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# Effects of Biweekly Circuit Training on the Improvement of Strength, Speed and Endurance Qualities in High-Level Handball Players in Algeria

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**Abstract:**

Physical preparation today is based on several foundations which are represented by scientific discoveries and experimental work, equipment and techniques used as well as the new methodological approaches which probably symbolize the most innovative advances in the improvement of physical qualities.

To estimate the structuring of training among high-level handball players, it is essential to include physical qualities as an essential basis for preparation athletic in handball, and for their improvement, we offer a form of training, which is most important: «Work in Circuit Training».

The origin of the research:

This involves responding to a request for improvement of a well-identified physical quality among high-level handball players in Algeria, the close succession of brief efforts and intense causes the handball player to request her VO²Max. This thus justifies the work of maximum aerobic power, intended to develop this but above all to improve the tolerance and adaptation of the body to this intensity of effort.Consequently, the development of strength-speed must be done in a specific way to activity, that is to say intermittently. The importance of maximum strength for strength-speed increases as the load to be overcome increases. Likewise, this work goes in the direction of improving the qualities of high recovery intensity of effort, and therefore an improvement in the ability to reproduce efforts explosives in another situation successively.

**Keywords:** biweekly training; circuit training; female handball players; Improvement of recovery qualities; Explosive efforts.

## Introduction

Circuit training is one of the most widely used forms of training in professional and amateur sports circles. Between a mix of strength, endurance and speed, composed according to the objectives targeted, circuit training contributes to an improvement in load tolerance, recovery capacity and overall muscle strengthening. In addition, it has an undeniable fun potential and allows you to break with a certain routine. In the perspective of this article and the modern conversion of the game into women's handball, the trends require: to manage the balance of power well, to seek the gain of the confrontation and finally to evolve in an optimally adapted context. This form of training consists of improving in practitioners and in a progressive manner their physical condition by systematically developing the qualities of endurance, strength and speed. Main objective: General development with two main axes:

- Development of VMA (Maximum Aerobic Speed).

- Development of the different parameters necessary for optimal physical condition (relaxation, coordination, support work, muscle strengthening, etc.).

This work is carried out in the form of circuit training and on the basis of endurance work. Some of the workshops that make it up must be directly related to handball. In this study, 32 high-level handball players in Algeria were randomly selected. For the research, they were divided into two different groups: the experimental group and the control group (GE = 16 / GT = 16). We proceeded progressively according to the following steps:

Step 1: Establish a report - or audit - relating to the measurement, evaluation or expertise of the physical quality considered in the two groups before the experiment. Step 2: Specify the training period of the physical quality itself in a circuit training for the experimental group. Step 3: Evaluate the physical quality trained using the same test as at the start with the two groups and by carrying out the necessary statistical processing of the data. Therefore, the present study aimed to reveal the impact of the circuit training work carried out, to highlight a significant improvement or not in the physical quality trained in our handball players and above all to be able to offer sports professionals the possibility of defining the training loads of their athletes to constantly monitor their progress. To design an efficiency of training programs or even prevent a loss of performance linked to fatigue. They thus have, during the phases of physical preparation as during the competition period, precise indications on the fitness of their athletes.

**Methods and Investigation**

**Experimental Approach**

A questionnaire was established for the benefit of coaches and experts in the discipline who, by a first deduction, the majority do not seem to use this training method. In this study, circuit training work is apprehended through a few open questions aimed at helping the respondent to better value this working method, which mainly consists of improving the physical condition of practitioners and progressively. Consequently, it was designed to answer the following questions: How to manage and intermittently the development of strength and speed qualities in relation to the importance of maximum strength? To what extent can (10) weeks of biweekly circuit training work in season improve strength, speed, agility, high-intensity aerobic capacity and vertical jump among high-level handball players in Algeria? Can this method really go in the direction of improving the qualities of recovery at high intensity of effort?

This study was conducted over a ten-week period from October to December, a phase that can be decisive for the rest of the competitive season. We conducted tests before and after the intervention on the two groups: the control group GT (Standard program with microcycles according to the planning of the technical and administrative staff) and the experimental group GE (A circuit training work carried out twice a week over five training sessions accentuated and designed to maximize physical condition).

**The participants**

In this study, 32 high-level handball players in Algeria (National Excellence Senior Women's Championship) who were healthy and non-smokers were randomly selected. In addition to the competition, the participants followed a regular microcycle frequency of up to five times a week (from 12 to 15 hours / week).

The participants consented in writing to participate in the study, after: having read the aim and the experimental protocol with its potential risks and benefits. After obtaining authorization from the technical and administrative management. A medical examination was carried out to exclude all orthopedic pathologies and other contraindications to physical resistance training. The participants were divided into two different groups: the experimental group (Circuit training group) and the control group (Standard training group in season) (GE = 16 / GT = 16).

