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Impact of Multiple Training Programs on Physical Fitness, Body Composition, and Performance of Female Handball Players of Bahawalpur City

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Abstract

This study investigates how various training programs affect female handball players' body composition, fitness, and performance. Thirty female handball players (age = 20.14±1.23 years) were equally divided into three groups, such as a specific group, a medicine ball group, and a strength group. The selected variables were endurance, agility, speed, flexibility, vertical jump, skinfolds, girths, breadths, height, and weight. To compare the groups' performance, anthropometric, and physical fitness, ANOVA for statistical analysis. Results showed that the medicine ball training group was significantly higher in elbow angle ($P < 0.01$), ball speed ($P < 0.02$), agile ($P < 0.00$), hand grip strength ($P < 0.01$), endurance ($P < 0.04$), sit-ups ($P < 0.04$), standing board jump ($P < 0.05$), 7-meter throw, and reduction in fat percentage than the other training groups. It was concluded that six weeks of medicine ball training enhanced the performance of female handball players.

Keywords: Body Composition, Physical Fitness, Handball Kinematics Analysis, Female Handball Players

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Impact of Multiple Training Programs on Physical Fitness, Body Composition, and Performance of Female Handball Players of Bahawalpur City

Abstract

This study investigates how various training programs affect female handball players' body composition, fitness, and performance. Thirty female handball players (age = 20.14±1.23 years) were equally divided into three groups, such as a specific group, a medicine ball group, and a strength group. The selected variables were endurance, agility, speed, flexibility, vertical jump, skinfolds, girths, breadths, height, and weight. To compare the groups' performance, anthropometric, and physical fitness, ANOVA for statistical analysis. Results showed that the medicine ball training group was significantly higher in elbow angle (P < 0.01), ball speed (P < 0.02), agile (P < 0.00), hand grip strength (P < 0.01), endurance (P < 0.04), sit-ups (P < 0.04), standing board jump (P < 0.05), 7-meter throw, and reduction in fat percentage than the other training groups. It was concluded that six weeks of medicine ball training enhanced the performance of female handball players.

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Contents

Introduction

Handball is an active and dynamic sport that emphasizes running, jumping, sprinting, throwing, hitting, blocking, and pushing (Gorostiaga et al., 2006). It refers to a sport that is played by two teams, each consisting of six players on the court with a goalkeeper, and involves physical contact and advanced motor abilities, including speed, explosive force, endurance, and strength (Saeterbakken et al., 2011). The power applied by the object in the hand during throwing activities is mostly generated by the shoulder and arm muscles. Certain anthropometric features, such as measurements of length and width, are mostly influenced by genetics and are resistant to modification with a training program. The study by Mikulić and Prebežac (2008) discovered a strong correlation between many anthropometric parameters and exceptional performance.

Anthropometric measures and body composition assist coaches and players in choosing teams and researching how training affects handball players' bodies and muscular growth. In past studies physical fitness of handball players such as sprint speed or vertical jump height, without considering the comprehensive nature of the sport (Ramirez-Campillo et al., 2020; Hermassi et al., 2019). Previously, several studies have compared handball players' anthropometric measures and body composition to the players of other sports (Ciplak et al.,2019; Wagner et al., 2019). Few studies have compared the anthropometric measures and body composition of female handball players in training (Masanovic et al., 2021; Akdogan & Tasçioglu, 2022).

Previous studies had indicated that strength training could significantly enhance the throwing velocity, power, and endurance of female athletes, yet there was limited exploration of how such gains translated into game-specific skills (Hoff & Almasbakk, 1995). Finally, specific training programs tailored to the unique demands of handball, such as agility drills and sport-specific strength routines, had been under-explored in the context of female players, leaving a gap in understanding how these practices could enhance competitive performance and reduce injury risks.

The biomechanical characteristics of female handball players in a particular ability, such as the 7-meter throw, dribbling, and shooting are not well studied by scientists (Granados et al., 2020; Rios et al., 2023). To our knowledge, a lack of study has looked at the comparison of the kinematics of various handball skills. Few studies find that the elbow, shoulder, and knee angular displacement during free throw action (Serrien & Baeyens, 2017; Pascoal et al., 2023). The primary issue identified in the research on strength training, medicine ball training, and specific training for female handball players.

Research Methodology:

Participants

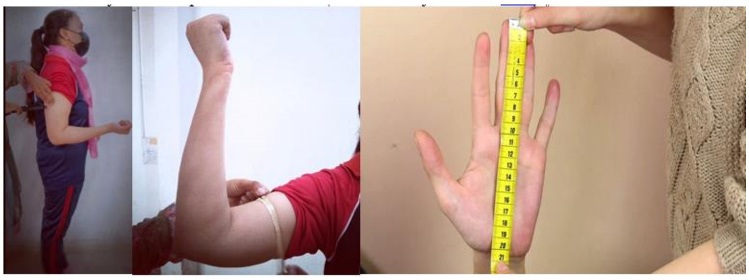
The selected population for this study was (n = 30) female handball players aged 19.25+1.14 years, equally divided into three training groups. The groups based on specific sometimes referred to as weight training or resistance training (Hermassi et al., 2019), medicine ball training with a medicine ball is a weighted ball with a diameter and the breadth of a shoulder (Raeder et al., 2015). The information was gathered with the agreement of the ethics committee of The Islamia University of Bahawalpur During data collection, was ensured that participants' privacy was respected by keeping their information confidential. We obtained consent letters from all participants after clearly explaining the study's goals, procedures, risks, and benefits, ensuring their voluntary participation.

