

IMPROVING BALL THROWING SPEED IN PERFORMANCE FEMALE HANDBALLISTS THROUGH AN INDIVIDUALIZED TRAINING PROGRAM

Roxana Gatzel^{1*}, Ion Loredana¹, Aurelia Brădeanu¹, Bogdan Burcea²

¹Doctoral School of Social Sciences and Humanities, University of Craiova, Craiova, Romania

²University of Craiova, Faculty of Physical Education and Sport

*gatzel.roxana.t2@student.ucv.ro

<https://doi.org/10.52846/jskm/41.2023.1.12>

Abstract: The research aimed to create and test a training program specific to the game of performance handball, and was centered on ball throwing exercises. The study involved 15 elite female handball players, aged between 18 and 32 years, who completed the intensive four-month training program in the pre-competitive period. Measurements were taken both before and after the completion of the training period, and both the team average in the handball throwing test and the ball throwing speed recorded statistically significantly higher values as a result of the participation of the female players to the specific training program. Thus, these techniques and the specific physical training methods could be included in the basic training of female athletes, so that they can achieve the best possible results when throwing the ball and, implicitly, when scoring goals and winning as many games as possible.

Keywords: handball, throwing the ball with impetus, specific training

Introduction

The process of obtaining sports performance, training athletes in the perspective of increasing their bio-motor potential directly influences the formation and development of their personality, taking on particular forms, specific to sports branches (Popescu V., 2011). As a sport, handball involves a total commitment from the athletes who, in order to support training and competitions, must have certain somatic characteristics, master a series of technical and especially tactical skills, supported by a good development of motor capacities whose defining parameters, also aims at a capacity for aerobic and anaerobic effort, applied in dynamic game situations, where, from a decision-making point of view, the mental preparation can make the difference between failure and victory. The activity involves intermittent physical actions, with multiple changes of direction, which require a high level of muscle power, and then, according to the opinion of several authors cited by Hammami, physical training will have as its main objective the development of neuromuscular qualities, the specific training targeting the characteristics of the competition (Hammami et al., 2019).

Physical training was a topic of great importance in the research of specialists, among whom we mention Urban & Kandrak (2013), Manchado et al. (2013), Michalsik et al. (2015), Milanese et al. (2011). It is known that sport has evolved, sports games are in a continuous dynamics and coaches are looking to identify the best solutions to optimize the training process. In the game of handball, the speed of throwing the ball is essential in achieving the ultimate goal of the game, which is to score a goal. Manchado (2013) conducted a study in which he analyzed the effect of a basic handball training program on throwing speed in 30 handball players, 15 of whom randomly formed an experimental group that, in addition to participating in training sessions over a period of ten weeks, four times a week, who participated in a program aimed at progressive strengthening of the lumbopelvic region and this included seven exercises performed after the general warm-up in each regular session.

Pre- and post-tests of the investigation period were conducted to analyze the throwing speed of each player from different throwing positions using a radar StalkePro Inc., Plano, with a recording frequency of 33 Hz and a sensitivity of 0.045 m·s⁻¹. Statistically

significant differences in throwing speed were observed between the experimental group, which showed a 4.5% percent improvement, and the control group, which showed no improvement. Wagner & Müller (2010), concerned with the biomechanics of movements, undertook extensive investigations starting from the need to know the factors that influence the maximum speed and accuracy of the ball in a handball throw and what kind of training should be undertaken to increase their values. Among the multiple complex throwing motions in Olympic handball, the 7 m throw was selected for analysis and intervention. In testing to determine the image coordinates, we used two NTSC 180-Hz (640 × 480) high-speed cameras (HSC- 250, Motion Analysis Co.). To measure accuracy, a third camera (JVC 120 Hz digital camera) was used to film the moment of ball-target contact. This third camera was positioned behind the participant. SIMI Motion was used for image processing and video evaluation. In the pretest and retest for ball speed, there were significant differences between the trainee and the model at all measurement points except the post-test where the trainee's performance increased by more than 10%. Unlike ball speed, no significant differences were observed for accuracy, the second characteristic of interest. The throwing speed was measured following a high-intensity interval training program, after various recovery periods. 14 performance handball players were involved in the research and the results indicated that throwing speed was not determined by intense lower body exercises, the combination of high intensity lower body training and throwing technique did not lead to increased performance in handball (Seipp et al., 2022). Another study involved 127 professional handball players, whose ball throwing speed was measured. In this regard, the Bushnell radar gun was used to measure the throw speed. Among other handball-specific anthropometric and technical data, handball players' body weight, body fat percentage, arm length, leg, back, shoulder and jump strength were used as predictors. The researchers' conclusion was that the more

coaches know about all the factors that facilitate speed and accuracy in throwing the ball, the more they can create and adapt training programs that lead athletes to better goal-scoring performance. decider who wins or loses a game (Tejaswi, 2022).

