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RESEARCH ARTICLE

IMPACT OF PLYOMETRIC TRAINING ON SEASAND AND PHYSICALQUALITIES OF ETOILE DU CONGO HANDBALL PLAYERSDURING THE 2022-2023 NATIONAL CHAMPIONSHIP

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ABSTRACT

Objective: The aim of this study was to evaluate the maximal power of the lower limbs during plyometric training in a sandy environment. Methodology: Our study was experimental. It involved 10 elite handball players from the Etoile du Congo team. Anthropometric measurements and two physical tests were measured before and after. However, the jump versus movement jump (CMJ) tests were measured using the Myotest, the speed sprint test over 5, 10, 20 and 30 meters and the repeated sprint test with a two-minute recovery between series. Results: The results obtained showed a significant stabilization of weight and body mass index, and an increase in counter-movement jumping with the arms (p=0.20) and leg power in counter-movement jumping (p=0.57). However, reaction speed at different distances decreased very significantly and there was a significant increase in the counter-movement jump with the arm (p=0.20) and leg power in the counter-movement jump (p=0.57). However, reaction speed at the different distances decreased very significantly. However, there was only a significant increase at SR. ***Conclusion:*** Plyometric training improves the explosiveness of handball players' lower limbs. Indeed, this study integrates the current logic of handball intermittence. It can serve as a guide for optimizing performance in intermittent sports such as basketball.

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INTRODUCTION

Testing and evaluating performance are core subjects in sports science studies because they play a key role in sports training and competition Mehmet, (2020). Handball is a team sport par excellence because it is characterized by very different physiques per position. The development of training methods that increasingly meet the requirements of modern handball, particularly the intermittent nature of the game. Today's handball players need a very high level of physical preparation if they are to succeed in top-level competition. Technical and tactical mastery alone is no longer sufficient to achieve world-class performances. In fact, a number of studies show that high levels of muscular strength and power, as well as a high aerobic capacity, are important factors in sports performance in handball. Similarly, explosiveness, endurance and running speed are determinants of better sports performance in handball Grostiaga *et al*. (2004).

However, the issue of the intermittency of playing phases in handball testifies to this repeated sprinting capacity (CSR) being one of the main physical determinants of performance in team sports (Nakamura *et al*, 2009; Dawson, 2012). In handball, for example, matches are characterized by high-intensity actions such as high-speed running, endurance, strength and power (Granado *et al*, 2006; Ronglan *et al*, 2006 Cherif *et al*, 2012). Its practice requires a high level of preparation, to enable the best performance to be achieved (Cherif *et al*, 2012). It is for this reason that Plyometrics is one of the training methods recommended for improving power in the relaxations and in running speed Kotzamanidis, [2006]. It leads to explosive muscles. Plyometric training has been advocated as a suitable approach for sports requiring explosiveness and improving vertical relaxation Eduardo, (2008). Moreover, handball is a high-intensity sport Chelly *et al*, (2012), less time wasted in its play IHF, 2018.

