirm the performance of the tests, and day D6 was dedicated to performing the functional tests.

In the third week (W_3), the participants participated in the first week of training. The EG1 followed training protocol A while the EG2 followed training protocol B. Each protocol included two exercise sessions (SW_1 and SW_2), separated by 48 hours. Week 3 ended with the evaluation tests (post-test) which were carried out immediately 24 and 48 hours after the second session. After a two-week withdrawal period (S_4 and S_5), the last week of training (W_6) followed the same configuration as the first, but the order of application of training protocols was reversed. This gave us two treatment groups: T0.5 with all participants who completed Training A and T1.0 with all participants who completed Training B (Figure 1).

The training sessions were composed of a specific exercise that characterized the main program, and complementary exercises that involved the antagonistic muscles of the lower limbs and upper body muscles. The training sessions began with a standardized dynamic warm-up, then the main program was put in place, and finally the session ended with the complementary exercises (Table 1).

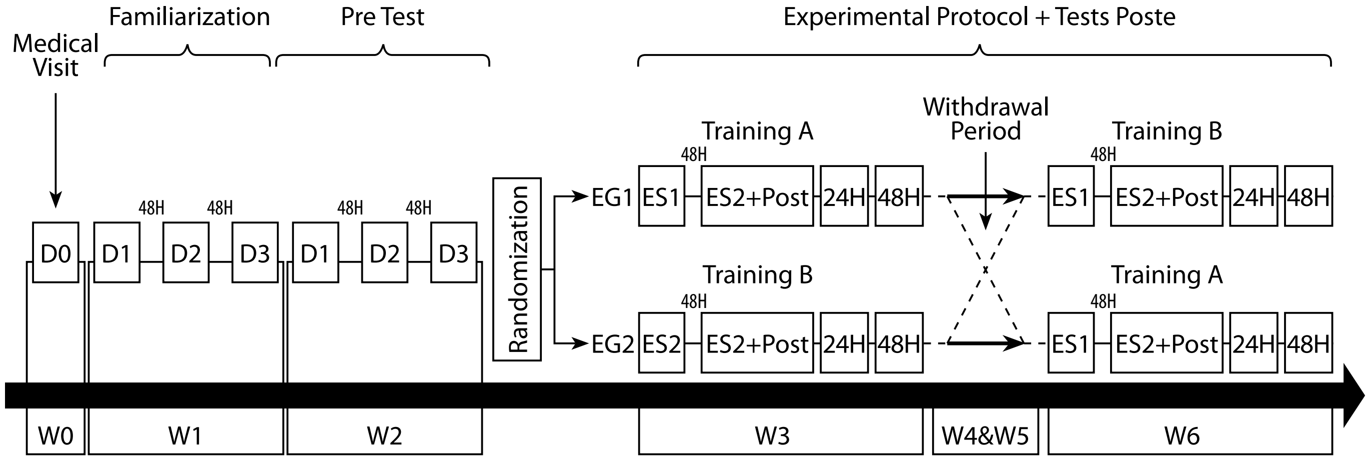

Figure 1. Experimental protocol.
ES — Exercise Session; D — Day; EG — Experimental Group; W — Week end.

Methods

Anthropometric measurements

- **Body mass (BM)**

The body mass was measured using an electronic scale (Balance NRBF701-17) (Accuracy: 0.1 kg). The participants were lightly clothed.

- **Standing waist**

The standing height was measured using a tape measure attached to the wall and a horizontal cursor which was brought into contact with the highest point of the head. The participant was in a standing position, with bare feet and arms together, with his arms facing forward.