Soto, García-Herrero & Carcedo in 2020 analyzed the effect of feedback on handball performance as measured by throwing speed and accuracy. They had a sample of 39 elite handball players, who were divided into three groups, namely, one group that received positive feedback, one that received negative feedback, and one that did not receive any form of feedback during training . The results drew attention to the fact that any form of feedback, regardless of polarity, is preferable to its total absence and throwing speed, as well as the well-being of female handball players, were improved in the case of handball players who received negative feedback and not positive feedback , which could have been thought more predictable. These results may have implications if taken up in the training and conditioning programs of performance athletes (Soto, García-Herrero & Carcedo, 2020).

Materials and method

The research was carried out at the level of a female handball team from Romania, which plays in the first echelon of the national championship. 15 female players, aged between 18-32, were included in the research. The players participated in an intensive training program aimed at improving the speed of throwing the ball. Thus, in addition to the standard training, they were also involved in a specific individualized training. The work schedule was adapted according to the individual characteristics of the players, physical training being scheduled 3 times/week. Worked with elastic bands, dumbbells, weights. The program was carried out over a period of 4 months, during the pre-competitive period.

Excerpt from the work schedule:

- Dumbbell push-up +5 plyo push-ups
- 3 sets of 8x12kg each
- horizontal pull- 3 sets- 10 repetitions 30/40kg
- lifting dumbbells seated - 3 series

- dumbbells of 8/12kg- 10 Repetitions

Example exercises:

Exercise 1

-P.I. lying on the back on the gym bench, pushed from the chest with 10 kg dumbbells – 3x 12 repetitions.

Exercise 2

-P.I. in a seated position on the gym bench, overhead press with 10 kg dumbbells 3x 12 repetitions.

Exercise 3

-P.I. standing apart with the barbell on the shoulders, stepping with the right foot on the crate and raising the left knee to 90 degrees, alternately perform 3x 10 repetitions.

The research subjects were tested initially and at the end, before and after participating in the intensive training program. The tests were:

- Throwing the ball with momentum/impetus – aims to assess the strength of the upper limb. The athlete stands 3m behind a line drawn on the ground and executes a throw of the handball, making an added or crossed step. The distance traveled by the ball is measured.

- Throwing at the goal from 7m - the ball transmission speed was measured with the RadarCoach device. The ball throwing speed was evaluated, both before and after the implementation of the intensive training program. This assessment was done with the Smart Coach Radar device, which is a complete object velocity measurement system that provides today's athletes and coaches with instant feedback and a digital record of progress.



Figure 1. Example assessment with the Smart Coach Radar device

To analyze the data recorded at the initial and final testing, their statistical processing was carried out by means of the SPSS program, v.28, performing descriptive statistics, as well as the T-test for paired samples, to determine the significance of the difference in means.

Hypotheses H1. Following the participation of female handball players in the intensive training program based on specific exercises, the values recorded in throwing the ball with momentum improved.

H2. Following the participation of female handball players in the intensive training program based on specific exercises, the recorded values of the speed of throwing the ball with momentum improved.

Results

H1. Following the participation of female handball players in the intensive training program based on specific exercises, the values recorded in throwing the ball with swing improved

Figure 2. Initial and final results recorded for the throwing the ball with momentum