To perform well and meet these requirements (speed, high intensity), handball players need to develop, among other things, explosive leg power and the ability to perform sprints (Marques *et al*, 2006; Granados, 2007). So, the importance of speed, explosiveness, motor coordination, maximum aerobic power and inter-exertion recovery capacity Rampinini *et al*. (2007). Power, relaxation and agility are often important at critical moments in the game. Deng N *et al*., 2023 mention that lower limb power, and in particular vertical rebound, is considered crucial to athletic performance. In recent years, it has been shown that the physical qualities developed primarily in team sports are often quite different from those developed in other types of sport. Indeed, in team sports such as handball, athletes are often confronted with intermittent-type efforts, which require players to have great muscular power. The study conducted by Harrieche *et al* (2021), on the evaluation of muscle power in counter-movement jump handball; revealed that players possess considerably lower limb muscle power qualities to perform better. Significant differences were detected between playing positions in terms of height. Center-half players performed best in jumping, with a non-significant difference in maximum power. For the single-leg jump, the pivots represented the best values, with a bilateral deficit noted in the subjects. In Congo Brazzaville in general, we note that not all clubs respect the hourly volume of physical preparation, even though physical preparation is the basis of training in the field of sport to reinforce aerobic and muscular physical capacities. More precisely, the Etoile du Congo club in the Men's section only trains technico-tactically once a day, whereas at international level it is recommended that a team should train a maximum of two (2) times. So this way of training doesn't allow us to improve and reach the best possible level. Why do the Etoile du Congo handball players have such a low level of physical development? Does plyometric training on sea sand improve the muscular strength of handball players' lower limbs? The drop in the level of physical fitness observed among Etoile du Congo handball players is justified by the fact that they are less exposed to physical fitness training. Plyometric training on sea sand improves the explosiveness of the handball players' lower limbs. The aim of this study was to show the effect of physical preparation based on plyometric training in a sandy environment on the development of the physical qualities of Etoile du Congo handball players. Thus, we will specifically evaluate the maximum power of the lower limbs at the beginning and end of physical preparation based on plyometric training.

MATERIALS AND METHODS

Setting and type of study: In order to understand the impact of fatigue generated by repeated sprints during plyometric training during a vertical jump (CMJ), an experimental study was set up using a single-group design. It took place in Brazzaville, the capital of the Republic of Congo, at the Etoile du Congo team stadium.

Participants: Our study population consisted of 20 handball players from the Etoile du Congo team playing in the first departmental division of the 2023-2024 sports season. The sample size was determined by the G*Power software (Kang H, 2021)) which links the statistical power of the test and the sample size. For the purpose of sample representativeness, Student's paired-sample test was used by this software setting an effect size of 0.6 a significance level α= 0.05 and a statistical power 1-β= 0.9 and yielded a current statistical power 1-β=0.9082645 and a sample size of 21 subjects. The sample for our study was drawn using the simple (non-probabilistic) method. The reasoned choice method was used to select the Etoile du Congo club as the resource team. To take part in the study, the following criteria had to be met: To be handball players of the Etoile du Congo club; to be frequently selected among the 10 players who usually take part in matches; to have already taken part in a national championship; to have signed an informed consent; to be healthy (absence of pathology) certified by a doctor. Those excluded from our experimentation were: having a pathology; having a medical rest of at least 3 months; not having already participated in any championship. To have some trauma such as articular and ligamentary; not to be regular at training; to have resigned, been injured or had other problems during the experiment. To avoid any confusion in the results of our study, we took a few precautions, namely: to eat two hours before the experimental session; not to be mentally unwell on the day of the experiment; to ensure that we ate three hours before the experimental session.

Technical measurement equipment and data collection: Anthropometric measurements and two physical tests were used in this study.

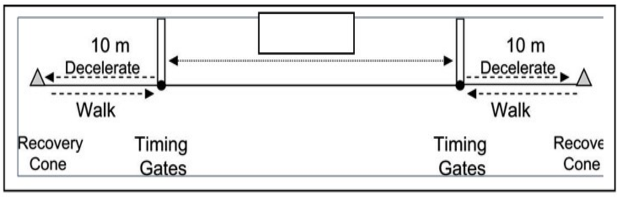
Measurements taken: Anthropometric parameters: Body mass was measured using a seca electronic scale with a maximum capacity of 150 kg and an accuracy of 0.1 kg, installed on a hard, horizontal, stable and vibration-free surface. At the time of measurement, the subject was in an upright position, facing the scale and looking straight ahead, feet slightly apart so as to distribute the weight evenly over both feet. The measurement was taken twice, with an accuracy of 0.5 kg. If the difference between the two measurements was greater than 0.5 kg, a third measurement was taken. The value used was the average of the two closest measurements. The height of the subjects was assessed using a measuring tape. When the measurement was taken, the subject was in an upright position, with his or her back to the height gauge, so that the head, shoulders, buttocks and heels were resting on the vertical bar of the height gauge, while maintaining a natural lumbar curve. The subject was in shorts or camisole and barefoot. He should have his hands at his sides, palms facing his thighs, legs straight, and keep his head upright while looking straight ahead. Before the measurement, the subject should take a deep breath and hold it until the movable part of the toise is lowered onto his head and the measurement is completed. Zagatto *et al*. (2009).