- **Body mass index (BMI)**

The BMI was calculated by the ratio of body mass in kilograms (kg) and height per square meter (m):

$$BMI = BM (kg) / (Height (m))^2$$

- **Waist Circumference (WC)**

Waist circumference was measured using a tape measure. The participant remained standing, with the weight distributed between both feet, feet slightly apart. The measurement was taken in a horizontal plane at the narrowest level of the waist, equidistant between the bottom of the ribs and the pelvic bone (iliac crest). The evaluator adjusted the tape measure without compressing the underlying soft tissue. Waist circumference or abdominal circumference was measured to the nearest 0.1 centimeter (cm) at the end of an exhalation

- **Hip Circumference (HC)**

The hip circumference was measured using a tape measure. The participant was standing, upright, with arms on either side of the body and feet joined. The assessor was seated next to the participant to see at what level the hip circumference is maximum. He placed the tape measure around the hips in a horizontal plane. The tape measure must be adjusted without compressing the soft tissues. The measurement is recorded to the nearest 0.1 cm.

- **Hip Waist Ratio (HWR)**

The hip height ratio was calculated by the ratio of the waist circumference and the hip circumference.

$$WHR = WC (cm) / HC (cm)$$

This calculation allows a valid, rapid, and accurate estimate of the risk of developing cardiovascular disease. Indeed, the higher the abdominal fat concentration, the higher the risk of presenting problems such as high cholesterol, diabetes, high blood pressure or atherosclerosis [13].

- **Physical Abilities Tests**

Sub-maximum load test based on speed. To determine the initial load of the training session, a sub-maximum load test based on speed, adapted from the protocol proposed by [14], was applied. The purpose of this test is to have a basis of work, in order to program the workouts. The participants performed a training session using a weight bar.

The test took place over 2 days: On the first day, the participants began with the standardized warm-up followed by another specific, which consisted of a series of 10 repetitions on the ST Charge test with a load of 10% of the body mass. After the warm-up, the participants had 5 attempts (each separated by a 2-minute interval) to reach the ideal load allowing them to maintain a speed of execution of 0.75 to 1 $m.s^{-1}$ during 6 repetitions. The initial load of the test was 15% of body mass, which increased or decreased by 5% each

Table 1. Characteristics of study participants

	EG1 (n=39)	EG2 (n=39)	P
Age (years)	39,31±6,13	37,1±7,16	<0,01
Height (m)	1,57±0,9	1,57±0,11	<0,01
Weight (Kg)	86,66±12,24	85,03±12,83	<0,01
BMI (kg/m²)	30,6±3,18	34,9±4,18	<0,01
WC (m)	85,9±6,8	88±10,9	<0,01
HC (cm)	94±6,7	99±8,2	<0,01
WHR	0,9±0,1	0,9±01	<0,01

Note. Values are expressed as Mean standard deviation; BMI: Body mass index; WC: waist perimeter; HC: PH: hip perimeter; WHR waist/hip ratio time. After a 15-minute recovery, the participants performed another test in order to achieve, this time, the speed of execution of 0.50 to 0.74 m.s^{-1}, always with the same load adjustment and the same number of attempts and repetitions. The second day of the test was 48 hours later and had the same configurations on the first day, except for the initial load, it was set to the highest standard obtained on the first day, and for the order of the tests, which have been reversed to avoid possible influence of the order of application. In addition, the initial order of testing was randomized.

Bar speed control during the training session was performed by an accelerometer (push training 2.0-Toronto, Canada) that was attached to a bar using the "Push" mobile application. The average propulsion speed of each repetition was recorded, and the maximum load obtained on the two days was defined as the driving load. The participants were instructed not to do exercises between the two days of testing.

- **Vertical Jump Test**

The jump height during a Counter-Movement Jump (CMJ) or a Squat Jump (SJ) is an index of maximum lower limb power. Following the recommendations of the protocol described by [15], for the JMC, the participants started the test from the standing position, then they made a counter-motion downward (i.e., a bending of the lower limbs) immediately followed by a complete extension of the lower limbs.

For the SJ, the participants left bent knees, then they jumped without performing counter-movement before performing the jump. During the tests, it was asked about jumping as high as possible, keeping their hands on their hips to avoid swinging with their arms.

