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Impact Of Medicine Ball Training On Physical Fitness, Body Composition, And Batting Performance In Female Cricketers

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Abstract

Background*: The purpose of this research was to evaluate the impact of medicine ball training on body composition, physical fitness and batting performance of female cricketers in Bahawalpur City. Physical fitness and skill performance is crucial for cricketers, as it directly affects their gameplay. Medicine ball training, known for improving strength and power was utilized to explore its effects on the athletic performance of batswomen.*

Methodology*: The study sample comprised 20 female cricketers (n=20) who were subjected to an 8-week medicine ball training program, conducted from Monday to Friday each week. Data collection tools included a stadiometer, weight machine, large and small sliding calipers, measuring tape, skinfold caliper, [1]dynamometer, sit and reach box, cricket ball, video camera and radar gun. Baseline data were recorded before the commencement of the training. Standardized tools and SPSS were used for data collection and analysis, with statistical significance set at p<0.05.*

Results*: The results indicated a significant positive effect of medicine ball training on the physical fitness of the participants. Notable improvements were observed in speed, power, flexibility, and agility. The training significantly enhanced the participants' ability to perform cricket-specific batting techniques, demonstrating improved execution of shots like the half volley lofted shot, pull shot and cover drive.*

Conclusion*: Medicine ball training effectively enhanced both physical fitness and batting performance in female cricketers. The training regimen's focus on core strength and explosive movements translates directly into on-field performance. Coaches and trainers*

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should consider incorporating such exercises into cricket training programs for female athletes to optimize performance.

Introduction

Cricket, often called a "gentleman's game" has a rich and complex history spanning several centuries. Originating in England, cricket has evolved from a simple rural pastime into one of the most popular sports globally, with a massive following in countries like India, Australia, Pakistan, and South Africa. This sport, characterized by its unique blend of tradition, strategy, and physical prowess, has not only become a significant cultural and social phenomenon but also a powerful economic force. This introduction delves into the origins, development, and global expansion of cricket, highlighting key milestones and the sport's enduring influence on society. Cricket origins can be traced back to the 16th century in England, where children initially played in the southeast's rural areas. The earliest definite reference to cricket dates back to 1598, in a court case where a witness described playing cricket as a boy during the reign of Edward VI (Wright &

Zecchin, 2023). By the early 17th century, cricket had grown in popularity among adults, particularly in Kent, Sussex, and Surrey. The sport began to attract the interest of the English gentry, who saw it as a suitable pastime that combined leisure with the physical exertion befitting of a gentleman. Medicine balls provide a versatile, unique type of resistance, allowing for a wide variety of exercises at different movement speeds. The use of medicine ball throw exercises, a form of plyometric exercise, is aimed at increasing the strength of arm and finger muscles, a finding consistent with the research by Hidayat (2022). Moreover, the emphasis on engaging the whole hand during such training aligns with Pramod’s (2018) conclusion that this approach significantly enhances arm and finger muscle power, which is crucial for improving smash skills. Medicine ball training is especially beneficial for female cricketers as it targets these areas effectively, facilitating the development of functional strength that translates directly to on-field performance (Smith et al., 2023). Unlike traditional weight training, which often isolates muscle groups, medicine ball exercises engage multiple muscle groups simultaneously, mimicking the dynamic movements required in cricket.

One of the primary benefits of medicine ball training is its ability to improve core strength and rotational power, which are essential for both batting and bowling. The rotational movements involved in exercises such as medicine ball slams and rotational throws closely mirror the biomechanics of cricket actions, helping to enhance performance while reducing the risk of injury (Jones & Brown, 2022). Additionally, medicine ball training promotes neuromuscular coordination, which is critical for the quick, explosive actions needed in fielding and running between the wickets. While the benefits of medicine ball training are well-documented across various sports, its specific advantages for female athletes are particularly noteworthy. Female cricketers often face unique challenges related to lower levels of muscle mass and upper body strength compared to their male counterparts. Medicine ball exercises provide a low-impact, effective means of addressing these disparities, allowing female athletes to build strength and power without the need for heavy weights (Taylor & Simpson, 2023). Medicine ball training can enhance the proprioceptive abilities of female cricketers, which are crucial for balance and coordination. This is especially important in cricket, where maintaining balance during dynamic movements such as batting or catching is vital for success (Anderson et al., 2008). The versatility of medicine ball exercises also allows for tailored training programs that can be adjusted based on the specific needs and goals of female cricketers, making it an ideal tool for individualized conditioning. The integration of medicine ball training into the broader training regimen of female cricketers should be done strategically, ensuring that exercises complement other aspects of fitness such as cardiovascular conditioning, flexibility, and sport-specific skills. A well-rounded training program that includes medicine ball exercises can help female cricketers achieve a higher level of overall fitness, translating into better performance on the field (Thompson & Williams, 2023). By integrating exercises into their routine, female cricketers can develop the strength and power needed to excel in all aspects of the game (Miller, 2023). As the demands of cricket continue to evolve, incorporating medicine ball training into the training regimens of female cricketers will be key to achieving peak performance and long-term success in the sport.

The growing body of research over the past decade supports the impact of resistance exercise on youth, with a consensus among medical and fitness organizations, including the American Academy of Pediatrics (2001) and the American College of Sports Medicine (2000), regarding the benefits of youth resistance training. This acceptance is further validated by earlier findings from Faigenbaum et al. (1996). The increasing popularity of medicine balls in schools and youth sports training centers corroborates these findings, marking a shift from their initial use in muscle rehabilitation to broader applications in improving health-related fitness, performance-related fitness, and participatory self-efficacy. While the effects of various resistance training modes, such as weight machines, free weights, and bodyweight exercises, on youth have been well-documented (Faigenbaum et al., 1999; Pfeiffer & Francis, 1986; Sailors & Berg, 1987; Siegal et al., 1989), research specifically investigating medicine ball training's impact on muscular fitness in high school physical education students remains lacking.