Jump test: The players' counter-movement jump (CMJ) performance was measured using the Myotest SA 1950 Sion /Switzerland and the manufacturer's prescribed test protocol. The Myotest was placed on the player's belt and he stood up to perform a jump, hands on his hips, looking straight ahead, knees bent at 900, in an immobile position and with a short beep, he jumped as high as possible with a free run-up, keeping his hands in contact with his waist. The landing was soft and cushioned. In fact, this test measures relaxation following muscular stretching. The CMJ consists of an eccentric phase followed by a concentric phase of the leg extensors. The elastic component therefore plays a major role in vertical jumping. The athlete's explosive strength can be assessed by calculating the height reached and the power values obtained with a Myotest® (2008).

Sprint test: Speed over 5m, 10m, 20m and 30m. This test involved an athlete running at maximum speed over a distance of 30m. Each player completed two runs, with the best time in seconds being recorded. Performances were taken at 5m, 10m, 20 and 30m.

Brower Timing System cells (USA, Utah, Draper City) were used to record running times during the reaction speed test, repeated sprints and explosive speed, the validity and reliability of which were verified.

Repeated sprint test: The repeated sprint ability test consisted in running in six repeated 35-meter sprints at full speed with a 10-second recovery time between each sprint (figure 1). The subject was asked to recover for 10 seconds and then repeat the same procedure for the remaining five sprints. Subjects were asked to perform three sets [3 X (6 X 35m)] with a two-minute recovery between sets. The time taken for each sprint was recorded by two pairs of Brower Timing System photocells (USA, Utah, Draper City) based on an infrared emitter and a reflector. For each sprint, power was calculated as described in the studies by Zagatto *et al*. (2009).

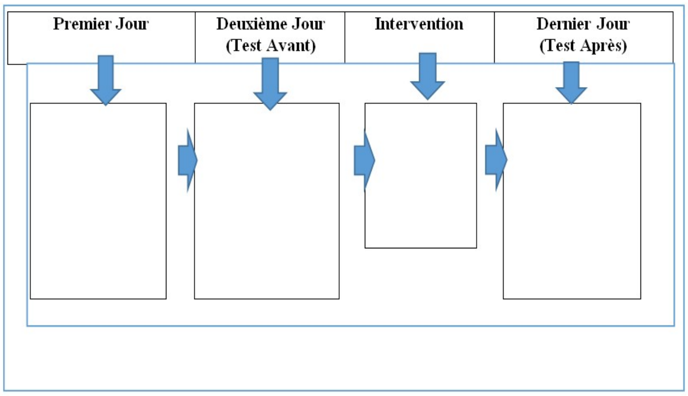


NB : Le score IF était égal au taux de variation (%)

Figure 1. Repeat Sprints Capability Test

Experimental protocol: Our field study was carried out at the Makélékélé sports center over a two-week period with handball players from the Etoile du Congo club. An initial session was held to make contact with the players, record anthropometric parameters and familiarize them with the repeated sprints, vertical jump and reaction speed tests. A general and specific warm-up followed by stretching exercises was then carried out. Our experiment began with a CMJ test, followed by a test of repeated sprints over 6 X (35m), with a 10-second recovery between sprints and CMJs at the end of training. The first CMJ test was performed in a maximum of two trials with a one-minute recovery between the second trial. After this test, subjects recovered for three minutes before performing the TSR. At the end of the TSR, the second CMJ test was performed three minutes later, and the last training session was devoted to recording reaction speed over 5m, 10m, 20m and 30m. Test avant, the physical preparation sessions consisted of a 15-minute general warm-up including running, joint mobilization, a 5-minute girdle-strengthening phase and a 20-minute plyometric phase for our Test avant experimental protocol. After this, subjects were asked to perform the following tests: Vertical jump or Counter Movement Jump (CMJ), repeated prints and speed over 5m, 10m, 20m and 30m. Test after: At the end of the training program, an evaluation of the physical parameters.