Anthropometric Measurement of the Female Handball Players

Skinfolds were measured using a 0.1 mm-calibrated skinfold caliper (British Indicators, UK). It was suggested that a skinfold caliper be utilized (Madou, 2020). The subject's arm is relaxed and the skinfold is located in the middle of the arm, the triceps skinfold is measured using a Lange caliper. Applying the caliper one centimeter away from the left thumb and index finger causes the right arm's posterior surface to rise vertically at the indicated mid-acromial-radiale line (Hume & Marfell-Jones, 2008). The measurement of the biceps is the biggest circumference of the upper arm, located between the elbow and shoulder. The subject is facing the observer and the left arm is hanging relaxed, but the palm is facing forward (Katanic et al., 2023). The thickness of the internal fat layer and calipers are used to measure the subscapular skinfold thickness (SST) at standardized skin pinch sites (Saroar et al., 2024). A tape measure should be used to measure the mark on the medial surface of the calf at the level of the biggest circumference. The individual should then position their foot on a chair or box such that their knee is almost 90 degrees. Parallel to the leg's long axis, is a vertical squeeze (Hume & Marfell-Jones, 2008).

Figure 1

Measurement of the anthropometric variables (Hume & Marfell-Jones, 2008)



The cross-hand technique was employed for all girth measurements, wherein the right hand held the tape case while the left hand pulled the edge of the tape to measure the circumferences of the body segments (Canli et al., 2021). The elbow of the lifted arm is sited at roughly a 45-degree angle, horizontal in the sagittal (forward) plane. The right side of the body is used to measure girth with flexible measure tape (Papanikolaoy et al., 2021). The individual was directed to lift his right hand while gripping his palm and the measurement was obtained from the forearm's maximum, which was determined to be 6 cm laterally from the radial (Alneama et al., 2023).

The total arm length has recorded the measurement to the nearest 0.1 cm (Milanese et al., 2015). The measurement is made from the acromial landmark to the posterior surface of the olecranon process of the ulna with the arm flexed at a 90° angle, with the forearm and hand's ulnar surfaces horizontal and the palms facing medially with the fingers extended (Roberts et al., 1959). and length measurement; Find the area where the wrist meets the hand by locating the base of the palm with the hand extended and the palm facing upward. Measure the distance from the base of the palm to the tip of the extended middle finger, making sure the measuring tape or ruler is held in a straight line (Poorhassan et al., 2017). Choose whether you prefer to use centimeters or inches for measurement units (Singh & Ram 2013).

Look at the caliper's dial to get an exact measurement (Manchado et al., 2020). The person reclined, keeping their left arm by their side. This measurement is the humerus breadth (Orphanidou et al., 1994). To measure hand breadth accurately, start by ensuring the person's hand is relaxed and fingers are spread naturally. It's essential to maintain consistency in technique and landmarks for reliable comparison or further analysis (Orphanidou et al., 1994). The individual leans back and relaxes, laying their palms against their thighs. To form a right angle with the thigh, the right knee is flexed. The epicondyles, felt as prominent bones, serve as landmarks. Apply consistent, firm pressure with your fingers to the caliper faces over the epicondyles to obtain a reading (Vila et al., 2012).

Figure 2

Measurement of anthropometric measures (Vila et al., 2012)

They were directed to stand with their heels together, backs against the vertical bar of the stadiometer, heads held high and arms extended downwards (Vila et al., 2012). A minimum reading model of 0.1kg was chosen for this situation (Piscitelli et al., 2015). Using an adjustable digital dynamometer from (Takei Scientific Instruments Tokyo, Japan) handgrip strength was measured. They were encouraged to give their best effort. Finally, the examiner recorded the results (Haksever et al., 2022).

Measurement of the Physical Fitness of Female Handball Players

All data were composed before and after the test. The test measures the player's ability to quickly change directions and maintain balance. The t-test is a mobility test for athletes that incorporate forward, sideways, and backward movements. The competitors took into position in front of the starting line, ready to go. This experiment outperformed the two preceding trials. The closest measurement for the test was 0.01 seconds. This test was repeated three times with a three-minute interval between each measurement and the statistical analysis was based on the quickest value. This experiment outperformed the two preceding trials. The closest measurement for the test was 0.01 seconds (Hermassi et al., 2019). Agility is not just about speed but also about maintaining balance and coordination while changing direction or speed (Zemková & Hamar 2013).

Figure 3

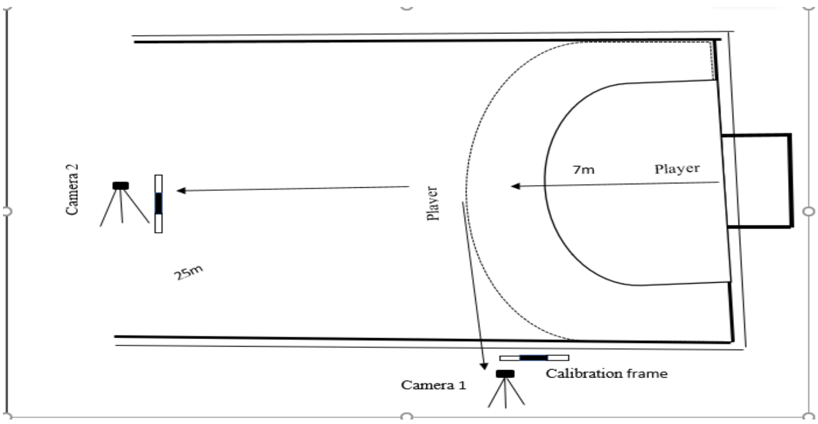
Measurements of the Fitness variables (Hermassi et al., 2019).