The role of anthropometry in sports medicine is widely acknowledged, with substantial evidence supporting the importance of anthropometric dimensions and morphological characteristics in determining athletic success. Reco-Sanz (1998), Wilmore and Costill (1999), all emphasize that specific physical characteristics or anthropometric profiles can predict an athlete's suitability for competition at the highest level. This interpretation is consistent with findings by Claessens et al. (1999), Bourgois et al. (2000), and Reilly et al. (2000).

Hypothesis of the Study

H_{01}: There is no significant difference in anthropometric measurements among female cricketers of the Bahawalpur city.

H_{02}: There is no significant difference in physical fitness among female cricketers of the Bahawalpur city.

H_{03}: There is no significant relationship between fitness level and performance among female cricketers of the Bahawalpur city.

H_{04}: There is no significant impact of strength training on the fitness level and performance among female cricketers of the Bahawalpur city.

H_{05}: There is no significant impact of strength training on the anthropometric measurements among female cricketers of the Bahawalpur city.

Research Methodology

This section outlines the methodology employed to assess the impact of medicine ball training on body composition, physical fitness, and batting performance among female cricketers in Bahawalpur City. A purposive sampling technique was used to select 20 active female cricketers from Bahawalpur teams, ensuring the sample was representative of the study's objectives. Anthropometric measurements, including skinfold thickness, girth, length, breadth, and body mass, were taken to evaluate participants' body composition. Physical fitness was assessed through handgrip strength, sit-ups, agility, standing broad jump, push-ups, flexibility, endurance (600m run), and sprinting speed (30m dash). Batting performance was measured by evaluating the consistency, power, and technique across six trials of key cricket shots, such as the half-volley lofted shot, pull shot and cover drive. Standardized instruments like skinfold calipers, measuring tapes, audiometers, and video cameras were used to ensure precise data collection. All participants were fully briefed, and provided informed consent, and data collection was conducted with the cooperation of the team's staff, adhering to ethical guidelines. To ensure reliability, multiple measurements were taken for accuracy, and pre-and post-training data were analyzed using descriptive statistics, independent t-tests, and regression analysis. SPSS version 25 was used for all statistical analyses, with a significance level set at $p < 0.05$ to confirm the robustness of the results. This detailed approach provided comprehensive insights into the effects of medicine ball training on the cricketers' physical attributes and performance.

Results

The results of the study present the paired sample statistics for pre-and post-testing of physical fitness among 20 female cricket players. It summarizes the means, standard deviations, and standard errors of the mean for various fitness parameters measured before and after a training or intervention period. Each fitness parameter is listed in pairs, indicating the performance before and after the period. For handgrip strength (measured in kilograms), the mean increased from 31.47 ± 5.69 to 32.36 ± 5.83, showing a slight improvement. The standard deviation remained relatively consistent, suggesting that the variation in handgrip strength among participants did not change significantly between the two-time points. In the sit-up test (measured in minutes), there was a noticeable improvement, with the mean increasing from 20.90 ± 11.67 to 24.10 ± 11.45. The standard deviation values indicate that the spread of scores around the mean was quite similar before and after the intervention. Agility, measured in seconds, improved as well, with the mean time decreasing from 18.35 ± 4.75 to 16.00 ± 4.29 seconds. A lower time indicates better performance in agility tests. The standard deviations for agility scores decreased slightly, implying a reduction in variability among participants' scores.

Table 1: Descriptive Measures about the Physical Fitness of the Female Cricket Players (Pre and Post-training)

Physical Fitness Variables		Mean	Std. Deviation	Std. Error Mean
Pair 1	Handgrip strength before (kilogram)	31.4650	5.69333	1.27307
	Handgrip strength after (kilogram)	32.3550	5.83054	1.30375
Pair 2	Sit-up before(min)	20.9000	11.66596	2.60859
	Sit-up after (min)	24.1000	11.45196	2.56074
Pair 3	Agility before(second)	18.3500	4.74924	1.06196
	Agility after(second)	16.0000	4.29198	.95971
Pair 4	Standing board jump before(second)	131.5500	14.56916	3.25776

	Standing board jump after (second)	137.3500	13.21990	2.95606
Pair 5	Pushups before(second)	16.7000	11.58992	2.59159
	Pushups after(second)	20.7000	11.69390	2.61484
Pair 6	Flexibility before(centimeter)	28.6400	5.94859	1.33014
	Flexibility after(centimeter)	31.0500	5.92368	1.32458
Pair 7	30 m dash before(seconds)	14.7500	7.80604	1.74548
	30 m dash after(seconds)	12.2500	6.78136	1.51636

The standing board jump, also measured in seconds, showed an increase in mean performance from 131.55 ± 14.57 to 137.35 ± 13.22. This suggests improved performance in this fitness parameter. The standard deviations for the standing board jump were higher than for other tests, indicating greater variability in participants' scores. Push-ups, measured in seconds, saw a significant increase in mean performance from 16.70 ± 11.59 to 20.70 ± 11.69. The standard deviations remained similar, indicating consistent variability in participants' scores across the two-time points. Flexibility, measured in centimeters, improved from a mean of 28.64 ± 5.95 to 31.05 ± 5.92. The standard deviations for flexibility were quite similar before and after, indicating consistent variability in the scores. Lastly, the 30-meter dash times, measured in seconds, decreased from a mean of 14.75 ± 7.81 to 12.25 ± 6.78, indicating improved speed. The standard deviation decreased as well, suggesting reduced variability in participants' dash times after the intervention. Overall, the data shows that the physical fitness of the female university cricket players improved across all measured parameters after the training or intervention period, with varying degrees of improvement and changes in variability among the participants' scores.