Test after: At the end of the training programme, an evaluation of physical parameters was organized for this group of subjects to compare the average values of the group. The statistical significance level was set at $p < 0.05$. M1: Anthropometric measurements; M2: Measurements of jump countermovement power, reaction speed over 10m, explosive speed over 20m, over 30m and repeated sprints; M3: Measurements of jump countermovement power, horizontal jump, reaction speed over 10m, explosive speed over 20m and repeated sprints.



Studied variables: Two variables were studied in this study: the independent variable and the dependent variable. The independent variable is linked to the practice of repeated sprinting over a distance of 35 meters (number of sessions, duration, effort intensity). The dependent variable is associated with anthropometric parameters (height, body mass), leg power and reaction speed.

Statistical analysis: Variables were recorded and processed using Stat View 5 (version 5) software. Descriptive statistics were used to generate means and standard deviations for subject samples. Mean values of variables recorded in two stages (pre- and post-intervention) were analyzed using the non-parametric Wilcoxon test to compare group mean values. The level of statistical significance was set at $p < 0.05$.

RÉSULTS

The results in Table 1 show no change in the average age and height of handball players before and after physical preparation, although there was a significant increase in weight (p=0.03) and body mass index (p=0.01). The results presented in Table 2 show a significant increase in counter-jump movement with the arm (p=0.20) and leg power in counter-jump movement (p=0.57).

The results obtained in Table 3 show that the handball players' mean values for reaction speed at different distances showed highly significant decreases in 5 m speed (p=0.004), 10 m speed (p=0.005), 20 m speed (p=0.005) and a significant increase in counter-movement jump with the arm (p=0.20) and in counter-movement jump leg power (p=0.57).

The results obtained in Table 4 show that the handball players' mean values for reaction speed over 5m (1.60 ± 0.18s vs. 1.46 ± 0.18s), 10m (2.28 ± 0.22s vs. 2.12 ± 0.26s), 20m (3.46 ± 0.23s vs. 3.28 ± 0.23s) and 30m (4.62 ± 0.42s vs. 4.42 ± 0.42s) after physical preparation. There were highly significant decreases in 5m speed (p=0.004), 10m speed (p=0.005), 20m speed (p=0.005) and 30m speed (p=0.007). The results presented in Table 5 show that the mean values for the repeated sprints test before and after physical preparation.

Table 1. Comparison of anthropometric parameters of the handball players of the Etoile du Congo

	Before (n = 10)			**After** (n = 10)			
	m ± s			m ± s			**P**
Age(years)	21,00	±	1,24	21,00	±	1,24	
Size (m)	1,76	±	0,07	1,76	±	0,08	
Weight (kg)	61,78	±	9,94	62,03	±	9,98	0,03*
BMI (kg/m²)	19,74	±	2,26	19,90	±	2,28	0,01*

Legend : n : player size ; m s : average more or less standard deviation ; Weight : body mass ; BMI : body mass index ; m : meter ; kg : kilogram ; kg/m2: kilogram per square metre; p: probable value; (*): significant difference at $p < 0.05$

Table 2. Comparison of the average values of the power of the legs of the handball players of the Etoile du Congo

	Before (n = 10)			**After** (n = 10)			
Paramètre	m ± s			m ± s			**P**
CMJ (cm)	0,52	±	0,08	3,52	±	0,93	0,20
PCMJ(w)	915,35	±	51,41	1049,24	±	133,44	0,57

Legend: n: player strength; m s: average plus or minus standard deviation; CMI: arm jump against motion; m: meter; cm: centimeter; p: probable value; PMI: leg power to CMI; (*): significant difference at $p < 0.05$

Table 3. Comparison of the average values of the handball players in the Etoile du Congo at the reaction speed 5 m, 10 m, 20 m and 30 m of the group before and after the intervention.