The test subjects extended their legs and sat on the ground, soles of their feet were flat on the wooden box. The participant extended their hand and tracked the place for at least two seconds. It was measured and recorded using a sit-and-reach box distance scale (Sporis et al., 2010). The participants underwent a standing-start, 20-meter sprint test to assess their acceleration speed with to 0.01 seconds was then recorded (Kale et al., 2009). Various protocols for vertical jumping were employed to assess the precise vertical jumping ability in handball, including the vertical block jump, the vertical countermovement jump, and the two-stage approach vertical jump (Orphanidou et al., 1994). To perform set-ups, lie on your back with knees bent and feet flat on the floor. Cross your arms over your chest or place them behind your head, then engage your core muscles and lift your upper body towards your knees, with your lower back down with control (Negra et al., 2024). It can also incorporate lateral movement or alternate hands for variety and increased difficulty (Hermassi et al., 2019). Select a beginning and ending location separated by no less than 600 meters. Note the duration it takes for you to cover 600 meters, speed was measured in meters per minute (Lemos et al., 2020).

Data Collection for Kinematics Analysis of Handball Throw

Data were collected with consent from both the coach and the players. Each player was selected for sufficient warm-up time before the start of free throw trials. Each student chose a goal by himself, which became the topic of 3 to 5 practice efforts before data collection, which involved executing a standing throw toward the goal from the 7-meter penalty spot. Handball Throw action was divided into four phases such as stance position, backswing, ball release, and follow through as adopted by (Akhtar et al., 2020, subsequently validated by reviewing slow-motion videos (Bedo et al., 2021). The motion analysis software Kinovea (version 8.27) was subsequently employed to examine the data. Video editing software was utilized to import footage from the first and second cameras into the computer. Each frame of the handball throw was manually digitized using a stick figure representation. The ball's movement was also digitized in the frames to identify the point of hand contact. The digitized data was converted from 2D coordinates (Manchado et al., 2020).

Figure 4



The intra-investigator approach was used to ensure the reproducibility of instruments and participants 'anthropometric measurements. Previous investigations have employed comparable instruments (Haksever et al., 2021). The intra-investigator approach was used to examine the investigator's competency recommended (Madou, 2020). The coefficient of correlation for assessing intra-investigator reliability.

Statistical Analysis

All data, including anthropometric and kinematic measures, were statistically described through the calculation of mean and standard. To compare the anthropometric data between the medicine ball training group, strength training group, and specific training group, a repeated one-way ANOVA was employed. Further, to explore group differences, Tukey's post hoc test was applied, to identify significant differences between paired group means. Data normality was assessed by using QQ plots and histograms, and homogeneity of variance, which ensures that variances across groups are equal, was validated using appropriate statistical tests. Findings where $p > 0.05$ were not considered statistically significant, in line with standard practices in hypothesis testing (Romaratezabala et al., 2020).

Results

Table 1

Comparison among training groups in girth measure of female handball players

	Medicine ball training		Strength training		Specific Training			
Variables	Pre data	Post data	Pre data	Post data	Pre data	Post data	F	Sig
	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)		
Arm girth Relax (cm)	22.86(3.78)	22.39(3.75)	23.8(4.85)	23.6(4.92)	23.02(2.21)	22.83(2.22)	16.6	0
Arm girth Flexed (cm)	24.33(4.15)	24(4.13)	25.54(4.87)	25(4.92)	24.51(2.21)	24.36(2.2)	3.26	0.1
Forearm girth (cm)	19.93(2.8)	19.65(2.8)	19.97(3.44)	19.79(3.45)	19.78(1.07)	19.61(1.07)	8.84	0

Table 01 shows that the strength training group was superior to the medicine ball and specific training groups in the comparison of pre-and post-data in the measurement of arm girth relaxed $F = 16.6$, $P < 0.00$, arm girth flexed $F = 3.26$, $P < 0.05$. forearm girth $F = 8.84$, $P < 0.00$, as reported in Tukey's post hoc results

Table 2

Comparison among training groups in breadth measure of female handball players

	Medicine ball		Strength Group		Specific group			
Variables	Pre Data	Post Data	Pre Data	Post data	Pre data	Post data	F	sign
	Mean (STD)	Mean(STD)	Mean (STD)	Mean (STD)	Mean(STD)	Mean (STD)		
Hand Length (cm)	17.64(0.89)	17.44(0.92)	15.91(2.07)	15.83(2.12)	16.41(1.44)	16.48(1.41)	4.5	0
Humerus Breadth (mm)	5.50(0.42)	5.25(0.39)	5.61(0.28)	5.31(0.29)	5.63(0.68)	5.14(0.50)	3.66	0.03
Handbreadth (mm)	7.04(0.31)	6.89(0.36)	6.98(0.37)	6.68(0.40)	6.95(0.53)	6.78(0.54)	4.64	0.01
Femur Breadth (mm)	7.40(0.67)	7.33(0.67)	7.26(0.86)	7.08(0.92)	7.93(0.47)	7.75(0.42)	3.71	0.03

Table 2 shows that the medicine ball training group was significantly higher in the hand length than strength training and specific training groups in comparison to pre-and post-data $F = 4.45$, $P < 0.02$, as reported by Tukey's post hoc results. Table also shows that specific training is significantly higher in comparison to pre-and post-data analysis than medicine ball training and strength training group in the measurement of humerus breadth $F = 3.66$, $P < 0.03$, in handbreadth $F = 4.64$, $P < 0.01$, femur breadth $F = 3.71$, $P < 0.03$, as reported Tukey's post hoc results showed.