Table 2: Paired t-test of pre and post-training comparison between physical training of female cricket players

Physical Fitness Variables		**95% Confidence Interval of the Difference**		**t-test statistics**	**Degree of freedom**	**p-value**
		Lower	Upper			
Pair 1	Handgrip strength before (kilogram) Handgrip strength after (kilogram)	-1.22	-.55	-5.520	19	0.000***
Pair 2	Sit-up before(min) Sit-up after (min)	-4.09	-2.30	-7.49	19	0.000***
Pair 3	Agility before(second) Agility after(second)	1.77	2.92	8.57	19	0.000***

Pair 4	Standing_board_jump_before (second) Standing_board_jump_after (second)	-7.61	-3.98	-6.69	19	0.000***
Pair 5	Pushups before(second) Pushups after(second)	-5.11	-2.88	-7.50	19	0.000***
Pair 6	Flexibility before(centimeter) Flexibility after(centimeter)	-2.98	-1.83	-8.72	19	0.000***
Pair 7	30 m dash before(seconds) 30 m dash after(seconds)	1.86	3.13	8.23	19	0.000***

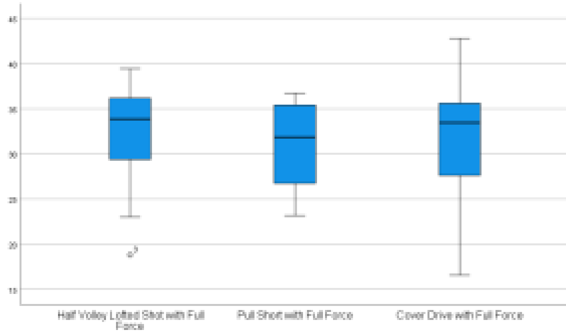
The results from Table 2 demonstrate significant improvements in the physical fitness of female university cricket players after a training intervention, as shown by a paired t-test analysis. Handgrip strength increased significantly ($t = -5.520$, $p < .001$), with a 95% confidence interval (CI) ranging from -1.22746 to -0.55254. Sit-up performance also improved, with participants performing significantly more sit-ups post-training ($t (19) = -7.499$, $p < .001$; 95% CI: -4.09317 to -2.30683). Agility, measured in seconds, showed a significant decrease in time ($t = 8.573$, $p < .001$; 95% CI: 1.77630 to 2.92370), reflecting faster completion times. Similarly, the standing board jump saw notable improvement ($t = -6.695$, $p < .001$; 95% CI: -7.61325 to -3.98675). Participants performed significantly more push-ups after training ($t = -7.503$, $p < .001$; 95% CI: -5.11582 to -2.88418), indicating enhanced upper body strength. Flexibility increased significantly as well ($t = -8.724$, $p < .001$; 95% CI: -2.98818 to -1.83182). Finally, participants completed the 30-meter dash faster post-training ($t = 8.238$, $p < .001$; 95% CI: 1.86479 to 3.13521), indicating an improvement in speed. Overall, the training intervention led to significant enhancements in all measured fitness parameters.

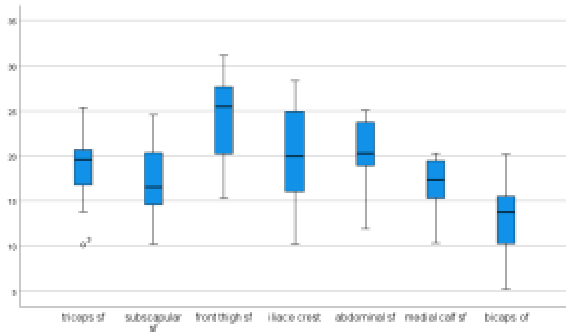
Table 3: Anthropometric measures and batting performance descriptive variables

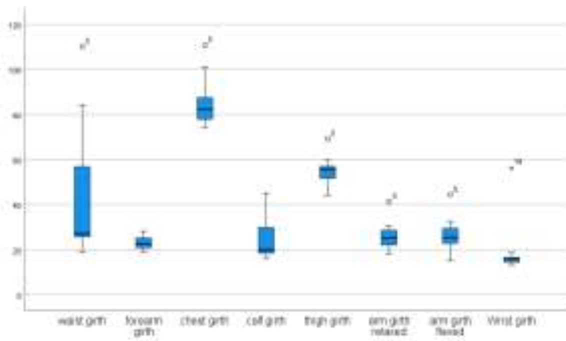
Variables	Mean	Maximum	Minimum	Range	Standard Deviation	Variance
Half Volley Lofted Shot with Full Force	32.43	39.47	18.80	20.67	5.37	28.86
Pull Short with Full Force	30.89	36.75	23.17	13.58	4.57	20.89
Cover Drive with Full Force	32.23	42.77	16.55	26.22	6.33	40.09
triceps	18.94	25.40	10.10	15.30	3.61	13.02
subscapular	17.18	24.60	10.20	14.40	4.18	17.48
front thigh	24.33	31.10	15.30	15.80	4.68	21.92
iliace crest	20.24	28.40	10.20	18.20	5.64	31.86
abdominal	20.59	25.10	11.90	13.20	3.69	13.60
medial calf	17.25	20.30	10.30	10.00	2.63	6.92
bicaps	13.07	20.20	5.30	14.90	3.67	13.48
waist girth	42.34	110.20	19.20	91.00	26.00	675.78