**Experimental Protocol**

Participants underwent anthropometric measurements (height, weight, wingspan, span). To estimate the value of lean mass and the percentage of fat mass, a measurement of 4 skinfolds was carried out using a clamp - HARPADEN SkinfoldCaliper-Durnin and Womersley skinfold clamp (Frédéric 2008) Table 2. On the ground, tests were carried out to assess physical qualities (strength, speed, power, agility and endurance). They allowed us to make an initial objective comparison between the two groups. This step concerns the following factors:

- Speed (sprint over 15m and 30m with standing start);
- Strength and power of the upper and lower limbs (bench press, half back squat, CMJ jump, SJ power jump);
- Endurance (Progressive 20-meter shuttle race test with 1-minute steps - Light);
- Agility (T-Half).

**Tools and Test Protocol**

-Weighing weight

*Using a SEBSON scale (Sc_BODY_BT_D) Bluetooth body fat analyzer, the initial body weight of the sample (36 handball players) was determined. Other body values can be determined with the Fridays application (BMI; TGC; Subcutaneous adipose tissue; Visceral fat; Body water; TMS; Muscle mass; Skeletal mass; Protein; BMR).

*On a firm, flat, vibration-free surface, place the device so that the 4 adjustment feet touch the ground. Place one foot on the scale to activate the device. Launch the application and select the athlete profile previously created. Place the other foot parallel to the scale (the feet must be bare with the body standing). The measurement was taken at the same time of day while maintaining the water balance as constant as possible (in the morning after a visit to the toilets).

**-The 15 and 30 meter sprints**

*We used a digital stopwatch, 24 h / 0.01 s / 1 s from the sports trimer brand, 7-digit LCD display. Controls: Start, Stop, Reset, Addition, Split, Double measurement. Measuring ranges: minute / second / 1/100 second and hour / minute / second. Resolutions: 1/100 s and 1 s. Display: 59 min. 59 s / 99 1/100 s / 23 h 59 min. 59 s. Dimensions (mm): 62 × 52 × 15.

*Place two cones 15 meters apart to mark the start and finish lines of the timed race. At the signal, the athlete sprints from the start line (maximum speed) and tries to reach the finish line as quickly as possible.

*The same procedure for the 30-meter sprint.

- Shuttle race over 20 meters with 1 minute step (Luc LEGER)

*Between 2 lines spaced 20 meters apart (the width of the handball field), run for as long as possible while respecting a running pace that accelerates every minute (each step at its own pace). The participants are divided into groups of eight, they must have one foot on the starting line, the test begins at the first beep with a very light run. The pace is increased at each step by 0.5 km/h. The first step generally corresponds to a speed of 7 to 8 km/h. It is therefore not necessary to warm up. When the participant is no longer in line with the beep and the line, she has reached her VMA. She must then stop and note the step she has reached as well as the number of shuttles she has completed.

**- CMJ Jump (Height & Power)**

* Ranges: Min = 25.80 / Max = 38.80

* After starting the Myotest, select the "CMJ Jump" test and check that the body weight is correct, otherwise adjust it. Place the Myotest on the belt and press "Enter". Start standing, hands on hips, look straight ahead, stay still. At the short beep, make a free swing movement (bend the knees) and jump as high as possible (seek the maximum height), keeping the hands in contact with the waist. The landing is done in a smooth and cushioned manner. After landing, return to the standing position and wait motionless for the next beep to repeat the jump. After 5 repetitions, the double beep signals the end of the test, we can then obtain the Height, Power, Strength and Speed of the jump. (For this test we will keep the results of the height / power variables).

**- Power Jump SJ (Height & Power)**

* Reaches: Min = 23.80 / Max = 35.80

* The same procedure as for the CMJ except that the start must be done by bending the knees at 90° and remaining still. At the short beep, jump as high as possible without momentum, keeping your hands in contact with your waist. The landing is done in a flexible and cushioned manner. Return to the bent and still position until the next beep. After 5 repetitions, the double beep signals the end of the test

**- Bench Press Profile (total weight lifted with bar included)**

* Reaches: Min = 35.50 / Max = 60.50

* After starting the Myotest, select the “Bench Press Profile” test. Load the bar to reach a total of 20kg/45lbs, bar included. Place the Myotest on the bar and press “Enter”. Get into position on the bench, lift the bar and remain still. At the long beep, lower the bar to your chest and wait in a static position. At the short beep, propel the bar with the intention of maximum speed while holding it firmly, until your arms are fully extended. After the push, stay in the straight arms position, a double beep indicates the end of the series (8 repetitions max). Place the bar on the supports. Consult the screen and load the bar to reach the total weight indicated during the pause countdown (1mn 30sec). After the end of pause beep, press "Next" then "Enter" to confirm the next series (8 series maximum of one repetition by increasing the load in stages). The results displayed represent the analysis of the profile of each participant and the evolution compared to the average of the three previous tests. The estimate of 1RM is the last maximum load lifted.