The maximum knee flexion (during the push phase of the CMJ and at the start of the SJ) was predetermined at 70º, the angular position considered the best performing in vertical jump tests [15]. This was done during the familiarization period using a goniometer (Baseline®, Aurora, IL, EUA). To maintain the same angular position, a rigid bar was placed under the participants' hips and attached to a vertical support graduated every 1 cm. As they jumped, the participants squatted until they felt the bar on their posterior thigh, before performing the concentric action as quickly as possible.

The performance of the jumps was evaluated by the mobile application «My Jump», recorded by a mobile phone at a sampling rate of 240 Hz. This system was developed to calculate jump height from flight time to an accuracy of 0.10–3 s, using the high-speed video recording function of the iPhone. This equipment has previously shown good validity and reliability, even for senior jump height measurements [16]. The order of test application was randomized, and each participant had three attempts (each separated by a 1.5 min interval), to obtain the best jump result.

Functional capacity tests

- **Test 5 assist-standing**

The sit-to-stand test is designed to assess the strength and power of the lower limb muscles. To begin the test, participants were seated on a chair without armrests and with a backrest, positioned against a wall to keep it stable. Participants' feet were flat on the floor, their backs were against the backrest, and their arms were crossed at chest height. They were asked to stand up five times until they reached a standing position (defined as standing up straight with knees extended), and then return to the seated position, leaning their backs against the backrest on each repetition. The timer was started when the participant made the movement of trunk flexion, lifting their back from the chair's backrest, and stopped when their back touched the backrest completely, returning to the initial position of the test. Only one attempt was made, and the time for that attempt was recorded.

- **Timed Up and Go**

Timed Up and Go (TUG) test is a test of coordination and agility for obese people. It aims to measure speed, agility, and dynamic balance. Participants began the test in a seated position in a standard chair against the wall, with their arms crossed at shoulder height and their feet flat on the floor and slightly forward at each other. At the signal of the evaluator, the participant stood up, keeping his arms crossed until the knees were fully extended. He walked in the direction of a beacon placed at a distance of 3 m from the chair, walked around it and then returned to the starting point. The timing started when the participant made the trunk flexion movement and stopped when the participant returned to its initial position. Three attempts were applied with a minimum interval of 30 s. The time of the best attempt has been recorded.

Statistical analysis

The analysis of the results was conducted by two statistical software, SPSS 18.0 (IBM, Inc., Chicago, IL) and Graph Pad Prism (version 6.0, Inc., CA). Before the use of all statistical tests, the normality of the distribution was verified by the Shapiro-Wilk test. Descriptive analysis was performed to present the anthropometric characteristics of the participants. The reliability of the tests was studied by calculating the intra-class correlation coefficient (ICC), using the different attempts obtained on the same day for each of the tests performed (Hopkins, 2000). The pre-training results of the variables manual grip strength, jump height (SJ and CMJ), walking speed (6 m), time to get up from a chair 5 times and time to get up, walk on a distance of 3m, return and sit again on the same chair, were set as the base values (100%). The percentage of post-training results (immediately, 24h and 48h after) was calculated compared to the baseline value.

Ethical expert review

The epidemiological study as part of the thesis work has been approved by the local Ethics Committee Faculty of Medicine, Pharmacy and Dentistry (protocol number 145/1974 from 08/11/2022).

RESULTS

Each experimental group consisted of 39 (EG1) and 39 (EG2) participants.

High intra-examiner reliability was observed from the Intra-class Correlation Coefficient (CCI) calculation for the right hand and left hand manual grip force tests (0.950 and 0.952 respectively), SJ and CMJ vertical jump (0.984 and 0.972 respectively) and walks 6 m, without and with double task (0,956 and 0,939 respectively). For timed go up and go (TUG) tests, the CCI was classified as moderate (0.520 and 0.663 respectively) The time effect was observed for the jump height in the SJ test (F (3.87) =4.31; p=0.007, p2=0.129). The jump height at 48h was greater than 24h (p=0.003) (Figure 2).