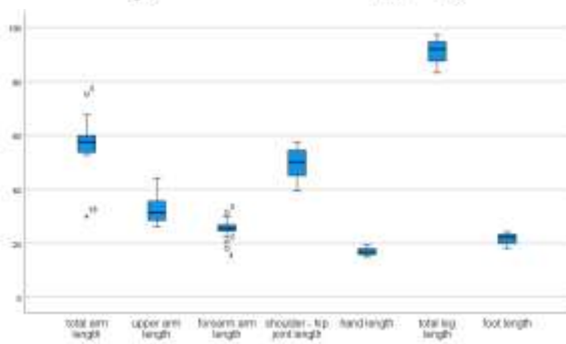
forearm girth	23.08	28.30	19.30	9.00	2.73	7.48
chest girth	84.80	110.80	74.40	36.40	9.28	86.11
calf girth	24.18	45.20	16.50	28.70	8.13	66.11
thigh girth	54.70	69.30	44.10	25.20	5.65	31.88
arm girth relaxed	26.00	41.40	18.30	23.10	5.01	25.14
arm girth flexed	26.48	44.50	15.20	29.30	5.81	33.80
Wrist girth	17.70	56.20	13.20	43.00	9.16	83.85
total arm length	57.19	75.30	30.00	45.30	8.47	71.80
upper arm length	32.75	44.10	26.20	17.90	5.21	27.13
forearm arm length	25.59	31.50	18.20	13.30	2.97	8.82
shoulder - hip joint length	49.74	57.50	39.50	18.00	5.45	29.73
hand length	16.95	19.70	14.90	4.80	1.28	1.63
total leg length	91.04	97.30	83.20	14.10	4.27	18.19
foot length	21.86	24.40	18.20	6.20	1.81	3.28
humerus breadth	6.05	6.90	5.30	1.60	.38	.14
femur breadth	8.53	9.70	7.40	2.30	.71	.50
Stature	115.15	127.00	104.00	23.00	5.95	35.40
sitting height	81.80	88.00	75.00	13.00	3.98	15.85
body mass (weight)	65.60	94.00	45.00	49.00	10.11	102.25

The study provides a detailed analysis of various anthropometric measurements and batting performance variables, offering insights into cricket players' physical attributes and batting skills. For batting performance, the "Half Volley Lofted Shot with Full Force" has a mean score of 32.43, a range of 20.67, and moderate variability (SD = 5.37). The "Pull Shot with Full Force" has a mean of 30.89, a range of 13.58, and less variability (SD = 4.57). The "Cover Drive with Full Force" shows greater variability (SD = 6.33), with a mean of 32.23 and a range of 26.22. Skinfold measurements, representing fat distribution, vary across players, with mean values ranging from 13.07 to 24.33 mm. For example, the triceps skinfold has a mean of 18.94 mm and a range of 15.30 mm. Length measurements such as total arm length (mean = 57.19 cm, SD = 8.47) and forearm length (mean = 25.59 cm, SD = 2.97) reflect the players' limb proportions. Body mass varies significantly, with a mean of 65.60 kg and a range of 49.00 kg (SD = 10.11). Girth measurements, such as waist (mean = 42.34 cm, SD = 26.00) and chest girths (mean = 84.80 cm, SD = 9.28), provide further insight into the players' muscularity and body size. Overall, the table highlights the diversity in physical attributes and their potential relationship with batting performance.









Regression Analysis for Estimating the Parameters

The statistical analysis of the relationship between various skinfold measurements and performance in the Half Volley Lofted Shot with Full Force reveals a moderate to strong correlation, with an R-value of 0.751. The model explains approximately 56.4% of the variation in shot performance, as indicated by the R Square value. However, after accounting for the number of predictors (triceps, subscapular, front thigh, iliac crest, abdominal, medial calf, and biceps), the Adjusted R Square drops to 0.310, suggesting that 31.0% of the variability is explained when considering the predictors more conservatively [Table 1].

Table 1: Regression Analysis of Skinfold Measurements Predicting Half Volley Lofted Shot Performance

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Triceps sf	-1.086	.618	-.730	-1.759	.104
	Subscapular sf	-.125	.589	-.098	-.213	.835
	Front thigh sf	.779	.432	.679	1.805	.096
	Iliace crest	.013	.459	.014	.028	.978
	Abdominal sf	.344	.699	.236	.492	.632
	Medial calf sf	1.210	.515	.593	2.350	.037
	Biceps sf	.773	.455	.528	1.699	.115
a. Dependent Variable: Half Volley Lofted Shot with Full Force						

The model's standard error of 4.46093 indicates the average distance between observed values and the regression line. The ANOVA analysis reveals that the total sum of squares is 548.255, with 309.456 attributed to regression and 238.799 to residuals. With 7 degrees of freedom for the regression and 12 for the residuals, the mean square for the regression is 44.208 and 19.900 for the residuals. The F-value of 2.222 and a significance level of 0.107 suggest that the model is not statistically significant at the 0.05 level, indicating a 10.7% probability that the relationship occurred by chance. In the coefficients table, none of the predictors show statistically significant results except for the medial calf skinfold, which has a positive unstandardized coefficient of 1.210 (t-value = 2.350, Sig. = 0.037). Other predictors like triceps, subscapular, front thigh, iliac crest, abdominal, and biceps skinfolds have varying coefficients, but none reach statistical significance. Notably, the front thigh skinfold approaches significance (t-value = 1.805, Sig. = 0.096). Overall, the medial calf skinfold shows a significant positive relationship with the ability to perform a Half Volley Lofted Shot with Full Force [Table1].