**-Back Half Squat Profile (total weight lifted with bar included)**

*Extensions: Min = 40.50 / Max = 65.50

*After activating the Myotest, select the “Half Squat Profile” test. Load the bar to reach a total of 20kg/45lbs, bar included. Place the Myotest on the bar and press “Enter”. Get into position, load the bar on your shoulders and remain still. At the long beep, bend your knees 90°, stabilize the bar and remain still. At the short beep, jump as high as possible, without counter-movement of momentum, while firmly maintaining the load in contact with the shoulders. The landing must be done in a smooth and well-cushioned manner, a double beep indicates the end of the series, then place the bar on its supports. Consult the screen and load the bar to reach the total weight indicated during the countdown of the pause (1mn 30sec). After the end of pause beep, press "Next" then "Enter" to confirm the next series (8 series maximum of one repetition by increasing the load in stages). The results displayed represent the analysis of the profile of each participant and the evolution compared to the average of the three previous tests. The estimate of 1RM is the last maximum load lifted.

Using the Myotest -performance measuring system- we were able to: Calculate the power, strength and speed in the participants (The height of a jump; resistance to fatigue; evaluate the height of the vertical jump and the statodynamic explosiveness of the legs -without counter-movement of momentum-). The Myotest calculates the power, strength and

speed of a sports gesture using the principle of accelerometry (measurement of acceleration). The sensor contained in the Myotest records the acceleration (variation of speed over time) to which the device is subjected during a sports gesture. By indicating the weight of the body or the load, depending on the exercise, the Myotest automatically calculates the force developed in Newton (mass x acceleration). The integral of the acceleration allows the calculation of the speed in cm per second [cm/s], and the power in Watt [w] is the product of the force by the speed. All the pre-programmed tests and the corresponding results have been verified and validated by the international scientific community.

**-T-HALF**

*Ranges: Min = 7.5s / Max = 9.9s

*We used the same digital stopwatch, 24 h / 0.01 s / 1 s from the sports trimer brand.

*Position 4 cones to form a T on the handball field. The base of the T is separated from its perpendicular bar by 9.2 meters (10 yards). The bar itself measures 9.2 meters and is divided into two equal parts. Once warmed up, each participant (in turn) stands at the base of the T at the 1st cone. At the signal, she runs to the second cone, in the middle of the T bar. She continues her journey in side steps towards the 3rd cone on her left, which she touches with her left hand. She sets off again in side steps towards the right to the cone positioned at the far right of the T, which she touches with her right hand. She returns to the middle cone, touches it and sets off running backwards to the starting point. Two attempts are made, the best time recorded is to within 0.1s. The participant must always be facing forward, she must neither turn on herself nor cross her legs.

***The battery of tests was carried out in two phases, a first phase before the completion of the training circuit, a second phase after the ten weeks following the first phase before moving directly to the statistical analysis (presentation, interpretation and discussion of the results).***

**Study design**

Data were collected before and after the ten-week intervention. A standardized warm-up was performed before each test session. All participants had followed the same training sessions since the beginning of the competitive season (5 training sessions + one official match per week). For the experimental group, the technical and tactical training sessions were modified by the introduction of circuit training twice a week (designed to maximize fitness).

Test sessions were performed at the same time and under the same experimental conditions during the microcycles (at least two days after the competition and no physical training one day before the test). The Half Back Squat test was performed on day 1; day 2 was devoted to rest; the CMJ Jump Jump + SJ Power Jump + 15m and 30m Sprint with Standing Start tests were performed on day 3; The 4th day was also devoted to rest; the Leger Shuttle Run test was performed on the 5th day; the 6th and last day were performed the Bench Press + T-HALF Agility test.

Energy drinks and those containing caffeine were prohibited in the 4 hours preceding the test and no food was consumed at least 3 hours before the test. The sleep cycle was well respected throughout the study (All participants had at least 7.5 hours of sleep per night).

**Statistical Analysis**

All statistical analyses were performed using EXCEL (Microsoft 365 Personalversion -2021 Microsoft. x22-62082-02-). XLSTAT software (version 2022) was used to verify the normality of the data distribution. The parameters studied are expressed in descriptive results (mean and standard deviation for anthropometric measurements and assessment of athletic abilities). The descriptive comparison between groups (GE / GT) and sessions (pre-intervention / post-intervention) is noted by the relevant effect sizes (D-COHEN). Analytical comparisons (comparison of results by T student) were performed for the paired series. The significance threshold retained is $P < 0.05$ symbolized by (S).

**Analysis and interpretation of results**

***Presentation of the descriptive values of the different anthropometric parameters in high-level handball players in Algeria:***

Table (2) shows the mean, standard deviation and non-significant anthropometric differences ($p>0.05$) between the two groups (experimental / control) according to the different comparison factors: Age (year); weight (kg); height (cm); wingspan (cm); span (cm) and body mass index (kg / m2). According to the results obtained before carrying out the intervention of ten (10) weeks of biweekly circuit training with the experimental group, no significant difference was recorded between the two groups for the weight factor (variable to be taken into account for the analysis of post-test results): [GE (67.5 ± 6.80) / GT (66.3 ± 7.23); independent sample degree of freedom (N = 30); calculated value of t (0.796); critical value of t (2.042); not significant at a significance threshold for a bilateral test ($p>0.05$)].