	Before (n = 10)			**After** (n = 10)			
Variable	m ± s			m ± s			**P**
Vt_5 (s)	1,60	±	0,18	1,46	±	0,18	0,004**
Vt_{10} (s)	2,28	±	0,22	2,12	±	0,26	0,005**
Vt_{20} (s)	3,46	±	0,23	3,28	±	0,23	0,005**
Vt_{30} (s)	4,62	±	0,42	4,42	±	0,42	0,007**

Legend n: player strength; m s: average plus or minus standard deviation; Vt5: speed over 5m; Vt10: speed over 10m; Vt20: speed over 20m; Vt30: speed over 30m; s: second; p: probable value; (*): significant difference $p < 0.05$; (**): significant difference at $p < 0.01$.

Table 4. Comparison of the average values of the handball players at the reaction speed of the Etoile du Congo 5 m, 10 m, 20 m and 30 m of the group before and after the intervention.

	Before (n = 10)			**After** (n = 10)			
Variable	m ± s			m ± s			**P**
Vt_5 (s)	1,60	±	0,18	1,46	±	0,18	0,004**
Vt_{10} (s)	2,28	±	0,22	2,12	±	0,26	0,005**
Vt_{20} (s)	3,46	±	0,23	3,28	±	0,23	0,005**
Vt_{30} (s)	4,62	±	0,42	4,42	±	0,42	0,007**

Legend: n: player strength; m s: average plus or minus standard deviation; Vt5: speed over 5m; Vt10: speed over 10m; Vt20: speed over 20m; Vt30: speed over 30m; s: second; p: probable value; (*): significant difference $p < 0.05$; (**): significant difference at $p < 0.01$.

Table 5. Comparison of the average values of the handball players of the Etoile du Congo in the test of repeated sprints

	Before (n=10)			**After (n=10)**			**P**
	m ± s			m ± s			
SR_1 (s)	5,34	±	0,29	5,27	±	0,34	0,13
SR_2 (s)	5,44	±	0,30	5,42	±	0,40	0,68
SR_3 (s)	5,26	±	0,57	5,13	±	0,72	0,31
SR_4 (s)	5,68	±	0,28	5,46	±	0,34	0,81

Legend: n: player size; m s: average plus or minus standard deviation; SR1: 1st sprint repeated; SR2: 2nd sprint repeated; SR3: 3rd sprint repeated; SR4: 4th sprint repeated; SR5: 5th sprint repeated; SR6: 6th sprint repeated; s: second; p: probable value.

We observed a significant increase in the SR, especially in SR1 ($p = 0.13$), SR2 ($p = 0.68$), SR3 ($p = 0.31$), SR4 ($p = 0.81$), SR5 ($p = 0.38$) and SR6 is ($p = 0.28$).

DISCUSSION

Our study showing the impact of plyometric training in a sandy environment is of great interest to the development of several physical qualities of handball players. Indeed, at the end of the seven-week intervention, we noted a change in anthropometric parameters in Table 1.

This is explained by the fact that, this study revealed an increase in body mass of 0.25kg and body mass index is 0.16kg/m2 is observed in these optional handball players. For this reason, the situation encountered is at odds with the literature, which explains that regular activity alone reduces weight (Arntz *et al*., 2022), as well as, Chelly *et al*.'s, (2012) literature on the effect of elastic band plyometric training on the physical performance of team handball players on anthropometric parameters currently showed a moderate change in muscle volumes, implying increased muscle power. Competitive handball, in terms of physical characteristics, is a high-intensity sport that requires players to combine aerobic and anaerobic skills to perform coordinated movements