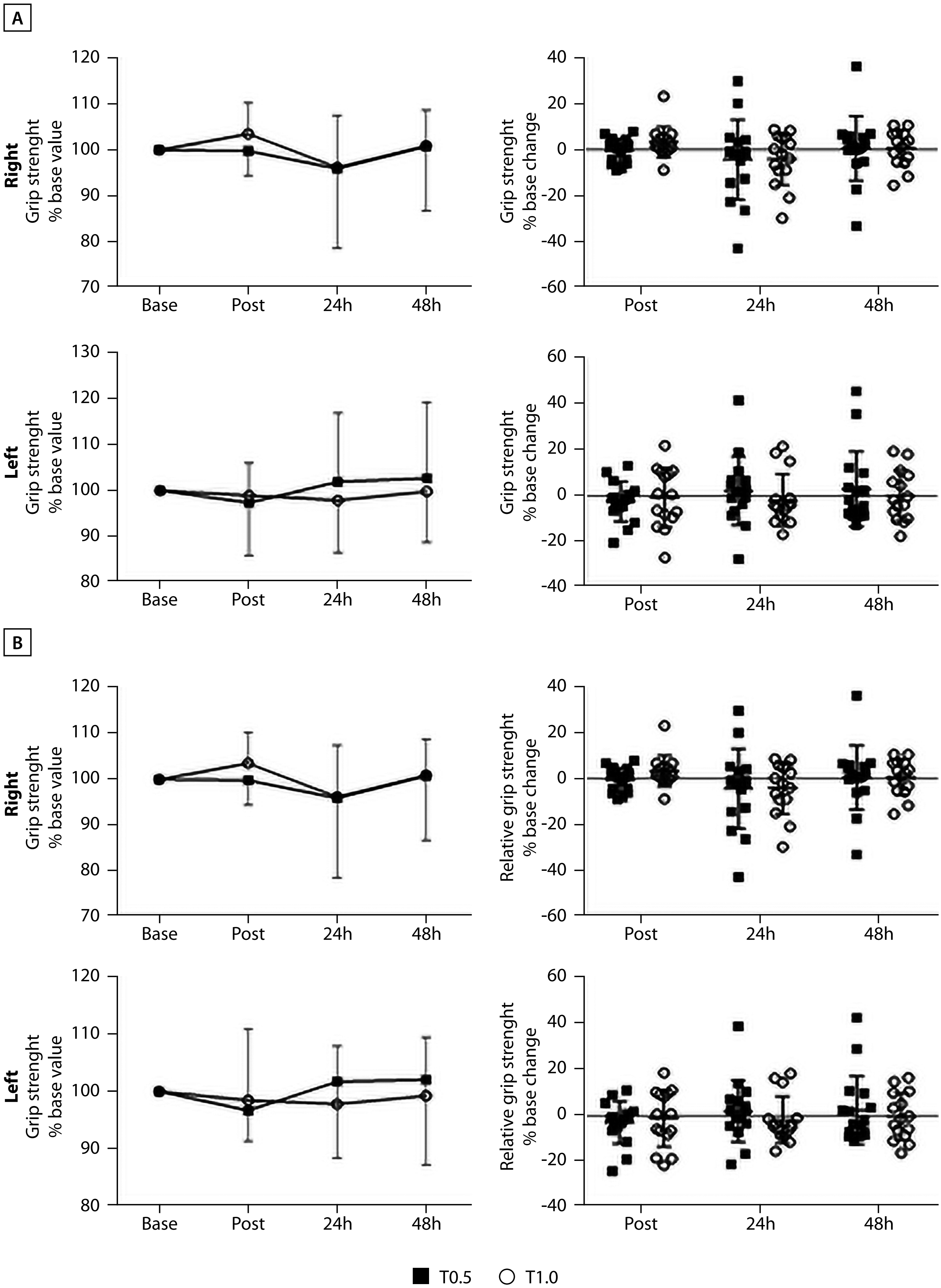

Figure 2. Graphical representation of the effect of time on manual grip force.

Average deviation for the effect of time (images on the left) before (base), immediately (post), 24h and 48h after two training sessions. And the individual reactivity as a percentage change from the base value for each participant (images on the right) of the low speed (T0.5: full square) and high speed (T1.0: empty circle) processing groups. The variables measured were: A) Right and left hand grip force and B) Right and left hand grip force.