Presentation of the descriptive and analytical values of the weight and fat mass variables in high-level handball players in Algeria:

Table (3) allows you to visualize the mean, standard deviation and differences between the weight (kg) and fat mass (%) variables not significant ($p>0.05$) between the two groups (experimental and control). According to the results obtained after the intervention of ten (10) weeks of biweekly circuit training with the experimental group, no significant difference was recorded between the two groups for the weight factor, as well as for that of fat mass:

[Post-test result GE (65.3 ± 6.82) / GT (64.5 ± 8.36) degree of freedom independent sample (N = 30); calculated t-value (0.381); critical t-value (2.042); not significant at a significance threshold for a two-sided test (p>0.05) of weight].
[Post-test result GE (21.9 ± 4.59) / GT (22.8 ± 3.62) degree of freedom independent sample (N=30); calculated t-value (0.628); critical t-value (2.042); not significant at a significance threshold for a two-sided test (p>0.05) of fat mass].
Presentation of the descriptive and analytical values of the speed (s) on 15-meter and 30-meter sprints among high-level handball players in Algeria:
Table (3) allows you to visualize the mean, standard deviation, range and non-significant differences (p>0.05) between the two groups (experimental and control) of the 15-meter and 30-meter sprint variables. According to the results obtained after the intervention of ten (10) weeks of biweekly circuit training work with the experimental group, no significant difference was recorded between the two groups when assessing the quality of speed (s):
[Post-test result GE (2.95 ± 0.15) / GT (2.98 ± 0.17) degree of freedom independent sample (N = 30); calculated value of t (0.543); critical value of t (2.042); not significant at a significance level for a two-sided test (p > 0.05) 15-meter sprint].
[Post-test result GE (4.03 ± 0.21) / GT (4.66 ± 0.19) degree of freedom independent sample (N = 30); calculated value of t (0.932); critical value of t (2.042); not significant at a significance level for two-tailed test (p>0.05) 30 meter sprint].
Presentation of the descriptive and analytical values of aerobic endurance (Vo2Max) in high-level handball players in Algeria:
Table (3) shows the mean, standard deviation, range and significant differences (p < 0.05) between the two groups (experimental and control) of maximum O2 consumption (ML.MIN-1 KG-1). According to the results obtained after the intervention of ten (10) weeks of biweekly circuit training, the O2 absorption rate in the experimental group is higher than that of the control group during the 20-meter shuttle test:
[Post-test resultGE (54.6 ± 4.21) /GT (50.9 ± 4.29) degree of freedom independent sample (N = 30); calculated value of t (2.487); critical value of t (2.042); significant at a significance threshold for bilateral test (p>0.05)].
Presentation of the descriptive and analytical values of the different parameters of the CMJ jump jump (w/kg – cm) in high-level handball players in Algeria:
Table (3) allows you to visualize the mean, standard deviation, range and non-significant differences (p>0.05) for power but significant (p<0.05) for height between the two groups (experimental and control) of the CMJ jump jump. According to the results obtained after the intervention of ten (10) weeks of biweekly circuit training, there is no significant difference between the two groups in jump power but the jump height is higher in the experimental group:
[Post-test result GE (37.15 ± 5.21) / GT (35.40 ± 4.79) degree of freedom independent sample (N = 30); calculated value of t (0.998); critical value of t (2.042); not significant at a significance level for bilateral test (p> 0.05) CMJ power].
[Post-test result GE (37.50 ± 4.77) / GT (32.48 ± 4.03) degree of freedom independent sample (N = 30); calculated value of t (3.245); critical value of t (2.042); significant at a significance threshold for bilateral test (p < 0.05) CMJ height].
Presentation of the descriptive and analytical values of the different parameters of the SJ power jump (w / kg - cm) in high-level handball players in Algeria:
Table (3) allows to visualize the mean, standard deviation, range and significant differences (p < 0.05) for the variables (power / height) between the two groups (experimental and control) of the SJ power jump. According to the results obtained after the intervention of ten (10) weeks of biweekly work in circuit training, the experimental group showed higher suites in power and height:
[Post-test result GE (44.88 ± 5.30) / GT (40.31 ± 4.26) degree of freedom independent sample (N = 30); calculated value of t (2.715); [Post-test resultGE (36.90 ± 5.21) /GT (32.20 ± 3.88) independent sample degrees of freedom (N=30); calculated t-value (2.926); critical t-value (2.042); significant at a two-tailed significance level (p<0.05) SJ height].
Presentation of the descriptive and analytical values of the different parameters of the bench press profile (1RM / kg) in high-level handball players in Algeria:
Table (3) allows you to visualize the mean, standard deviation, range and significant differences (p < 0.05) for the variables (maximum load / power) between the two groups (experimental and control) of the bench press profile. According to the results obtained after the intervention of ten (10) weeks of biweekly work in circuit training, the experimental group showed more dominant sequences in 1RM and power:
[Post-test result GE (60.31 ± 3.63) / GT (49.52 ± 5.14) degree of freedom independent sample (N = 30); calculated value of t (3.759); critical value of t (2.042); significant at a significance threshold for bilateral test (p < 0.05) maximum load lifted].
[Post-test result GE (964.96 ± 3.66) / GT (958.14 ± 4.96) degree of freedom independent sample (N = 30); calculated value of t (4.469); critical value of t (2.042); significant at a significance threshold for bilateral test (p < 0.05) power].
Presentation of the descriptive and analytical values of the different parameters of the half-back squat profile (1RM / kg) in high-level handball players in Algeria:

Table (3) allows to visualize the mean, standard deviation, range and significant differences ($p < 0.05$) for the variables (maximum load / power) between the two groups (experimental and control) of the bench press profile. According to the results obtained after the intervention of ten (10) weeks of biweekly circuit training work, the experimental group showed higher responses in 1RM and power:

[Post-test resultGE (62.50 ± 5.29) /GT (50.63 ± 4.28) degrees of freedom independent sample (N=30); calculated t value (3.286); critical t value (2.042); significant at a significance level for bilateral test ($p<0.05$) maximum load lifted].

[Post-test resultGE (958.13 ± 4.12) /GT (953.03 ± 3.98) degrees of freedom independent sample (N=30); calculated t value (3.596); critical t value (2.042); significant at a significance threshold for a two-sided test ($p < 0.05$) power].

Presentation of the descriptive and analytical values of agility among high-level handball players in Algeria:

Table (3) allows you to visualize the mean, standard deviation and significant differences ($p < 0.05$) for the variable of liveliness between the two groups (experimental and control). According to the results obtained after the intervention of ten (10) weeks of biweekly work in circuit training, the experimental group confirmed its ability to accelerate and counter-accelerate to change direction during the agility assessment (T-Half / s):

[Post-test result GE (7.00 ± 0.53) / GT (7.35 ± 0.24) degree of freedom independent sample (N = 30); calculated value of t (2.430); critical value of t (2.042); significant at a significance level for a two-sided test ($p<0.05$)].

**Discussion**

Circuit training takes place in the general preparation phase and should be repeated for two months at a rate of one to two weekly sessions, in parallel with specific training for the sporting discipline. The choice, duration of the exercises and breaks should be adapted regularly according to the level of the participants and the objectives to be achieved. A circuit is composed of six to twelve exercises interspersed with active or passive breaks. The duration of these two phases – exercises and breaks – and the activity performed during the break are the two levers for acting on the intensity of the effort. A relatively short break time or an aerobic task during it, for example, allows for maintaining constant cardiovascular activity. As with young athletes, it was preferable to opt for short exercises and significant recovery in order to favor good quality of movement. Under fatigue, the movements are in fact less fluid, less precise and they can be sources of injury. For these same reasons, the exercises must be known to everyone and have been trained beforehand. (Table 1)

To ensure the independence of the two groups (experimental and control) without adverse effects on each other, the results indicate non-significant anthropometric differences. (Table 2)

Our study aimed to reveal the impact of biweekly circuit training on speed with sprint capacity, agility, aerobic endurance, strength and power of the upper and lower limbs compared to standard training in handball players of National Excellence Dame in Algeria. The results indicate that a circuit training program can effectively improve the physical performance of our handball players compared to a classic training program. (Table 3)

To improve muscular endurance, we emphasized the work on the repetitions of the exercises. To improve muscular strength, we added additional resistance to the movement. We cannot know whether it is strength or endurance that will be improved first, it depends on the number of repetitions that can be performed. Low rep ranges (1-10) will primarily improve strength. Higher rep ranges (15-30) will primarily improve endurance. Medium rep ranges (10-15) will improve both to some extent and are recommended for general muscular fitness. (The complete guide to water exercises. Lawrence –A&C Black: 2004).

Speed is a key assessment indicator for handball players, it is a reflection of the different movements in a competition with speed of action/reaction/impulse. (Zilong H, Haiyang Z, Yousong T. Impacts of high intensity interval training on physical fitness in handball. Rev Bras Med Esport -2023; vol.29-e2022_0618

Sprinting and acceleration are important qualities for handball players (Gorostiaga et al., 2005; Hermassi et al., 2017). In our study we did not obtain significant improvements. The same for Helland et al. (2016) who did not observe a difference in sprinting over 30 meters after eight weeks of weightlifting training three times a week with a power training group.