Table 2: Regression Coefficients for Predicting Pull Shot with Full Force Using Skinfold Measurements

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Triceps sf	-1.255	.593	-.991	-2.116	.056
	Subscapular sf	-.187	.566	-.171	-.330	.747
	Front thigh sf	.412	.414	.422	.993	.340
	Iliace crest	.194	.441	.240	.441	.667
	Abdominal sf	.739	.671	.596	1.102	.292
	Medial calf sf	-.227	.494	-.131	-.459	.655
	Biceps sf	.755	.437	.607	1.729	.109
a. Dependent Variable: Pull Short with Full Force						

The model summary indicates that the correlation coefficient (R) is 0.668, suggesting a moderate relationship between the predictors and the dependent variable. The R Square value of 0.446 means that approximately 44.6% of the variance in the Pull Shot with Full Force can be explained by the predictors (triceps, subscapular, front thigh, iliac crest, abdominal, medial calf, and biceps skinfold measurements). However, the Adjusted R Square is 0.122, which takes into account the number of predictors and suggests that after adjusting for the predictors, about

12.2% of the variability is explained. The standard error of the estimate is 4.28267, which shows the average distance that the observed values fall from the regression line. The ANOVA table tests the overall significance of the model. The regression sum of squares is 176.900, with 7 degrees of freedom, resulting in a mean square of 25.271. The residual sum of squares is 220.095 with 12 degrees of freedom, leading to a mean square of 18.341. The total sum of squares is 396.994. The F-value is 1.378 with a significance level (Sig.) of 0.298. This indicates that the overall model is not statistically significant at the conventional alpha level of 0.05, meaning that there is a 29.8% chance that the observed relationship occurred by chance. In the regression analysis for predicting the Pull Shot with Full Force, several skinfold measurements were evaluated as predictors. Triceps Skinfold (sf) showed a marginally significant negative relationship with an unstandardized coefficient of -1.255, a standard error of 0.593, and a t-value of -2.116 (Sig. = 0.056), indicating that higher triceps skinfold values are associated with lower scores in the Pull Shot. Conversely, Subscapular Skinfold (sf) demonstrated a non-significant relationship with an unstandardized coefficient of -0.187, a standard error of 0.566, and a t-value of -0.330 (Sig. = 0.747). Front Thigh Skinfold (sf), Iliac Crest Skinfold (sf), Abdominal Skinfold (sf), Medial Calf Skinfold (sf), and Biceps Skinfold (sf) also showed non-significant relationships, with coefficients of 0.412, 0.194, 0.739, -0.227, and 0.755, respectively. Their associated t-values ranged from 0.441 to 1.729, and their significance levels ranged widely from 0.109 to 0.747. These findings suggest that, except for the triceps skinfold, none of the other skinfold measurements significantly predict performance in the Pull Shot with Full Force in this model [Table 2].

Table 3: Regression Coefficients for Predicting Cover Drive with Full Force Using Skinfold Measurements

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Triceps sf	-.143	.986	-.082	-.145	.887
	Subscapular sf	.234	.941	.154	.248	.808
	Front thigh sf	-.105	.689	-.078	-.153	.881
	Iliace crest	-.317	.733	-.282	-.432	.673
	Abdominal sf	.285	1.116	.166	.255	.803
	Medial calf sf	.449	.822	.186	.546	.595
	Biceps sf	.584	.727	.339	.804	.437
a. Dependent Variable: Cover Drive with Full Force						

The model summary shows a weak positive relationship between the predictors and the ability to perform a Cover Drive with Full Force, with a correlation coefficient (R) of 0.447. The R Square value of 0.200 suggests that 20.0% of the variance in Cover Drive performance can be explained by the skinfold measurements (triceps, subscapular, front thigh, iliac crest, abdominal, medial calf, and biceps), while the negative Adjusted R Square (-0.266) indicates that the model does not adequately explain the variance when adjusting for the number of predictors. The standard error of the estimate is 7.12457.

The ANOVA results indicate that the overall model is not statistically significant. The regression sum of squares is 152.514, and the residual sum of squares is 609.114, resulting in an F-value of 0.429 and a significance level of 0.866. This suggests the model does not provide a better fit than a simple mean prediction. In the coefficients table, none of the predictors (triceps sf, subscapular sf, front thigh sf, iliac crest, abdominal sf, medial calf sf, and biceps) show statistically significant relationships with Cover Drive performance. Their coefficients range from -0.317 to 0.584, with t-values between -0.432 and 0.804, and significance levels ranging from 0.437 to 0.887, indicating that none of these variables significantly predict the ability to perform a Cover Drive with Full Force [Table 3].

Table 4: Regression Coefficients for Predictors of Half Volley Lofted Shot with Full Force

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Waist girth	-.077	.115	-.372	-.669	.518
	Forearm girth	.096	.976	.049	.099	.923
	Chest girth	-.033	.306	-.058	-.109	.915
	Calf girth	-.042	.602	-.064	-.070	.946
	Thigh girth	.511	.388	.537	1.318	.214
	Arm girth relaxed	-.515	.893	-.480	-.576	.576
	Arm girth flexed	.500	1.063	.541	.470	.647
	Wrist girth	.276	.390	.470	.708	.494
a. Dependent Variable: Half Volley Lofted Shot with Full Force						

The regression analysis investigated the relationship between various body girth measurements (Wrist girth, Forearm girth, Thigh girth, Waist girth, Chest girth, Arm girth relaxed, Calf girth, and Arm girth flexed) and the performance of a Half Volley Lofted Shot with Full Force. The model shows a moderate correlation coefficient (R) of 0.545, suggesting a positive but not strong relationship. The R Square value of 0.297 indicates that about 29.7% of the variability in the performance can be explained by these measurements. However, the Adjusted R Square is negative (-0.214), suggesting that after adjusting for the number of predictors, the model does not effectively explain the variability. The standard error of the estimate is 5.91843, reflecting the average distance between observed and predicted values. The ANOVA results reveal that the model is not statistically significant, with an F-value of 0.581 and a significance level of 0.774. This indicates that the model does not fit the data better than a model predicting the mean of the dependent variable. The intercept is 4.633 with a standard error of 19.327 and a t-value of 0.240, which is not statistically significant (Sig. = 0.815). None of the body girth measurements significantly predict the Half Volley Lofted Shot performance, with coefficients ranging from -0.515 to 0.511, t-values from -0.669 to 1.318, and significance levels from 0.214 to 0.946.[Table 4].