Table 3

Comparison among training groups in physical fitness measure of female handball players

	medicine ball		strength	group	specific group			
Variables	Pre Data	Pre Data	Pre Data	Pre Data	Pre Data	Pre Data	F	sign
	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)		

	medicine ball		strength	group	specific group			
Variables	Pre Data	Pre Data	Pre Data	Pre Data	Pre Data	Pre Data	F	sign
Agility (min)	16.12(3.77)	15.84(3.86)	18.34(0.94)	17.30(0.88)	17.98(2.18)	17.69(2.64)	7.8	0
speed (Sec)	5.99(1.16)	5.79(1.19)	6.77(0.74)	6.31(0.65)	6.53(0.39)	5.93(0.69)	4	0
Endurance (min)	6.18(0.29)	5.22(0.31)	5.70(5.37)	5.32(0.48)	5.90(0.45)	5.71(0.43)	3.4	0
flexibility (Cm)	26.11(7.56)	28.82(7.94)	27.39(4.30)	28.28(4.09)	27.41(3.68)	27.89(3.53)	3.5	0
sit-ups (No)	24.4(9.75)	29.50(8.35)	24.70(4.78)	26.60(8.11)	21.00(3.83)	24.80(11.22)	3.6	0
standing jump (cm)	130.9(14.26)	139.5(13.22)	128.5(18.24)	134.5(11.92)	128.2(17.4)	133.7(12.12)	3.3	0.1
vertical jump (cm)	23.33(3.01)	29.67(2.37)	25.86(10.43)	28.6(8.94)	23.14(5.18)	27.51(7.30)	9.8	0
hand grip strength	20.6(5.17)	23.30(5.18)	19.31(4.17)	22.80(3.70)	19.01(3.79)	21.56(3.74)	4.9	0

Table 3 shows that the medicine ball training group was higher than the strength training, and specific training groups in the comparison of pre and post-measures in agility F = 7.76, P < 0.00, in speed F = 3.97, P < 0.03. Endurance F = 3.42, P < 0.04, flexibility F = 3.53, P < 0.04, sit-ups F = 3.57, P < 0.04, standing jump F = 3.25, P < 0.05, vertical jump F = 9.83, P < 0.00, and grip strength F = 4.90, P < 0.01, as Tukey's post hoc results show that pre-data and post data analysis of the medicine ball group

Table 4

Angular kinematics of analysis handball of female handball players after six weeks of multiple training

	medicine ball		strength group		specific Group			
Variables	Pre data	Post data	Pre data	Post data	pre data	post data	F	sign
	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)	Mean (STD)		
Elbow angle stance	76.93(4.85)	80.42(3.59)	64.04(6.30)	65.81(6.37)	59.46(3.75)	61.13(3.95)	5.14	0.01
Elbow angle backswing	83.18(13.41)	86.69(11.82)	88.42(4.34)	90.23(4.30)	88.54(2.75)	90.29(2.43)	5.88	0
Elbow angle following throw	63.73(10.17)	67.72(9.67)	65.57(7.72)	67.37(7.32)	70.32(9.04)	72.30(9.55)	3.86	0.03
ball speed	18.25(4.25)	18.50(4.42)	14.95(3.79)	15.06(3.74)	16.12(3.22)	16.80(3.42)	4.14	0

Table 4 shows the medicine ball training group significantly higher in pre and post-data analysis than the strength training group and specific training groups in the measurements of elbow angle stance F = 5.14, P < 0.01, in elbow angle backswing F = 5.88, P < 0.00, in the elbow angle following throw F = 3.86, P < 0.03, in the measurement of ball speed performance analysis of female handball players F = 4.14, P < 0.02, as reported in the analysis of Tukey's post hoc.

Discussion

The main purpose of this research was to study the physical abilities of female handball players. Results show that arm girth relaxed and flexed have significantly higher of the medicine ball, strength, and specific training groups. The result supports present research, which emphasizes that strength training, particularly involving resistance exercises, is highly current in increasing muscle hypertrophy, which directly inspirations girth measurements. The result matches the earlier (Schoenfeld et al.,2020) study and the current study's significant result shows that the strength training group is higher than the medicine ball group and specific training after 6 weeks of training. Forearm girth also showed significant differences among the groups (F = 8.84, p < 0.00), with the strength training group again showing the highest values. The result matches the earlier (Morton et al 2016) study and the current study's significant result shows that the strength training group is higher than the medicine ball group and specific training after 6 weeks of training. Strength training has a significant impact on muscle development in areas directly involved during training.