(Chelly *et al*., 2011; Buchheit *et al*., 2010). The distance covered by players varies from 4.5 to 6.5 km depending on the playing position Zapartidis *et al*., (2009). Other authors have shown that during matches, the most frequent high-intensity actions were stops, changes of direction and one-on-one situations (Alongo *et al*., 2018). High-intensity runs, walks and sprints account for 8%, 29% and 4% of game time respectively Chelly *et al*., (2011). (Buchheit *et al*., 2010; Dawson., 2012). Regarding physiological characteristics, the demands are enormous in a handball game Chelly *et al*., (2011). Research has shown that during the game, handball players reach an intensity of between 75 and 80% of their maximum heart rate (Platen and Manchado., 2011). In a study of professional handball players, Chelly *et al*. (2011) showed that the average heart rate of eighteen elite teenage players during the match was 82 ± 3% of their maximum heart rate. VO2max is also an important physiological characteristic for handball players. Indeed, de Zapartidis *et al*. (2009) showed that in 88 young players aged 14.05 ± 0.35 years, the V̇O2max was 50.41± 4.60 mL/kg/min. These enumerated results show that during a handball match, the ATP/CP system is put under great strain. The literature also illustrates this perfectly, comparing the effect of physical activity alone with an energy expenditure of 700kcal/day. It therefore makes sense for training programs designed to prepare players for competition to take all these characteristics into account, especially the ability to sprint repeatedly, which is an important fitness requirement for handball players (Buchheit *et al*., 2010; Dawson., 2012). Samozino., (2009). The question that arises is whether the improvements in upper and lower body power in the current study translate into improvements in transfer, so we conclude that our results are inferior to those of other authors just because we noticed an increase in anthropometric parameters at the end of intervention. We may consider that our 7-week intervention duration was too short to observe a change in compared with these studies, which lasted on average at least 17 weeks of intervention.

In addition, this increase in anthropometric parameters also occurred in these athletes due to low-intensity training, lack of follow-up and, moreover, poor dietary habits between food consumption and energy expenditure excluding environmental factors. In particular, the average leg power values of Etoile du Congo team handball players during a vertical jump (counter-movement jump) are considered to be a key factor in performance in many sporting activities Samozino, (2009).With this in mind, we also found in Table 2 that, at the end of the intervention, there was a significant increase in the counter-movement jump with the either arm (p=0.20) and leg power in the east counter-movement jump (p=0.57). Granado (2007) studied elite and amateur female players. Their results show CMJ values ranging from 34.9 (cm) for the Elite. The study by Samantha, (2015) shows values from 28.2 ± 5.42 (cm) for Elite to 26.5 ± 4.5 (cm) for amateurs. Work by Ivana., (2019) carried out on female handball players during the competition period shows values of 26.91 (cm) for both legs and 12.48 cm right leg and 12.94 cm left leg, Mehmet., (2020) show average SMJ values of 24.4 cm for super league players. However, in our study we possessed by an intervention program that left 2 meso cycles to which our subjects were subjected, not by shift as does Harrieche *et al*, (2021) and we worked with male subjects. Our results corroborate those of Samantha, (2015) who found values between 2302.6 ± 552.01 (w) for non-elites and 2442.5 ± 470.54 (w) for elites and 3231.5 ± 460.0 (w) for elite tops for the CMJ test. We note that the age of female players was between (16.07 ± 1.30) compared with our results, although our hypotheses were verified. On the other hand, Alongo *et al* (2018) noted in their work on the effects of sandball-based plyometric training on the physical performance of team handball players an improvement in muscle power and throwing speed and intermittence. Consequently, such exercises should be adopted as part of a pragmatic approach to handball training. Several researchers have highlighted the potentially favorable influence of training on an unstable surface on balance and agility [Granacher, Arazi, Behm and Prieske, 2012], offering training specific to the challenges encountered during actual play on uneven and soggy pitches. However, depending on the age, maturity and training status of the athletes, the likelihood of the sandy surface correcting some overtraining can also be heralded by the increase in muscle strength observed with the decrease in a standard plyometric regime of Lacey *et al*. (2014).