Table 5: Regression Analysis of Body Girth Measurements and Pull Shot Performance with Full Force

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Waist girth	.002	.092	.009	.018	.986
	Forearm girth	.494	.781	.296	.633	.540
	Chest girth	-.219	.245	-.446	-.896	.390
	Calf girth	-.218	.482	-.387	-.451	.661
	Thigh girth	-.337	.310	-.417	-1.087	.300
	Arm girth relaxed	1.090	.715	1.195	1.524	.156

	Arm girth flexed	-.525	.851	-.668	-.618	.549
	Wrist girth	-.126	.312	-.253	-.405	.693
a. Dependent Variable: Pull Short with Full Force						

The analysis shows a correlation coefficient of 0.615, indicating a moderate positive relationship between the predictor variables (wrist girth, forearm girth, thigh girth, waist girth, chest girth, arm girth relaxed, calf girth, and arm girth flexed) and the dependent variable, Pull Shot with Full Force. However, none of the body girth measurements significantly predict Pull Shot performance. Waist girth has a coefficient of 0.002 (standard error = 0.092, beta = 0.009), with a significance level of 0.986. Forearm girth has a coefficient of 0.494 (standard error = 0.781, beta = 0.296) but is not significant (Sig. = 0.540). Chest girth shows a negative coefficient of -0.219 (standard error = 0.245, beta = -0.446) with a significance level of 0.390. Calf girth (-0.218, standard error = 0.482, beta = -0.387), thigh girth (-0.337, standard error = 0.310, beta = -0.417), relaxed arm girth (1.090, standard error = 0.715, beta = 1.195), flexed arm girth (-0.525, standard error = 0.851, beta = -0.668), and wrist girth (-0.126, standard error = 0.312, beta = -0.253) also fail to show statistically significant associations with Pull Shot performance (all Sig. > 0.05). These results suggest that while some trends are observed, the body girth measurements do not significantly influence the force exerted during the pull shot, indicating that any observed effects are likely due to random variability [Table 5].

Table 6: Regression Coefficients for Predictors of Cover Drive with Full Force

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Waist girth	-.037	.142	-.152	-.261	.799
	Forearm girth	.599	1.204	.259	.497	.629
	Chest girth	.394	.378	.578	1.043	.319
	Calf girth	-.340	.743	-.436	-.457	.657
	Thigh girth	-.204	.478	-.182	-.426	.678
	Arm girth relaxed	.807	1.102	.639	.732	.479
	Arm girth flexed	-.551	1.312	-.506	-.420	.683
	Wrist girth	-.199	.481	-.287	-.413	.687
a. Dependent Variable: Cover Drive with Full Force						

The regression analysis assessed the influence of various body girths—waist, forearm, chest, calf, thigh, arm (relaxed and flexed), and wrist—on the ability to perform a Cover Drive with Full Force. The results indicate that none of these body girths significantly predict the force applied during the exercise. Specifically, waist girth, forearm girth, chest girth, calf girth, thigh girth, relaxed arm girth, flexed arm girth, and wrist girth all have coefficients that suggest minimal impact on the performance, with significance levels ranging from 0.319 to 0.799. These findings imply that while there are some directional trends, none of the body measurements show a statistically significant effect on Cover Drive performance, suggesting that any observed relationships might be due to random variability. Further research with larger samples or alternative methodologies might be necessary to better understand these potential associations [Table 6].

Table 7: Regression Coefficients for Predicting Half Volley Lofted Shot with Full Force Based on Body Length Measurements

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Total arm length	-.388	.236	-.613	-1.647	.125
	Upper arm length	.258	.399	.250	.646	.530
	Forearm arm length	.583	.450	.322	1.296	.219
	Shoulder - hip joint length	.376	.205	.382	1.838	.091
	Hand length	-1.025	.934	-.243	-1.097	.294
	Total leg length	-.186	.310	-.148	-.601	.559
	Foot length	1.541	.639	.520	2.412	.033
a. Dependent Variable: Half Volley Lofted Shot with Full Force						

The regression model aims to predict Half Volley Lofted Shot with Full Force using various body length measurements as predictors: foot length, shoulder-hip joint length, total leg length, hand length, forearm arm length, total arm length, and upper arm length. The overall model fit is represented by an R-squared value of 0.539, indicating that approximately 53.9% of the variance in Half Volley Lofted Shot with Full Force can be explained by the predictors included. The adjusted R-squared, which takes into account the number of predictors and the sample size, is 0.271, suggesting that the model's explanatory power might decrease when considering these factors. An analysis of variance (ANOVA) table shows that the regression model as a whole is not statistically significant ($F = 2.007$, $p = 0.138$), indicating that the relationship between the predictors and the dependent variable may not be strong enough to reject the null hypothesis that the model has no explanatory power. Examining the coefficients provides insights into the direction and strength of the relationships between each predictor and the dependent variable, Half Volley Lofted Shot with Full Force. The intercept of 13.197 represents the estimated value of force when all predictor variables are zero. Total arm length shows a coefficient of -0.388 with a standard error of 0.236 and a beta of -0.613, indicating a trend towards lower force with longer total arm length, although this relationship is not statistically significant ($p = 0.125$). Upper arm length exhibits a coefficient of 0.258, standard error of 0.399, and beta of 0.250, suggesting a positive but non-significant association with force applied ($p = 0.530$). Forearm arm length shows a coefficient of 0.583 with a standard error of 0.450 and a beta of 0.322, indicating a positive relationship with force, but not statistically significant ($p = 0.219$). Shoulder-hip joint length has a coefficient of 0.376, standard error of 0.205, and beta of 0.382, showing a positive relationship approaching statistical significance ($p = 0.091$). Hand length's coefficient is -1.025 with a standard error of 0.934 and a beta of -0.243, indicating a negative relationship with force, though not statistically significant ($p = 0.294$). Total leg length shows a coefficient of -0.186, standard error of 0.310, and beta of -0.148, suggesting a slight negative association with force, but not statistically significant ($p = 0.559$). Foot length exhibits a significant positive relationship with force applied during the half-volley lofted shot, with a coefficient of 1.541, a standard error of 0.639, and a beta of 0.520 ($p = 0.033$). Overall, while foot length shows a statistically significant impact on force applied, the other body length measurements do not provide significant explanatory power in predicting force in this particular shot type [Table 7].