The medicine ball training group is higher than the strength and specific training group. The hand length measurement was the only variable where a statistically significant difference was observed. The result matches the earlier (Karampatsos et al.,2019) study and the current study's no significant result shows that the medicine ball training group is higher than the strength training group and specific training after 6 weeks of training. The statistical significance values of humerus breadth, The specific training exercises, which might involve movements that involve the upper body more dynamically, could lead to slight but significant increases in bone breadth or related muscular structure. The result matches the earlier (Rantalainen et al.,2019) study and the current study's significant result shows that the specific training is higher than the medicine ball training and specific training group after 6 weeks of training. The medicine ball training group is higher than the specific training and strength training group. Handbreadths also exhibited significant differences. Medicine ball training often involves exercises that require gripping and handling the ball, which may lead to slight increases in hand breadth over time due to adaptations in muscle and connective tissue in response to the repetitive stress of these movements. The result matches the earlier (Schoenfeld et al.,2020) study and the current study's significant result shows that the medicine ball training group is higher than the strength training group and specific training group after 6 weeks of training. The statistical significance value of femur breadth, as a result, matches the earlier (Nikander et al.,2018) study, and the current study's significant result shows that the medicine ball training group is higher than the strength training group and specific training group after 6 weeks of training.

The statistical significance value of agility is ($F = 7.76$, $p < 0.00$). Agility is a crucial aspect of handball, requiring players to make quick directional changes during play. The result matches the earlier (Milanović et al.,2021). The statistical significance value of speed is ($F = 3.97$, $p < 0.03$). The result matches the earlier (Jiménez-Reyes et al. 2019) study and the current study's significant result shows that the strength training group is higher than the medicine ball training group and specific training group after 6 weeks of training. The statistical significance value of endurance is ($F = 3.42$, $p < 0.04$). Endurance is critical for maintaining high-performance levels throughout the game. The medicine ball training might have included circuit-style workouts that simultaneously build endurance and strength, leading to these improvements. The result matches the earlier (MacInnis et al.,2017). The statistical significance value flexibility is ($F = 3.53$, $p < 0.04$). The specific training likely incorporated more dynamic stretching or flexibility-focused exercises, leading to these improvements. The result matches the earlier (Thomas et al.,2020). The statistical significance value of sit-ups ($F = 3.57$, $p < 0.04$). The strength training group likely benefited from exercises that target the core muscles more directly, such as weighted sit-ups or planks, which are effective for building core stability and endurance. The result matches the earlier Schoenfeld et al. (2020). The statistical significance value of standing and vertical jump is (standing jump $F = 3.25$, $p < 0.05$; vertical jump $F = 9.83$, $p < 0.00$). The result matches the earlier one (Markovic & Mikulic, 2010). The medicine ball training group is higher than the specific training and strength training group. The statistical significance value of hand grip strength ($F = 4.90$, $p < 0.01$). Hand grip strength is vital for ball handling and control in handball. The result matches the earlier (Karampatsos et al., 2019) study and the current study's significant result shows that the medicine ball training group is higher than the strength training group and specific training group after 6 weeks of training.

The medicine ball training group is higher than the specific training and strength training group. The statistical significance value of elbow angle stance ($F = 5.14$, $p < 0.01$). This improvement is crucial, as the elbow angle during the stance phase directly impacts the accuracy and power of the throw. The result matches the earlier (Wagner et al.,2019). The statistical significance value of elbow angle backswing ($F = 5.88$, $p < 0.00$). The backswing phase is critical for storing potential energy, which is then converted into kinetic energy during the throw. The specific training likely included exercises that focused on optimizing the backswing movement, thereby enhancing the elbow angle. The result matches the earlier Van den (Van den Tillaar & Ettema.,2011). The statistical significance value of elbow angle following throw ($F = 3.86$, $p < 0.03$). The specific training likely emphasized proper follow-through mechanics, leading to the observed improvements. The result matches the earlier (Van den Tillaar 2011). The medicine ball group is higher than the specific training and strength training. The statistical significance value of ($F = 4.14$, $p < 0.02$). The medicine ball training group exhibited the highest ball speed post-training, moving from a mean of 18.25 to 18.50. Specific training might have included exercises that focused on refining the technique, which, when combined with improved strength and power, can contribute to increased ball speed. The result matches the earlier (Gorostiaga et al.,2018).

Conclusion

It was concluded that female handball players' physical fitness, body composition, and performance were all positively impacted by multi-training regimens. Numerous fitness metrics, including strength, endurance, agility, speed, and flexibility, might have improved significantly as a result of the training regimen. The athletes may have shown improved handball performance, with better execution of skills, quicker recovery times, and greater overall effectiveness during games. The conclusion may emphasize the comprehensive benefits of multi-training, suggesting that such programs are crucial for the development of female handball players, particularly in enhancing their competitive edge in the sport.

The recommendations from a study on the effects of multi-training programs on physical fitness, body composition, and performance of female handball players in Bahawalpur city may include the following: It is recommended to integrate a variety of training methods, such as strength training, endurance workouts, agility drills, and sport-specific exercises, to address all aspects of physical fitness and enhance overall performance.

The present study's limitations include changeable concepts for handball's future planes. The first idea is the relative study of the anthropometric characteristics of control and experimental group handball players by considering their dribbling/shooting. By offering athletes supervision and instruction, coaches and trainers are essential in ensuring the safe and efficient execution of various workout sessions. To reduce the chance of injury, they make sure that players practice proper methods and techniques.