VO2max is a value of oxygen consumption that appears during prolonged effort in the severe domain. Our study showed significant results in O2 consumption, however it is in cross-country skiing that we find the highest values of VO2max, they can reach more than 70 ml/kg/min in women. The record values measured in this sport to date are 96 ml/kg/min in men and 80 ml/kg/min in women. (UpsideStrengthSàrl;

**Table 1:Sessions « 10 week Biweekly Circuit Training»**

| EXERCICES | *Session -1-* | *Session -2-* | *Session -3-* | *Session -4-* | *Session -5-* |
|---|---|---|---|---|---|
| *Soulevé de Kettlebell | 10 * 3 Rép / 6 kg | 10 * 3 Rép / 6 kg | 10 * 3 Rép / 6 kg | 10 * 3 Rép / 6 kg | 12 * 3 Rép / 6 kg |
| *Lancé vertical de Médecine-ball | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg |
| *Saut sur Box+Box (80cm) | 6 * 3 Rép / I= R | 6 * 3 Rép / I= R | 6 * 3 Rép / I= R | 6 * 3 Rép / I= R | 6 * 3 Rép / I= R |
| *Climber avec poids | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 12 * 3 Rép / 4 kg |
| *Course vitesse en zig zag | 4 * 5 m (20 m) | 4 * 5 m (20 m) | 4 * 5 m (20 m) | 4 * 5 m (20 m) | 4 * 5 m (20 m) |
| *Pushups avec levé jambes | 8 * 3 Rép / I= M | 8 * 3 Rép / I= M | 8 * 3 Rép / I= M | 8 * 3 Rép / I= M | 10 * 3 Rép / I= M |
| | *Session -6-* | *Session -7-* | *Session -8-* | *Session -9-* | *Session -10-* |
| *Soulevé de Kettlebell | 12* 3 Rép / 6 kg | 12 * 3 Rép / 6 kg | 12 * 3 Rép / 6 kg | 15 * 3 Rép / 6 kg | 15 * 3 Rép / 6 kg |
| *Lancé vertical de Médecine-ball | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg |
| *Saut sur Box+Box (80cm) | 8 * 3 Rép / I= M | 8 * 3 Rép / I= M | 8 * 3 Rép / I= M | 8 * 3 Rép / I= M | 8 * 3 Rép / I= M |
| *Climber avec poids | 12 * 3 Rép / 4 kg | 12 * 3 Rép / 4 kg | 12 * 3 Rép / 4 kg | 15 * 3 Rép / 4 kg | 15 * 3 Rép / 4 kg |
| *Course vitesse en zig zag | 4 * 5 m (20 m) | 4 * 5 m (20 m) | 4 * 5 m (20 m) | 4 * 5 m (20 m) | 4 * 5 m (20 m) |
| *Pushups avec levé jambes | 10 * 3 Rép / I= M | 10 * 3 Rép / I= M | 10 * 3 Rép / I= M | 12 * 3 Rép / I= M | 12 * 3 Rép / I= M |
| | *Session -11-* | *Session -12-* | *Session -13-* | *Session -14-* | *Session -15-* |
| *Squat avec Kettlebell | 10 * 3 Rép / 5 kg | 10 * 3 Rép / 5 kg | 10 * 3 Rép / 5 kg | 10 * 3 Rép / 5 kg | 12 * 3 Rép / 5 kg |
| *Lancé horizontal de Médecine-ball | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg |
| *Saut sur Box+Box (80cm) | 10 * 3 Rép / I= M | 10 * 3 Rép / I= M | 10 * 3 Rép / I= M | 10 * 3 Rép / I= M | 10 * 3 Rép / I= M |
| *Climber avec poids | 12 * 3 Rép / 4 kg | 12 * 3 Rép / 4 kg | 12 * 3 Rép / 4 kg | 15 * 3 Rép / 4 kg | 15 * 3 Rép / 4 kg |
| *Sit-Ups | 10 * 3 Rép / I= R | 10 * 3 Rép / I= R | 10 * 3 Rép / I= R | 10 * 3 Rép / I= R | 12 * 3 Rép / I= R |
| *Skippings avec harnais de traineau | 4*10 m (8 kg) | 4*10 m (8 kg) | 4*10 m (8 kg) | 4*10 m (8 kg) | 4*10 m (8 kg) |
| | *Session -16-* | *Session -17-* | *Session -18-* | *Session -19-* | *Session -20-* |
| *Squat avec Kettlebell | 12* 3 Rép / 5 kg | 12 * 3 Rép / 5 kg | 12 * 3 Rép / 5 kg | 15 * 3 Rép / 5 kg | 15 * 3 Rép / 5 kg |
| *Lancé horizontal de Médecine-ball | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg | 10 * 3 Rép / 4 kg |
| *Saut sur Box+Box (80cm) | 12 * 3 Rép / I= L | 12 * 3 Rép / I= L | 12 * 3 Rép / I= L | 12 * 3 Rép / I= L | 12 * 3 Rép / I= L |
| *Climber avec poids | 15 * 3 Rép / 4 kg | 15 * 3 Rép / 4 kg | 15 * 3 Rép / 4 kg | 20 * 3 Rép / 4 kg | 20 * 3 Rép / 4 kg |
| *Sit-Ups | 12 * 3 Rép / I= R | 12 * 3 Rép / I= R | 12 * 3 Rép / I= R | 15 * 3 Rép / I= R | 15 * 3 Rép / I= R |
| *Skippings harnais traineau | 4*10 m (8 kg) | 4*10 m (8 kg) | 4*10 m (8 kg) | 4*10 m (8 kg) | 4*10 m (8 kg) |