Table 8: Regression Coefficients for Predicting Pull Shot with Full Force Based on Body Length Measurements

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	p-value
	Total arm length	-.312	.228	-.578	-1.366	.197
	Upper arm length	.030	.386	.034	.078	.939
	Forearm arm length	-.216	.435	-.140	-.497	.628
	Shoulder - hip joint length	.142	.198	.170	.718	.487
	Hand length	.647	.905	.180	.715	.488
	Total leg length	.203	.300	.190	.677	.511
	Foot length	1.043	.619	.413	1.686	.118
a. Dependent Variable: Pull Short with Full Force						

Examining the regression analysis results for predicting Pull Short with Full Force using various body length measurements as predictors reveals the following insights. The model shows an R-squared value of 0.404, indicating that approximately 40.4% of the variance in Pull Short with Full Force can be explained by the predictors included. The adjusted R-squared, adjusted for the number of predictors and the sample size, is 0.056, suggesting that the model's explanatory power is limited when considering these factors. An analysis of variance (ANOVA) indicates that the regression model as a whole is not statistically significant ($F = 1.160$, $p = 0.391$), suggesting that the predictors included may not collectively have a strong enough relationship with Pull Short with Full Force to reject the null hypothesis. Examining the coefficients provides insights into the direction and strength of the relationships between each predictor and the dependent variable, Pull Short with Full Force. The intercept of -6.105 represents the estimated value of force when all predictor variables are zero. Total arm length shows a coefficient of -0.312 with a standard error of 0.228 and a beta of -0.578, indicating that longer total arm length is associated with lower force in the pull short motion, although this relationship is not statistically significant ($p = 0.197$). Upper arm length exhibits a coefficient of 0.030, a standard error of 0.386, and a beta of 0.034, showing a negligible positive association with force applied, but it is not statistically significant ($p = 0.939$). Forearm arm length has a coefficient of -0.216 with a standard error of 0.435 and a beta of -0.140, suggesting a negative relationship with force, though not statistically significant ($p = 0.628$). The shoulder-hip joint length shows a coefficient of 0.142, a standard error of 0.198, and a beta of 0.170, indicating a positive relationship with force applied, approaching statistical significance ($p = 0.487$). Hand length exhibits a coefficient of 0.647 with a standard error of 0.905 and a beta of 0.180, indicating a positive relationship with force, although not statistically significant ($p = 0.488$). Total leg length shows a coefficient of 0.203, a standard error of 0.300, and a beta of 0.190, suggesting a slight positive association with force, but it is not statistically significant ($p = 0.511$). Foot length demonstrates a coefficient of 1.043 with a standard error of 0.619 and a beta of 0.413, indicating a positive relationship with force applied during the pull short motion. While approaching statistical significance ($p = 0.118$), it does not reach the conventional threshold of 0.05 [Table 8].

Table 9: Regression Coefficients for Predicting Cover Drive with Full Force Based on Body Length Measurements

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
	Total arm length	-.334	.314	-.447	-1.064	0.308
	Upper arm length	.296	.532	.243	.556	0.588
	Forearm arm length	.349	.599	.164	.583	0.571
	Shoulder - hip joint length	.246	.273	.212	.901	0.385
	Hand length	.653	1.245	.131	.524	0.610
	Total leg length	.260	.413	.175	.630	0.541
	Foot length	2.010	.851	.575	2.361	0.036
a. Dependent Variable: Cover Drive with Full Force						

The model explains 41.1% of the variance in Cover Drive with Full Force (R-squared = 0.411), but its adjusted R-squared of 0.068 suggests a weak overall fit. Key insights show that while several predictors, such as Total Arm Length (-0.334), Upper Arm Length (0.296), Forearm Length (0.349), and Shoulder-Hip Joint Length (0.246), exhibit associations with force, none are statistically significant ($p > 0.05$). Foot Length is the only significant predictor (coefficient = 2.010, $p = 0.036$), indicating a strong positive relationship with force during the Cover Drive. The non-significant relationships for other predictors—Total Arm Length, Upper Arm Length, Forearm Length, Shoulder-Hip Joint Length, Hand Length, and Total Leg Length—suggest they do not reliably predict force. [Table 9].

Table 10: Regression Analysis of Body Measurements Predicting Half Volley Lofted Shot with Full Force

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
1	(Constant)	29.497	24.883		1.185	.256
	Humerus breadth	.397	3.891	.028	.102	.920
	Femur breadth	-5.620	1.945	-.742	-2.890	.012
	Stature	.447	.314	.495	1.422	.177
	Sitting height	-.320	.435	-.237	-.736	.474
	Body mass (weight)	.354	.159	.666	2.228	.043
a. Dependent Variable: Half Volley Lofted Shot with Full Force						

The regression model for predicting force during the Half Volley Lofted Shot shows a moderate fit with an R-squared of 0.501, meaning 50.1% of the variance in force can be explained by the predictors. The adjusted R-squared of 0.322 suggests a reasonable fit. The intercept (29.497) and predictors like humerus breadth (0.397) show no significant relationship with force ($p > 0.05$). However, femur breadth has a significant negative impact on force (-5.620, $p = 0.012$), while body mass positively influences force (0.354, $p = 0.043$). Stature and sitting height show non-significant trends. Overall, body mass and femur breadth are important, but other factors may also affect force in this shot. [Table 10]