References

Akdogan, E., & Tasçioglu, R. (2022). Comparison of body composition of volleyball, handball, and football female players. *Kinesiologia Slovenica*, *28*(3), 43-53. http://dx.doi.org/10.52165/kinsi.28.3.43-53
Google Scholar Worldcat Fulltext

Akhtar, S., & Bej, D. K. (2022). Relationship between kinematic parameters of standing throw and ball velocity of female handball players. *International Journal of Physical Education, Sports and Health, 9(1)*, 88-93.
Google Scholar Worldcat Fulltext

Alneama, A., Hermassi, S., Hayes, L. D., Bartels, T., Konukman, F., Fieseler, G., & Chelly, M. S. (2023). Differences in the Anthropometric Measurements and Performance Tests of Qatari First Division Handball Players Depending on Position. *Applied Sciences*, *13*(23), 12644-12648. https://doi.org/10.3390/app132312644
Google Scholar Worldcat Fulltext

Bedo, B. L. S., Cesar, G. M., Moraes, R., Mariano, F. P., Vieira, L. H. P., Andrade, V. L., & Santiago, P. R. P. (2021). Influence of Side Uncertainty on Knee Kinematics of Female Handball Athletes During Sidestep Cutting Maneuvers. *Journal of Applied Biomechanics*, *37*(3), 188–195. https://doi.org/10.1123/jab.2020-0141
Google Scholar Worldcat Fulltext

Ciplak, M. E., Eler, S., Joksimović, M., & Eler, N. (2019). The relationship between body composition and physical fitness performance in handball players. *International Journal of Applied Exercise Physiology, 8(1)*, 347-353.
Google Scholar Worldcat Fulltext

Gorostiaga, E. M., Granados, C., Ibañez, J., González-Badillo, J. J., & Izquierdo, M. (2006). Effects of an entire season on physical fitness changes in elite male handball players. *Medicine and science in sports and exercise*, *38*(2), 357–366. https://doi.org/10.1249/01.mss.0000184586.74398.03
Google Scholar Worldcat Fulltext

Haksever, B., Micoogullari, M., Soylu, C., & Baltaci, Y. G. (2022). Does gluteus medius muscle strength affect balance and jumping performance in elite female handball players? *Science & Sports*, *37*(2), 151-159. http://dx.doi.org/10.1016/j.scispo.2021.06.002
Google Scholar Worldcat Fulltext

Haksever, B., Soylu, C., Micoogullari, M., & Baltaci, G. (2021). The physical characteristics and performance profiles of female handball players: influence of playing position. *European Journal of Human Movement, 46*(2), 37-49. http://dx.doi.org/10.21134/eurjhm.2021.46.7
Google Scholar Worldcat Fulltext

Hermassi, S., Haddad, M., Bouhafs, E. G., Laudner, K. G., & Schwesig, R. (2019). Comparison of a Combined Strength and Handball-Specific Training vs. Isolated Strength Training in Handball Players Studying Physical Education. Wirksamkeitsvergleich eines kombinierten Kraft- und Handballtrainings gegenüber einem isolierten Krafttraining ohne Handballspezifik bei Handballern während des Sportstudiums. *Sportverletzung Sportschaden : Organ der Gesellschaft fur Orthopadisch-Traumatologische Sportmedizin*, *33*(3), 149–159. https://doi.org/10.1055/a-0919-7267
Google Scholar Worldcat Fulltext

Hoff, J., & Almåsbakk, B. (1995). The effects of maximum strength training on throwing velocity and muscle strength in female team-handball players. *The Journal of Strength & Conditioning Research*, *9*(4), 255-258.
Google Scholar Worldcat Fulltext

Hume, P., & Marfell-Jones, M. (2008). The importance of accurate site location for skinfold measurement. *Journal of Sports Sciences*, *26*(12), 1333–1340. https://doi.org/10.1080/02640410802165707
Google Scholar Worldcat Fulltext

Jiménez-Reyes, P., Pareja-Blanco, F., & Cuadrado-Peñafiel, V. (2019). Effect of resisted sprint training on acceleration and maximum speed performance: A systematic review and meta-analysis. *Sports Medicine, 49*(9), 1419-1443.
Google Scholar Worldcat Fulltext

Kale, M., Aşçi, A., Bayrak, C., & Açikada, C. (2009). Relationships among jumping performances and sprint parameters during maximum speed phase in sprinters. *Journal of strength and conditioning research*, *23*(8), 2272–2279. https://doi.org/10.1519/JSC.0b013e3181b3e182
Google Scholar Worldcat Fulltext

Karampatsos, G. P., Trikas, A., & Manou, V. (2019). Effects of strength and conditioning on grip strength and hand span in athletes. *Journal of Human Kinetics, 67*(1), 195-204.
Google Scholar Worldcat Fulltext

Katanic, B., Bjelica, D., Sebic, L., Preljevic, A., Stankovic, M., & Brkic, S. (2023). Comparative Analysis of Anthropometric Characteristics and Body Composition among Elite Female Futsal Players in Montenegro, North Macedonia and Croatia. *Sport Mont, 21*(3), 77-81. http://dx.doi.org/10.26773/smj.231012
Google Scholar Worldcat Fulltext

Lemos, L. F., Oliveira, V. C., Duncan, M. J., Ortega, J. P., Martins, C. M., Ramirez-Campillo, R., Sanchez, J. S., Nevill, A. M., & Nakamura, F. Y. (2020). Physical fitness profile in elite beach handball players of different age categories. *The Journal of sports medicine and physical fitness*, *60*(12), 1536–1543. https://doi.org/10.23736/S0022-4707.20.11104-6
Google Scholar Worldcat Fulltext