**Table 2. Comparison of anthropometric factors between the experimental and control groups**

| | *Groupes* | Experemental group | Control group | |
|---|---|---|---|---|
| | *samples* | N = (16) | N = (16) | T- Test |
| Factors | Âge (years) | 23.81 ± 2.35 | 23.75 ± 2.82 | *(NS)* |
| | weight (kg) | 67.5 ± 6.80 | 66.3 ± 7.23 | *(NS)* |
| | length (cm) | 174.33 ± 7.50 | 173.87 ± 5.53 | *(NS)* |
| | Envergure (cm) | 171.2 ± 6.73 | 172.4 ± 3.94 | *(NS)* |
| | Empan (cm) | 22.57 ± 1.20 | 23.13 ± 1.25 | *(NS)* |
| | IMC | 23.36 ± 1.59 | 24.53 ± 0.84 | *(NS)* |
| | | | | p> 0.05 |

Our study showed gains in height but not in jumping power in the spring (CMJ) unlike in the (SJ) where we were able to observe improvements in power and height, like those observed in handball players (Gorostiaga et al., 1999). Hermassi, Laudner and Schwesig.
(2020) observed after 12 weeks of circuit training work with young handball players gains in vertical jump height (7.8% CMJ – 12.5% SJ). The plausible explanation for the improvement in jumping performance lies in the alternation during the same series of heavy loads and light loads with a movement executed as quickly as possible. The aim is to take advantage of the sensory contrast induced by lifting the heavy load to lift the light load immediately afterwards. A heavy leg exercise in general, such as the squat, is relatively more effective in developing intramuscular coordination, while squats with loaded jumps are more effective in developing intermuscular coordination (Crewther et al., 2005), (Hermassi, Launder, & Schwesig., 2020).

**Table 3. Analytical comparison before and after a 10-week biweekly Circuit Training workout.**

| test | variables | Experemental group | | Control group | | T test |
|---|---|---|---|---|---|---|
| | | Pre test | Post test | Pre test | Post test | |
| antropometry | weight | 67.5 | 65.3 | 66.3 | 64.5 | NS |
| | Mass grass | 25.8 | 21.9 | 24.3 | 22.8 | NS |
| Performance de vitesse | Sprint 15 m | 3.26 | 2.95 | 3.30 | 2.99 | NS |
| | Sprint 30 m | 4.58 | 4.03 | 4.72 | 4.66 | NS |
| Maxamial consumption of O2 shuttle course 20 m with 1 min level | shuttle course 20 m with 1 min level | 47.3 | 54.6 | 46.8 | 50.9 | S |
| jump performance (power/ | Test CMJ (power/ height | 34.11 | 37.15 | 33.20 | 35.40 | NS |
| | | 29.26 | 37.50 | 28.60 | 32.48 | S |

| | | | | | | |
|---|---|---|---|---|---|---|
| **height** | **Test SJ (power/ height** | **38.40** | **44.88** | **37.53** | **40.31** | **S** |
| | | **26.60** | **36.90** | **25.90** | **32.20** | **S** |
| | **Min- max** | **25.80- 38.80** | | **23.80 – 35.80** | | **P ≤ 0.05** |
| **Power of the superior limbs and Developed Infers** | **Developed Bench press (1rm/kg)** | **41.56** | **60.31** | **39.69** | **49.52** | **S** |
| | **Half squat bar on the shoulder (1 rm/ kg)** | **792.20** | **964.96** | **747.10** | **958.14** | **S** |
| | | **42.19** | **62.50** | **41.56** | **50.63** | **S** |
| | | **794.16** | **958.13** | **782.30** | **953.03** | **S** |
| **Agility performance** | **T- Half** | **7.15** | **7.00** | **7.13** | **7.35** | **S** |
| | **Min - max** | **7.5 -9.9** | | | | **P ≤ 0.05** |