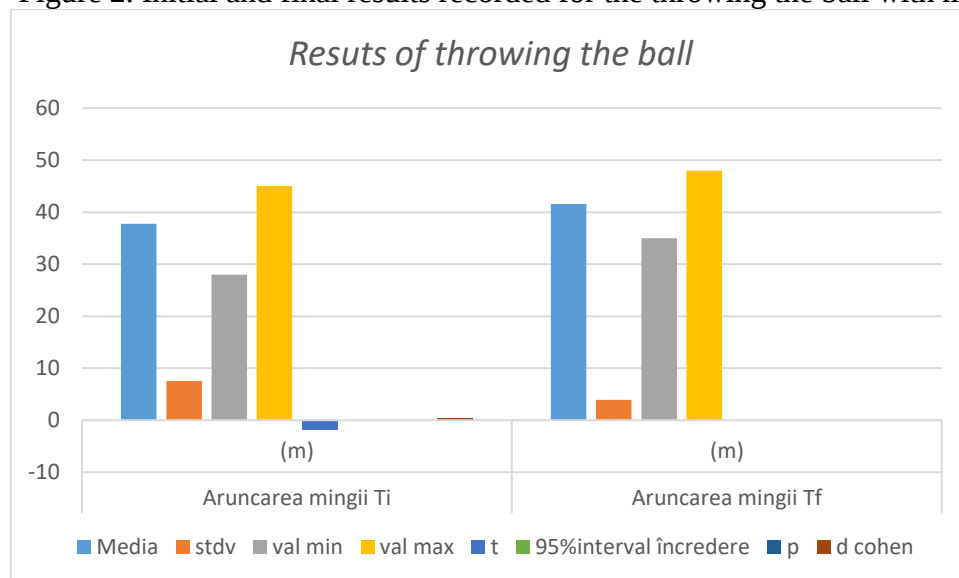
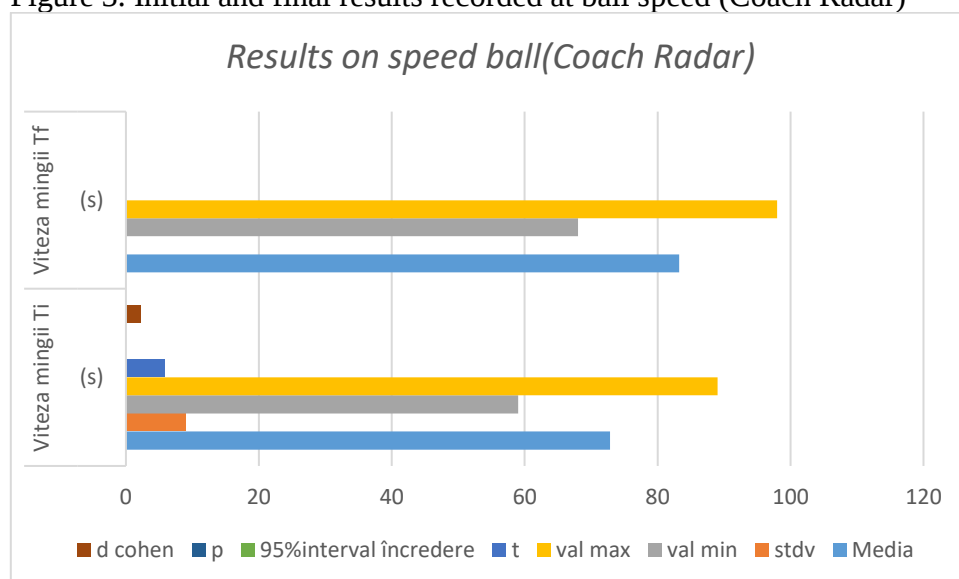


Figure 2 shows the results recorded in the handball throwing test with a dexterous arm, which recorded a team average value of 37.76 (AS-7.55m) in the initial test, and 41.58 in the final test (AS-3.93m), there being a difference of 3.82m between the two tests. The dependent samples t-test value (-1.89), which falls within the confidence interval 0.07 and 0.2, indicates a significant difference in means at a statistical threshold of $p < 0.05$. The effect size is average, Cohen's d value being 0.437. Considering the recorded results, we can state that hypothesis 1 is supported by the data obtained.

H2. Following the participation of female handball players in the intensive training program based on specific exercises, the recorded values of the ball throwing with momentum speed improved.

Figure 3. Initial and final results recorded at ball speed (Coach Radar)



In the test carried out with the RadarCoach device, a test that assessed the speed of

throwing the ball from a shot from 7m, the average value of the team at the initial test

was 72.82 (AS-8.96m/s), and at the final test of 83.24 (AS -8.07m/s). The value of the t-test for dependent samples (5.86), which falls within the confidence interval 0.09 and 0.02, indicates a significant difference in the difference of the means of the two tests, corresponding to a statistical threshold of $p < 0.01$. The effect size is large, Cohen's d value being 2.12.