MacInnis, M. J., & Gibala, M. J. (2017). Physiological adaptations to interval training and the role of exercise

intensity. *The Journal of Physiology*, *595*(9), 2915–2930. https://doi.org/10.1113/JP273196
Google Scholar Worldcat Fulltext

Madou, K. H. (2020. Physical demands and physiological aspects in elite team handball in Germany and Switzerland: An analysis of the game. *MOJ Sports Medicine, 4(2)*, 55-62.
Google Scholar Worldcat Fulltext

Manchado, C., Tortosa Martínez, J., Pueo, B., Cortell Tormo, J. M., Vila, H., Ferragut, C., Sánchez Sánchez, F., Busquier, S., Amat, S., & Chirosa Ríos, L. J. (2020). High-Performance Handball Player's Time-Motion Analysis by Playing Positions. *International journal of environmental research and public health*, *17*(18), 6768. https://doi.org/10.3390/ijerph17186768
Google Scholar Worldcat Fulltext

Markovic, G., & Mikulic, P. (2010). Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. *Sports medicine (Auckland, N.Z.)*, *40*(10), 859–895. https://doi.org/10.2165/11318370-000000000-00000
Google Scholar Worldcat Fulltext

Masanovic, B., Gardasevic, J., & Bjelica, D. (2021). Comparative Study of Anthropometric Measurement and Body Composition between Elite Handball and Volleyball Players from the Serbian National League. *International Journal of Morphology*, *39*(1), 287-293. http://dx.doi.org/10.4067/S0717-95022021000100287
Google Scholar Worldcat Fulltext

Mikulić, J., & Prebežac, D. (2008). Prioritizing improvement of service attributes using impact range-performance analysis and impact-asymmetry analysis. *Managing Service Quality: An International Journal*, *18*(6), 559-576. http://dx.doi.org/10.1108/09604520810920068
Google Scholar Worldcat Fulltext

Milanese, C., Cavedon, V., Corradini, G., De Vita, F., & Zancanaro, C. (2015). Seasonal DXA-measured body composition changes in professional male soccer players. *Journal of Sports Sciences*, *33*(12), 1219–1228. https://doi.org/10.1080/02640414.2015.1022573
Google Scholar Worldcat Fulltext

Milanović, Z., Sporiš, G., Weston, M., & Krustrup, P. (2021). Effects of sprint and plyometric training on muscle function and athletic performance in female athletes. *Sports, 9*(1), 22-95.
Google Scholar Worldcat Fulltext

Morton, R. W., Oikawa, S. Y., Wavell, C. G., Mazara, N., McGlory, C., Quadrilatero, J., Baechler, B. L., Baker, S. K., & Phillips, S. M. (2016). Neither load nor systemic hormones determine resistance training-mediated hypertrophy or strength gains in resistance-trained young men. *Journal of Applied Physiology (Bethesda, Md.: 1985)*, *121*(1), 129–138. https://doi.org/10.1152/japplphysiol.00154.2016
Google Scholar Worldcat Fulltext

Negra, Y., Sammoud, S., Bouguezzi, R., Moran, J., & Chaabene, H. (2024). Effects of a horizontal speed deceleration training programme on measures of physical fitness in youth male handball players. *Journal of Sports Sciences*, *42*(7), 638–645. https://doi.org/10.1080/02640414.2024.2356440
Google Scholar Worldcat Fulltext

Nikander, R., Sievänen, H., Heinonen, A., Daly, R. M., Uusi-Rasi, K., & Kannus, P. (2018). Exercise loading and bone structure. *Sports Medicine, 48*(3), 735-751.
Google Scholar Worldcat Fulltext

Orphanidou, C., McCargar, L., Birmingham, C. L., Mathieson, J., & Goldner, E. (1994). Accuracy of subcutaneous fat measurement: comparison of skinfold calipers, ultrasound, and computed tomography. *Journal of the American Dietetic Association*, *94*(8), 855–858. https://doi.org/10.1016/0002-8223(94)92363-9
Google Scholar Worldcat Fulltext

Papanikolaoy, F., Rousanoglou, E. N., Psychountaki, M., & Konstantinos, N. S. (2021). Relationship between throwing accuracy and performance indices in female and male adolescent handball players. *Journal of Physical Education and Sport*, *21*(5), 2633-2640.
Google Scholar Worldcat Fulltext

Pascoal, A. G., Ribeiro, A., & Infante, J. (2023). Scapular Resting Posture and Scapulohumeral Rhythm Adaptations in Volleyball Players: Implications for Clinical Shoulder Assessment in Athletes. *Sports (Basel, Switzerland)*, *11*(6), 114. https://doi.org/10.3390/sports11060114
Google Scholar Worldcat Fulltext

Piscitelli, F., Milanese, C., Sandri, M., Cavedon, V., & Zancanaro, C. (2015). Investigating predictors of ball-throwing velocity in team handball: the role of sex, anthropometry, and body composition. *Sport Sciences for Health*, *12*(1), 11–20. https://doi.org/10.1007/s11332-015-0248-7
Google Scholar Worldcat Fulltext

Poorhassan, M., Mokhtari, T., Navid, S., Rezaei, M., Sheikhazadi, A., Mojaverrostami, S., & Hassanzadeh, G. (2017). Stature estimation from forearm length: an anthropological study in Iranian medical students. *Journal of Contemporary Medical Sciences, 3(11)*, 270-2.
Google Scholar Worldcat Fulltext