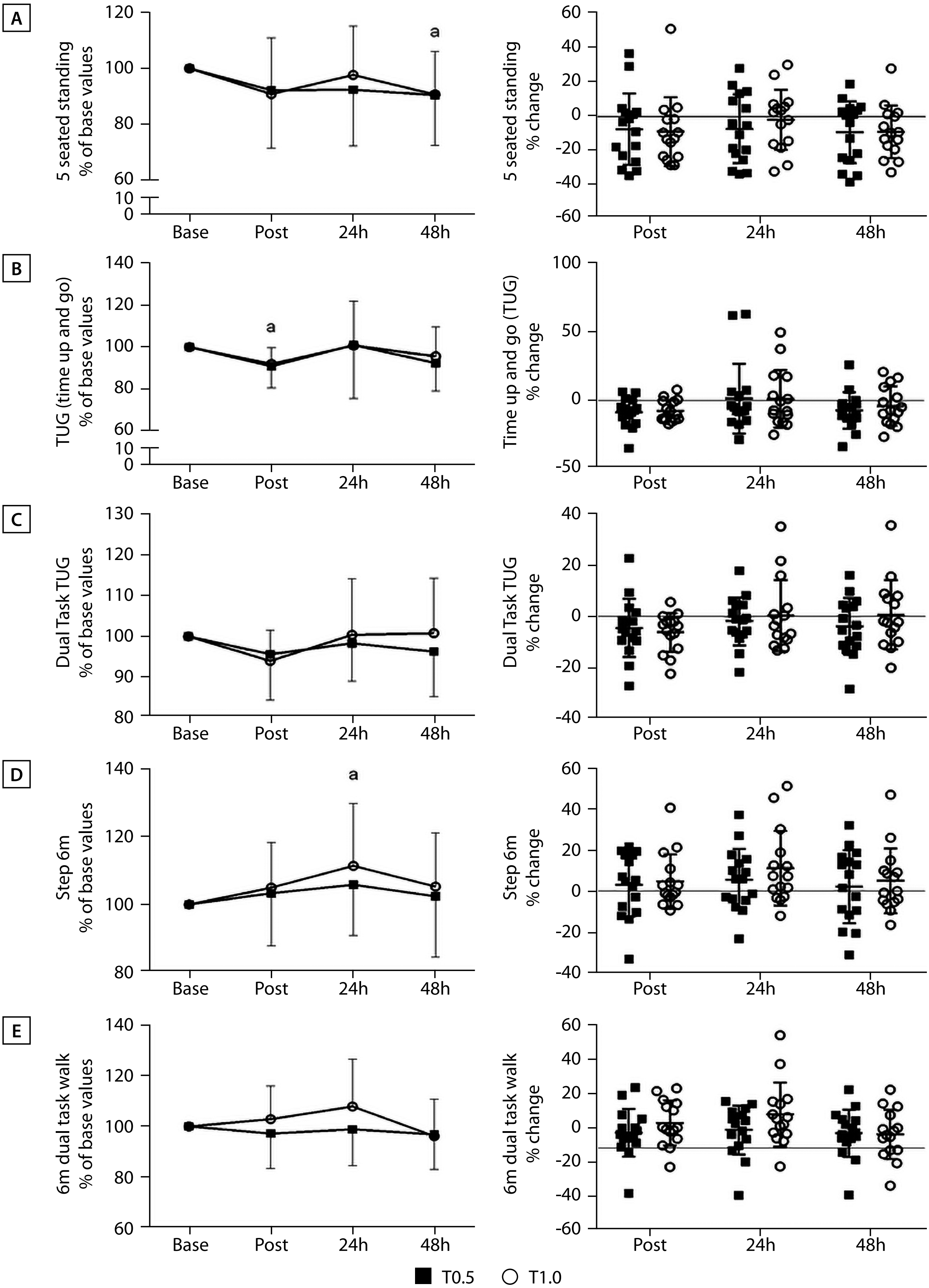

Figure 3. Graphic representation of the effect of time on functional abilities.