Considering the recorded results, we can state that hypothesis 2 is supported by the data obtained.

Discussions

An interesting study is carried out by Raeder, C., et.al. (2015) which considers both throwing speed and accuracy and shoulder rotator strength in female handball players, as he believes that there are many studies that have demonstrated the positive transfer of weight training, but accuracy has not been taken into account, registering more errors in girls compared to boys. In his research, he included a group of 28 handball players with an experience of 6 years, 15 of which made up the experimental group who performed a training for 6 weeks with the medicine ball, 3 times a week. The remedial program consisted of throwing exercises, two-arm overhead throw, two-arm overhead back throw, two-arm diagonal overhead throw, two-arm lateral rotation throw, squat chest throw and one-arm throw single arm, using 2 different ball weights, 2 and 1 kg, followed by throws using a regular ball, training loads gradually increasing by 2 repetitions per week.

Throwing speed and fitness level were measured in 15 professional handball players at the end of a playing season. All specific assessment exercises were used and measured four times over the course of the 11-month season. These included jumping, running, endurance and throwing speed exercises. The only statistically significant differences reported were between the first measurement (T1) and the third (T3) regarding the increase in free fat mass and throwing speed. Correlations have been noted between increased training time and better performance. The conclusions of the study

were that, during the season, strength is developed in the upper extremities of the players, but not in the lower ones, so coaches should allocate specific activities during physical training and exercises to develop handball players' leg strength (Gorostiaga et al., 2006). Other researchers had a sample similar to that of our study, namely young handball players (N= 39), randomly divided into an experimental and a control group. They tested the impact of strength training on the rotator cuff muscles, the imbalance of which is considered a risk factor for injury. In this regard, they used elastic bands and measured the speed of throwing the ball. The handball players followed, in addition to the usual training, a training with elastic bands for a month and a half, and the results obtained were some very good ones, namely the fact that the use of the bands improved the muscular strength of the players, as well as the speed of the ball (Mascarin et al., 2017).

The aim of another study was to compare two training programs on ball speed and maximal lower and upper body strength in elite handball players (N= 34). Both workouts involved ball throwing exercises, but one used the regular ball and the other the medicine ball to increase endurance. The results were significantly better for the group that used the three-kilogram medicine ball, with strength measured by the maximum distance it was thrown overhead. Thus, if a resistance training program were included in the regular program of elite handball players, they could improve their throwing speed, maximal upper body strength, and anthropometrics (Hermassi et al., 2015). Another 14 elite handball players were involved in a study that assessed both ball throwing speed and dynamic power during a bench press exercise. A radar gun was used to measure the throwing power of the ball. The results indicated that the throwing speed of the handball players is a function of the maximum dynamic power, so the goal of training should be to increase both the strength and the power of the upper body of the handball players (Marques et al., 2007). Another research aimed to evaluate the effects of strength and power training on the throwing speed of elite handball players

according to playing positions (N=22). The sample was divided into a control and an experimental group. Maximum strength training was used in the experimental group over a period of three months and was used in addition to regular training. Ball throwing speed was higher in players from back positions compared to front players, and muscle strength was improved with the help of strength training for all handball players in the experimental group (Cherif et al., 2016).

Another research carried out a characterization of the physical and physiological profile of female handball players in Portugal. 24 female professional players were involved, with an average age of 24 years, an average height of 173 cm and an average body mass of 73 kg. The results indicated that the results of physical training are related to the players' height, oxygen consumption, time limit and arm span. Thus, the development of these fitness indicators should be taken into account to optimize training for handball players (Rios et al., 2023). Even if the specialized literature indicates the existence of programs that improve throwing speed, there are still few studies that analyze these aspects during some competitions (Vila&Ferragut, 2019). A limitation of our research is the lack of a test to assess accuracy. Thus, we wish that in the future we can apply such a test and identify possible correlations between the two evaluated parameters.

Acknowledgement

This work was supported by the grant POCU/993/6/13/153178, "Performanță în cercetare" - "Research performance" co-financed by the European Social Fund within the Sectorial Operational Program Human Capital 2014-2020.