Raeder, C., Fernandez-Fernandez, J., & Ferrauti, A. (2015). Effects of Six Weeks of Medicine Ball Training on Throwing Velocity, Throwing Precision, and Isokinetic Strength of Shoulder Rotators in Female Handball

Players. *Journal of strength and conditioning research*, *29*(7), 1904–1914. https://doi.org/10.1519/JSC.0000000000000847
Google Scholar Worldcat Fulltext

Ramirez-Campillo, R., Alvarez, C., Garcia-Hermoso, A., Keogh, J. W., Garcia-Pinillos, F., Pereira, L. A., & Loturco, I. (2020). Effects of jump training on jumping performance of handball players: A systematic review with meta-analysis of randomised controlled trials. *International Journal of Sports Science & Coaching*, *15*(4), 584-594. http://dx.doi.org/10.1177/1747954120928932
Google Scholar Worldcat Fulltext

Rantalainen, T., Mikkola, A., Vainionpää, A., & Heinonen, A. (2019). Effects of exercise on bone and muscle in healthy athletes. *Journal of Sports Science and Medicine, 18*(4), 651-658.
Google Scholar Worldcat Fulltext

Rios, M., Fernandes, R. J., Cardoso, R., Monteiro, A. S., Cardoso, F., Fernandes, A., Silva, G., Fonseca, P., Vilas-Boas, J. P., & 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. https://doi.org/10.3390/ijerph20095751
Google Scholar Worldcat Fulltext

ROBERTS, D. F., PROVINS, K. A., & MORTON, R. J. (1959). Arm strength and body dimensions. *Human biology*, *31*, 334–343.
Google Scholar Worldcat Fulltext

Romaratezabala, E., Nakamura, F., Ramirez-Campillo, R., Castillo, D., Rodríguez-Negro, J., & Yanci, J. (2020). Differences in Physical Performance According to the Competitive Level in Amateur Handball Players. *Journal of strength and conditioning research*, *34*(7), 2048–2054. https://doi.org/10.1519/JSC.0000000000002533
Google Scholar Worldcat Fulltext

Saeterbakken, A. H., van den Tillaar, R., & Seiler, S. (2011). Effect of core stability training on throwing velocity in female handball players. *Journal of strength and conditioning research*, *25*(3), 712–718. https://doi.org/10.1519/JSC.0b013e3181cc227e
Google Scholar Worldcat Fulltext

Saroar, A., Arafat, M. Y., Rickta, J. F., & Mukta, F. T. J. (2024). The Body composition Feature among different ball game players: A comparative study. *Sports Science & Health Advances*, 2(1), 261–266. https://doi.org/10.60081/ssha.2.1.2024.261-266
Google Scholar Worldcat Fulltext

Schoenfeld, B. J., Ogborn, D., Krieger, J. W., Contreras, B., & Sonmez, G. T. (2020). Resistance training volume enhances muscle hypertrophy but not strength in trained men. *Medicine and Science in Sports and Exercise, 52*(12), 2476-2485. http://dx.doi.org/10.1249/MSS.0000000000001764
Google Scholar Worldcat Fulltext

Serrien, B., & Baeyens, J. P. (2017). The proximal-to-distal sequence in upper-limb motions on multiple levels and time scales. *Human movement science*, *55*, 156–171. https://doi.org/10.1016/j.humov.2017.08.009
Google Scholar Worldcat Fulltext

Singh, K., & Ram, M. (2013). Prediction of handball players playing ability on the basis of their anthropometric measurements and physical fitness components. *International Journal of Innovative Research & Development, 2(7),* 151-155.
Google Scholar Worldcat Fulltext

Sporis, G., Vuleta, D., Vuleta, D., Jr, & Milanović, D. (2010). Fitness profiling in handball: physical and physiological characteristics of elite players. *Collegium antropologicum*, *34*(3), 1009–1014.
Google Scholar Worldcat Fulltext

Thomas, E., Bianco, A., Messina, G., Bellafiore, M., Battaglia, G., & Palma, A. (2020). The effect of different dynamic warm-up protocols on flexibility and vertical jump in female athletes. *Journal of Sports Science and Medicine, 19*(3), 606-613.
Google Scholar Worldcat Fulltext

van den Tillaar, R., & Ettema, G. (2011). A comparison of kinematics between overarm throwing with 20% underweight, regular, and 20% overweight balls. *Journal of Applied Biomechanics*, *27*(3), 252–257. https://doi.org/10.1123/jab.27.3.252
Google Scholar Worldcat Fulltext

Vila, H., Manchado, C., Rodriguez, N., Abraldes, J. A., Alcaraz, P. E., & Ferragut, C. (2012). Anthropometric profile, vertical jump, and throwing velocity in elite female handball players by playing positions. *Journal of strength and conditioning research*, *26*(8), 2146–2155. https://doi.org/10.1519/JSC.0b013e31823b0a46
Google Scholar Worldcat Fulltext

Wagner, H., Pfusterschmied, J., von Duvillard, S. P., & Müller, E. (2019). Strength training's effect on throwing velocity in team handball players. *Journal of Strength and Conditioning Research, 33*(4), 940-949.
Google Scholar Worldcat Fulltext

Zemková, E., & Hamar, D. (2013). Assessment of agility performance under sport-specific conditions. *Asian Journal of Exercise & Sports Science*, *10*(1), 47-60.
Google Scholar Worldcat Fulltext