The use of heavy loads (> 80% of the max) to create maximum tensions is the ideal solution to optimize strength. Range of motion work and muscle stretching allows the development of the number of sarcomeres by performing a full range of motion during the exercise. In our study, the loads used during the circuit training program seem perfectly adapted to maximize the strength of the upper and lower limbs (Hermassi et al., 2017; Fieseler et al., 2017; Hermassi et al., 2011), the gains for the bench press and half barbell squat on shoulders were greater than those observed by HermassiLaunder and Schwesig. (2020) the reason for these differences is certainly due to the years of practice as well as the level of physical condition among high-level handball players in Algeria. The first study to examine the effects of circuit training on agility in handball is that of Hermassi-Launder and Schwesig. (2020) with young handball players, the results showed significant improvements in the circuit training group compared to the control group. The same is true for our study, even if the significance is not the most important, it comes down to the factors limiting agility. Size can refer to different profiles, it can be a factor relative to the size of the legs compared to the size of the body (Aurelien-Broussal-Derval., 2019). Other studies confirm this theory, Grosgeorges and Farcy (2016) illustrate this effectively. They take in particular the example of the athletic monitoring of young basketball players from the French pole at INSEP, where they carried out several athletic tests. Correlations between leg size, vertical jump with the Counter Movement Jump (CMJ) and an agility test were evaluated. For this population of adolescents, leg size was found to be independent of the CMJ but on the other hand the more the leg size increases the more the time in the agility test increases significantly. However Curitinu IM; Turcu I; Alexe DI; Alex CI and Tohanean D. (2022) refute this theory by the technical assets and characteristics related to the speed and agility of Asian handball players (known for their small size). The observed performance improvements can offer sports professionals (coaches, physical trainers, sports doctors and physiotherapists) the opportunity to define the training loads of their athletes, to continuously monitor their progress, to verify the effectiveness of training programs or to prevent a loss of performance related to fatigue. They thus have, during the physical preparation phases as well as during the competition period, precise indications on the fitness of the athletes they are monitoring. In the first general preparation phase (GPP), effective walking training can be carried out for all levels of physical condition and then adopt an "Outdoor" circuit training program. Carry out an interval training approach at more or less high speeds and finally integrate body weight exercises to provide strength and muscular endurance work within the program.

**Conclusion**

Circuit training should follow the same session structure as any other. The session should be preceded by an adequate warm-up period and end with an adequate recovery period as well. The design of the main session will depend on the reasons for the handball players' participation. It is wise to include activities aimed at improving all components of physical condition.

However, our results revealed that Algerian handball players playing in the national excellence division responded very well to the biweekly circuit training program, special attention can be paid to:

• Reproduce the activities performed maximally throughout the training sessions;

• Counterbalance the strength of the antagonist muscles to those used maximally throughout the activity by developing muscle flexibility, which does not only consist of contracting them forcefully but also making them sufficiently flexible.

To design an effective and handball-specific training session, it is necessary to carry out an analysis of the needs specific to the latter. Each of the following should be considered: The main types of movements and skills required in the sport, the movement of the joints, the muscles used and their type of contraction (concentric, eccentric, isometric and plyometric), the dominant energy pathway (aerobic/anaerobic) and common injuries particularly associated with handball.

Circuit training can be adapted to different fitness levels but also to technical-tactical skills. The programme will be designed with the aim of achieving progressive overload within the time allotted to one of the phases during the season. The time frame will also depend on whether the circuit is a single session or part of a wider training programme.

**Références Bibliographiques**

1. Aranda, J. S. [Rosa Sole Cases] (Éd.). (2003). Les variables du travail en circuit. Entrainement physique du sportif 1088 exercices en circuit (Décembre 1999, isbn. 2-85 180-541-X). Amphora**.**
2. Biéchy, J. (2012). Approche systémique de la performance sportive : analyse de la performance et planification, quantification des charges d'entraînement et de compétition. Editions Amphora.
3. Broussal-Derval, A., &Bolliet, O. (2012). Les tests de terrain : Plus de 130 protocoles pour mesurer la performance sportive. (part. 3. Les tests de Force ; 4.Les tests de Vitesse ; 6. Les tests Aérobie). isbn. 979-10-91285-02-5
4. Curitianu IM, Turcu I, Alexe CI, Tohanean D. Effects of Tabata and HIIT Programs Regarding Body Composition and Endurance Performance among Female Handball Players. Balneo PRM Res J. 2022;13(2): 500.
5. Debbie Lawrence & Bob Hope. The complete guide to circuit training. Bloomsbury Publishing Plc, 2014; 50 Bedford square; London; WC1B 3DP (2014, sect. session with circuit training exercices)
6. Gallais, D. L., & Millet, G. (2007). La préparation physique : optimisation et limites de la performance sportive. Elsevier Masson. isbn.978-2-294-07257-4
7. Grage, W. (2014). Das neue Super-Handball-Training. Meyer & Meyer Verlag. (2014, part. 1. PhysischeVorbereitung). isbn. 978-3-89899-866-6
8. Marie le MENN, Romain GUILLET, Nicolas PRAQUIER. (2015) (s. d.). Handball guide de l'entraineur : De la formation à la performance (1re éd.). Amphora.
9. Hermassi S, Laudner K, Schwesig R. The effects of circuit strength training on the development of physical fitness and performance-related variables in handball players. Journal of Human Kinetics, 2020; 71(01): 191-203
10. Storen et al. (2017). The effect of age on the VO2max response to high-intensity interval training. Medicine and Science in Sports and Exercise, 49(1), 78-85. DOI: 10.1249/MSS.0000000000001070.
11. Touabti-Mimouni, N. (2015). *Biométrie et analyse de la morphotypologie des sportifs*. (2015, sect. Etude des relations statistiques entre caractères mesurés. isbn.978-3-8416-7139-4
12. Zilong H, Haiyang Z, Yusong T. Impacts of High-Intensity Interval Training on Physical Fitness in Handball. Rev Bras Med Esporte, 2022; 29(11): e2022_0618