Mean ± standard deviation for the effect of time (images on the left) before (baseline), immediately (post), 24h and 48h after the two training sessions. And the individual responsiveness as percent change from baseline for each participant (images on the right) of the low speed (T0.5: filled square) and high speed (T1.0: open circle) treatment groups. The variables measured were: A) 5 sit-stand; B) TUG (time up and go); C) TUG with dual task; D) 6m walk, and E) 6m walk with dual task. For both treatments, difference with respect to: a. the base value, b. post, and c. 24h ($p<0.05$).

Table 2. Intergroup comparison (Wilcoxon test (*) and Student t for dependent variables (#). mean AND group $T_{0.5}$ vs $T_{1.0}$)

	$T_{0.5}$	$T_{0.1}$	p
Absolute Charge (kg)	33.28±17.01	11.03±5.66	P=0.01#
Relative charge m.s^{-1}	0.50±0.22	0.16±0.06	P<0.01*
Movement speed	0.56±0.06	0.89±0.06	P=0.001#
RPE	4.53±1.27	2.03±1.06	P<0.01*

Note. RPE — rate of perceived exertion

For functional ability tests, the time effect was observed for Test 5 Sit-Stand (F (3.87)=4.22; p=0.008, p2=0.127), TUG (F (3.87)=4.56; p=0.019, p2=0.136) and 6 m walk (F (3.87)=3.81; p=0.013, p2=0.116). Test 5 sitting and standing at 48h was lower than the base value (p=0.024), when the TUG immediately after 01). The CMJ jump did not show a time effect (p>0.05) (Figure 3). (post) was less than the base (base) value (p<0.001). However, the 6 m to 24 m walking test was higher than the base value (p=0.044). The double-tasked activities did not show time effects (p>0.005).

The absolute and body weight values of the manual grip force also showed no time effect for any of the sides. (p>0.05)

In addition, there was no significant difference (p>0.05) between treatments, as well as for group vs time interaction (p>0.05). A very significant difference was observed for the mean training load, body weight load, load velocity and stress perception *Rate of Perceived Exertion* (RPE) between the two treatment groups (T0.5 and T1.0) at p 0.001. These results are presented in Table 2.

DISCUSSION

Representativeness of Samples

After the analysis and interpretation of the results on a finding that there is an effect of intense exercise on muscle power and functional capacity in people who suffer from obesity, these results cannot be generalized on the all the regions since there are several social, cultural, public parameters which make the situations heterogeneous, taking the nutritional factor of this region Fez Meknes is characterized by an irregular nutritional mode because of the lack of physical activity and the abuse in fast food consumption. The genetic factor is also one of the important factors in the prevalence of obesity.

Comparison with other publications

The main objective of our study was to verify the effect of the acute exercise of two speeds of resistance training on several parameters of muscular power and functional capacity in the obese person. The main results showed the effects of time on the recovery of physical and functional performance of obese people after two training sessions.

An improvement in the height of the SJ jump was observed 48 hours after the training sessions. The performance of a maximum vertical jump can be considered as an indirect indicator of the explosive capabilities of the lower limbs. It is a variable that has been shown to be a good predictor of the functional capacity of the elderly [16]. In our study, positive changes were only observed for the Squat Jump. The height of the Counter Movement Jump did not undergo significant changes during the entire experimental period. [17] verified an immediate reduction in the counter movement jump performance of 22 seniors (18–40 years old), followed by a rapid recovery 24 hours after a low intensity (70% of 5-RM) and high intensity (95% of 5-RM) resistance training session. A significant reduction in the Counter Movement Jump height of 78 institutionalized obese individuals (34±5 years old), immediately after high volume resistance training, was also demonstrated by Cruvinel-Cabral, R. M. & Oliveira-Silva [18]. The different results observed during the Counter Movement Jump and Squat Jump can give us an idea of the participants' ability to use the elastic energy of the musculotendinous units when jumping [19].