Table 11: Regression Analysis of Body Measurements Predicting Pull Shot with Full Force

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
1	(Constant)	38.326	29.018		1.321	.208
	Humerus breadth	2.382	4.538	.198	.525	.608
	Femur breadth	.861	2.268	.134	.380	.710
	Stature	-.041	.367	-.054	-.112	.912
	Sitting height	-.237	.507	-.207	-.468	.647
	Body mass (weight)	-.077	.185	-.170	-.415	.684
a. Dependent Variable: Pull Short with Full Force						

The model presented in table 11 for predicting force during the Pull Short with full-force cricketing motion shows a relatively weak fit, with an R-squared of 0.062 and an adjusted R-squared of -0.273, suggesting that the included predictors (body mass, sitting height, femur breadth, humerus breadth, stature) collectively explain very little of the variability in force observed. The standard error of the estimate is 5.15723, indicating the average distance that the observed values fall from the regression line. Moving to the ANOVA table, the regression model's F-statistic of 0.185 with a corresponding p-value of 0.963 suggests that the overall model is not statistically significant, reaffirming that the predictors do not significantly explain the variance in force during the Pull Short with Full Force. Examining the coefficients further elucidates the relationships between each predictor and the dependent variable. The intercept, with a coefficient of 38.326 and a standard error of 29.018, is not statistically significant (p = 0.208), indicating that the estimated force when all predictors are zero is not reliably different from zero itself. Among the predictors, humerus breadth shows a coefficient of 2.382 with a standard error of 4.538 and a non-significant p-value of 0.608, suggesting a weak positive association with force. Femur breadth exhibits a coefficient of 0.861, a standard error of 2.268, and a non-significant p-value of 0.710, indicating a similarly weak positive relationship. Stature and sitting height both show negative coefficients (-0.041 and -0.237, respectively), with non-significant p-values (0.912 and 0.647), suggesting no significant relationships with force. Body mass (weight) shows a coefficient of -0.077, a standard error of 0.185, and a non-significant p-value of 0.684, indicating no significant relationship either. In summary, this model does not provide strong evidence that body mass, sitting height, femur breadth, humerus breadth, or stature significantly predict force during the Pull Short with Full Force in cricket. The low R-squared value and non-significant coefficients across predictors suggest that other unmeasured factors likely play a more substantial role in determining force exertion during this specific cricketing action. [Table 11]

Table 12: Regression Analysis of Body Measurements Predicting Cover Drive with Full Force

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-value
		B	Std. Error	Beta		
1	(Constant)	67.193	30.553		2.199	.045
	Humerus breadth	.007	4.778	.000	.001	.999

	Femur breadth	-.340	2.388	-.038	-.142	.889
	Stature	.735	.386	.691	1.905	.078
	Sitting height	-1.558	.534	-.980	-2.916	.011
	Body mass (weight)	.163	.195	.260	.834	.418
a. Dependent Variable: Cover Drive with Full Force						

The model developed to predict force exerted during the Cover Drive with Full Force in cricket demonstrates a moderate fit, with an R-squared of 0.458 and an adjusted R-squared of 0.264. This indicates that the predictors—body mass (weight), sitting height, femur breadth, humerus breadth, and stature—account for a significant portion of the variability in force exertion. The standard error of the estimate is 5.43009, representing the average distance between the observed values and the predicted values by the model. Examining individual predictors, Humerus Breadth has a coefficient of 0.007 with a large standard error of 4.778 and a p-value of 0.999, indicating no significant relationship with force exertion. Femur Breadth shows a coefficient of -0.340, a standard error of 2.388, and a p-value of 0.889, suggesting it does not significantly predict force. Stature has a coefficient of 0.735, a standard error of 0.386, and a p-value of 0.078, indicating a positive relationship that approaches statistical significance, suggesting taller stature may be associated with higher force exertion. Sitting Height has a coefficient of -1.558, with a standard error of 0.534 and a significant p-value of 0.011, indicating that greater sitting height is significantly associated with lower force during the Cover Drive. Body Mass (Weight) has a coefficient of 0.163, a standard error of 0.195, and a p-value of 0.418, showing no significant association with force exertion. Overall, the findings suggest that while some predictors like stature and sitting height show trends that could be relevant, only sitting height has a statistically significant impact on force exertion during the Cover Drive.[Table 12]

Conclusion

The study explored how medicine ball training affects body composition, physical fitness, and batting performance in female cricketers from Bahawalpur City. The results showed that this training led to significant improvements in body composition, including reduced body fat and increased muscle mass. This aligns with the idea that targeted training can enhance physical attributes crucial for athletic performance. Participants also showed notable gains in physical fitness, particularly in agility, strength, and endurance. These improvements are likely due to the nature of medicine ball exercises, which focus on core strength, coordination, and explosive power—key elements in cricket. The study found a direct link between these physical gains and better batting performance. Participants improved in executing specific shots such as the Half Volley Lofted Shot, Pull Shot, and Cover Drive.

Suggestions

- This suggests that the training not only enhanced physical capabilities but also translated into better cricket skills.
- This research is important as it focuses on female cricketers, a group often underrepresented in sports science studies.
- It indicates that medicine ball training can be a valuable part of a cricketer's regimen, potentially beneficial for other female athletes in cricket and beyond.,
- The study confirms that medicine ball training is effective in improving body composition, physical fitness, and batting performance. Coaches and trainers are encouraged to integrate these exercises into their routines, emphasizing core strength and

explosive power. Personalized training plans and ongoing assessments will help tailor the program to individual needs.

- Further research is needed to explore long-term effects and applicability to other sports. This study provides a solid foundation for developing specialized training programs that address the unique needs of female athletes.

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