References

Vila, H.&Ferragut, C. (2019). Throwing speed in team handball: a systematic review. *International Journal of Performance Analysis in Sport*, 19(5):724-736

Gorostiaga, E. M., Granados, C. R. I. S. T. I. N. A., Ibañez, J. A. V. I. E. R., González-Badillo, J. J., & Izquierdo, M. (2006). Effects of an entire season on physical fitness changes in elite male handball players. *Medicine & Science in Sports & Exercise*, 38(2), 357-366.

Mascarin, N. C., de Lira, C. A. B., Vancini, R. L., de Castro Pochini, A., da Silva, A. C., & dos Santos Andrade, M. (2017). Strength training using elastic bands: Improvement of muscle power and throwing performance in young female handball players. *Journal of sport rehabilitation*, 26(3), 245-252.

Hermassi, S., Van den Tillaar, R., Khelifa, R., Chelly, M. S., & Chamari, K. (2015). Comparison of in-season-specific resistance vs. a regular throwing training program on throwing velocity, anthropometry, and power performance in elite handball players. *The Journal of Strength & Conditioning Research*, 29(8), 2105-2114.

Marques, M. C., Van Den Tillaar, R., Vescovi, J. D., & González-Badillo, J. J. (2007). Relationship between throwing velocity, muscle power, and bar velocity during bench press in elite handball players. *International journal of sports physiology and performance*, 2(4), 414-422.

Cherif, M., Chtourou, H., Souissi, N., Aouidet, A., & Chamari, K. (2016). Maximal power training induced different improvement in throwing velocity and muscle strength according to playing positions in elite male handball players. *Biology of Sport*, 33(4), 393-398.

Rios, M., Fernandes, R. J., Cardoso, R., Monteiro, A. S., Cardoso, F., Fernandes, A., ... & Silva, J. A. (2023). Physical Fitness Profile of High-Level Female Portuguese Handball Players. *International Journal of Environmental Research and Public Health*, 20(9), 5751.

Wagner, H. & Müller, E. (2010). Kinematic Description of Elite Vs. Low Level Players in Team-Handball Jump Throw. *Journal of sports science & medicine*, 9(1), 15-23.

Hammami, A., Harrabi, B., Mohr, M., & Krstrup, P. (2022). Physical activity and coronavirus disease 2019 (COVID-19): specific recommendations for home-based

physical training. *Managing Sport and Leisure*, 27(1-2), 26-31.

Urban, F., & Kandráč, R. (2013, November). The relationship between morphological profile and player performance in elite female handball players. In *2nd EHF Scientific Conference: Woman and Handball: Scientific and Practical Approaches* (pp. 22-23).

Manchado, C., Tortosa-Martínez, J., Vila, H., Ferragut, C., & Platen, P. (2013). Performance factors in women's team handball: Physical and physiological aspects—A review. *The Journal of Strength & Conditioning Research*, 27(6), 1708-1719.

Michalsik, L. B., Aagaard, P., & Madsen, K. (2015). Technical activity profile and influence of body anthropometry on playing performance in female elite team handball. *The Journal of Strength & Conditioning Research*, 29(4), 1126-1138.

Milanese, C., Piscitelli, F., Lampis, C., & Zancanaro, C. (2011). Anthropometry and body composition of female handball players according to competitive level or the playing position. *Journal of sports sciences*, 29(12), 1301-1309.

Chelly, M. S., Hermassi, S., & Shephard, R. J. (2010). Relationships between power and strength of the upper and lower limb muscles and throwing velocity in male handball players. *The Journal of Strength & Conditioning Research*, 24(6), 1480-1487.

Tejaswi, J. (2022). Developing model of throwing velocity based on anthropometric physiological and performance characteristics of handball players. *Lakshmibai National Institute of Physical Education*, XIX, 114.

Soto, D., García-Herrero, J. A., & Carcedo, R. J. (2020). Well-Being and throwing speed of women handball players affected by feedback. *International Journal of Environmental Research and Public Health*, 17(17), 6064.

Seipp, D., Feuerbacher, J. F., Jacobs, M. W., Dragutinovic, B., & Schumann, M. (2022). Acute Effects of High-Intensity Interval Running on Lower-Body and Upper-Body Explosive Strength and Throwing Velocity in Handball Players. *The Journal of Strength & Conditioning Research*, 36(11), 3167-3172.