Resistance training at low and high speeds, studied during this experiment, induced an acute fatigue of the ability to stand up from a chair. This functional capacity has been significantly correlated with the strength of the knee extenders [20]. However, in addition to quadriceps, the hamstring and lumbar muscles are among the most active during this test [21]. The current results suggest that the loss of muscle power and the ability to generate the strength of the primary agonist muscle groups involved in the task, may explain the still incomplete recovery of this ability, 48 hours after training in both treatment groups [22].

The fatigue of the lower limbs was also represented by an immediate decrease in the ability to perform the Timed up and go (TG) test, despite the rapid recovery observed for both groups after 24 hours. This test, which involves walking and chair lifting, was significantly correlated with power measured in the counter movement jump (CMJ) relative to body mass [23]. These results are again different from those of [24]. In their study, the performance of participants in the TUG test improved immediately after training, regardless of intensity. Walking speed, also altered by the results of this study, is strongly correlated with the ability to generate force from knee extenders, hip muscles and ankle flexors [25]. Maximum power and speed of contraction at different percentages of maximum force appear to be predominant factors in walking [26]. Positive changes in this functional capacity, 48 hours after low and high speed training, are also observed in the study of Sáez de Asteasu et al. [27]. The authors assessed 65 hospitalized persons aged 18–40. They found an improvement in functional capabilities, including the 6-metre walking speed with and without double task, after 5 consecutive days of progressive resistance training. For the authors, these changes can be explained by the improvement of the structure of movements in the different functional tasks and by the improvement of the health status of the elderly, which was precarious at the beginning of their experience.

Notwithstanding, there were no significant changes observed over time in the performance of the dual-task activities that were investigated in our study. According to Gillain et al. [28], in a dual-task test, additional cortical activity competes with the component cortical activity. This means that the execution of two actions at the same time not only disturbs postural balance, but also step parameters that are associated with the risk of falling. As such, our results suggest that the fatigue caused by the training protocols in this research did not increase the risk of falling for the participants.

Marques et al.'s study [29] found that grip strength is a reliable indicator of physical disability and mobility limitations, as it reflects overall body strength [30]. However, the study's results did not reveal any significant changes in the pressure forces of participants' right and left hands over time. This lack of alteration may suggest that the training protocols used in our study did not induce central fatigue.

To sum up, our study found that the two training protocols examined did not result in central fatigue. While most participants did not experience a decrease in jump height following the workouts, the muscle fatigue that occurred did impact their functional abilities, and it took at least 24 hours for them to fully recover to their initial values.

Study limitations

During the development of our scientific study, among the obstacles encountered are:

- We encountered difficulties in convincing individuals to participate in our study.
- the follow-up of our participants did not include monitoring their dietary habits before, during and after the training period.
- The lack of previous research studies on the participant that allowed for more in-depth analysis,

Next studies

- Our future work is to develop a well-structured physical activity program for obese patients to avoid harmful health complications.
- We are in the process of developing another study in the eastern regions of Morocco to make a comparative study between the two studies concerning the parameters studied.

CONCLUSION

Obesity-related complications are multiple and depend on several factors. The degree of obesity, its type, duration of its evolution are associated with an increased risk of developing a negative effect on functional capacity and power. In addition, obese people are under the higher risk of being suffering from diseases and disabilities in comparison to non-obese people. Therefore, weight gain prevention remains the best way to lower, or even stop this global epidemic.

The present study demonstrates that obesity represents an increased negative risk on functional capacity and muscle power what should be taken into account when developing measures for the prevention and treatment of the disease.

ADDITIONAL INFORMATION

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Conflict of interest. The authors declare no obvious and potential conflicts of interest related to the content of this article.

Contribution of authors. Lakhdar Nour El Yakine: study design, methodology, data collection, statistical analysis, data interpretation, article writing, article editing. Lamri Driss: review, supervision. Ouahidi Moulay Laarbi: review, supervision.

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