In support of this idea, Impellizzeri *et al*. (2008) noted that when their plyometric training programs were conducted on sand, muscle soreness was reduced. It's in the same vein that Zhang Y *et al* pointed out that CMJ have not only been one of the most frequently applied movements in training and testing particular physical abilities, but also a model often used to study fundamental properties and phenomena related to the human locomotor system, specifically the performance of various maximal vertical jumps has often been used to better assess the maximum power of body arm strength training. However, our study agrees with the results of these authors because, although they carried out their tests on sandy ground, their results are significant and identical to our own. As a result, we note a reduction in mean values in the repeated sprint test. Overall, plyometric training would have a favourable impact on repeated sprinting. For example, according to Haj *et al*,2009 showed that the relationship between significant performance in repeated line and change-of-direction sprints showed a significant difference between the different sprints in the SRL event (F=6.583; p<0.000). In fact, acceleration, deceleration and blocking prolong the duration of the SRCD event and result in higher energy expenditure than in line running Ahmaidi *et al*, (2007). Unlike isolated sprints, repeated sprints provide information on the amount of fatigue accumulated. This is why Bishop 2023 agrees that IF, although controversial in terms of reproducibility, nevertheless represents a key parameter of performance in repeated sprints. The decline in performance in the SRL event is triggered from the third repetition onwards, since significant differences were obtained between the first sprint and the fourth, fifth and sixth repetitions. However, no significant differences were recorded between the six repetitions in the SRCD. Likewise, the literature by Spencer *et al*. (2006) considers that tests involving six to seven repetitions of sprints represent an overload stimulus for repeated sprinting activities. For field hockey players, they proposed six to seven repetitions of four-second sprints with recovery periods of over 21 seconds. Whereas, the results obtained in the study by Abrantes *et al*. (2004) found, using the test (7×34.2m) in footballers of different ages and levels, that the highest times were recorded between the fifth and seventh sprints, which is in agreement with our literature. The protocol used in our study could have included more than six repetitions to detect significant differences between repetitions. We chose six repetitions in the sprints with changes of direction test to maintain the same total distances covered and total recovery time as in the SRL test proposed by Spencer *et al*. 2006. However, our results are in line with our previously stated hypotheses, which show the decline in physical fitness levels observed in these Etoile du Congo team handball players for reasons such as; the low intensity of work during plyometric training which allows them to develop so few of the physical qualities sought. This drop in physical level was caused by an intervention program that only included two short meso-cycles of two weeks each, as well as two phases of pre- and post-training tests, which did not allow for the proper development of the players because the time was too short.Study limitations Our study sample consisted of 10 handball players out of 16 handball players called up to take part in this study during the national championship. Our sample was reduced by non-inclusion criteria. The results do not take into account all the handball players who took part in this grouping. Noting that we could have used more sophisticated or technically credible equipment than the relatively simple equipment we used. For example, the measurement of time by manual stopwatches could have been carried out using photoelectric cells.

CONCLUSION

The aim of the present study carried out on handball players at the national championship was to measure the impact of plyometric training on improving handball player performance. We asked ourselves the following questions: Why do top-level handball players have a low level of physical development? Does plyometric training in a sandy environment improve the muscular power of the lower limbs of handball players? It appears that plyometric training in this environment improves the explosiveness of the lower limbs of handball players. In fact, the results obtained show on the one hand an increase in the anthropometric parameters of lean muscle mass, which can be associated with the dietary balance between food consumption and energy expenditure. On the other hand, we note an improvement in lower limb power, reaction speed, and repeated sprinting in handball players showed little improvement after a 7-week training program. The contribution of this research work is aimed not only at the handball players of the Etoile du Congo team, but also at coaches, to provide them with more knowledge in the field of physical preparation. Cici is a guide to develop the physical qualities of handball players for performance optimization.

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