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Anthropometry and mindset: Twin pillars of batting performance in cricket

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Abstract
This study examined the combined role of anthropometric characteristics and psychological attributes in shaping batting performance among cricket players. In the anthropometric component, twenty-five male cricketers (age 17–28 years; 19.16 ± 1.37 years) were drawn through random sampling from cricket academies, practice matches and camps in Haryana, and nineteen predictor variables — age, height, body weight, full arm length, hand length, full leg length, chest, abdomen and hip girths, humerus bicondylar diameter, wrist diameter, biceps, triceps, chest, calf and thigh skinfolds, BMI and fat percentage — were recorded. In the psychological component, fifty male cricketers (19.08 ± 1.22 years) from cricket academies, practice matches and camps in Haryana and Delhi were assessed on achievement motivation (SAMT, Kamlesh, 1990), self-confidence (ASCI, Agnihotri, 1987) and aggression (Smith, 1979). Batting performance was rated by three experienced coaches on a 10-point scale and averaged. Descriptive statistics, Pearson product-moment correlation and stepwise multiple regression were used, with significance fixed at 0.05. Results showed that age, chest skinfold and thigh skinfold emerged as the only significant anthropometric predictors of batting performance, jointly explaining 55.7% of the variance, while achievement motivation ($r = .407$, $p < .05$) and self-confidence ($r = .346$, $p < .05$) showed a significant positive relationship with batting performance; aggression ($r = –.008$, $p > .05$) did not. The findings suggest that batting excellence in cricket rests on twin pillars — an athlete's physical build and their psychological make-up — and that both dimensions merit attention in talent identification and training programmes.

Keywords: Anthropometry, psychological variables, regression, correlation, batting performance, cricket

Introduction

Cricket is among the most widely followed sports in the world, rivalled in popularity by only a handful of other games. Once regarded as a foreign pursuit in many developing nations, it has today become a virtually domestic sport, enjoyed across age groups and communities, including in India (Singh, 1988). The steady expansion of cricket calendars across seasons and continents has pushed players toward more consistent training and competition, which in turn has sharpened scientific interest in the factors that separate an average batsman from an excellent one.

Two broad families of factors are consistently implicated in batting excellence: the athlete's physical build and the athlete's mental make-up. Anthropometric and morphological traits — body mass index, height, circumferences, skinfold thickness and bone widths — have long been regarded as having a bearing on excellence in many sports (Rico-Sanz, 1998; Wilmore & Costill, 1999; Keogh, 1999[15, 20]; Heyward, 2006), since they influence an athlete's leverage, power output and movement efficiency at the crease.

Equally important, however, is the psychological dimension of performance. Sport calls upon both physical and cerebral capacities, and when an athlete's thoughts and emotions fall out of step with their physical ability, performance suffers (Sabir, 2016) [16]. Motivation, self-confidence and aggression are three psychological variables that are closely interlinked and central to optimal athletic performance. Achievement motivation, in particular, has repeatedly been identified as one of the strongest predictors of competitive performance (Huschle, 2008; Carey, 2000; Ames, 1984, 1992; Dweck, 1986; Nicholls, 1989; Sharma & Purashwani, 2021) [2, 3, 5, 7, 9, 14, 17]. Self-confidence, too, has been shown to meaningfully influence athletic performance and is widely regarded by athletes, coaches and sport psychologists alike as a fundamental requirement for sporting success (Taheri, Sohrabi, & Mohamadi, 2010) [19]. Aggression, defined as the intentional imposition of harmful verbal, gestural or bodily conduct on another person, has a more equivocal relationship with performance outcomes (Chawla, 2017) [6].

Since batting performance is, at its core, a product of both what a player's body can do and what a player's mind allows it to do, the present study brings these two strands of enquiry together and examines them side by side rather than in isolation.

It aims

a. To determine the relationship between selected anthropometric variables and batting performance in cricket and to develop a predictive regression equation for the same, and
b. To determine the relationship between selected psychological variables — achievement motivation, self-confidence and aggression — and batting performance in cricket.

Procedure and Methodology

1. Sample

For the anthropometric component of the study, a total of 25 male participants aged 17–28 years were selected through random sampling from cricket camps, practice matches, and cricket academies across Haryana. All participants were regular cricket players with a good level of playing skill.

For the psychological component, a total of 50 male participants were similarly selected through random sampling from cricket camps, practice matches, and cricket academies in Haryana and Delhi. All participants were regular cricket players of comparable age and skill level.

2. Variables

Nineteen anthropometric variables were recorded: age, height, weight, full arm length, hand length, full leg length, chest circumference, abdominal circumference, hip circumference, humerus bicondylar diameter, wrist diameter, biceps skinfold, triceps skinfold, chest skinfold, thigh skinfold, calf skinfold, BMI and fat percentage. Height, leg length, arm length, hand length, chest, abdominal and hip circumferences were measured with a measuring tape; humerus bicondylar and wrist diameters with a sliding calliper; weight with a weighing machine; and skinfold sites with a skinfold calliper.

Three psychological variables were recorded: achievement motivation, evaluated using the Sports Achievement Motivation Test (SAMT) developed by Dr. M.L. Kamlesh (1990); self-confidence, assessed using the Agnihotri Self-Confidence Inventory (ASCI) developed by Rekha Agnihotri (1987); and aggression, evaluated using Smith's (1979) standard psychological instrument.

3. Batting Performance (Dependent Variable)

Three experienced cricket coaches evaluated the playing prowess of the chosen batsmen, following assessment guidelines provided by the investigator. Each coach rated the players on a 10-point scale for each criterion, and the sum of the three coaches' ratings was divided by three to obtain each subject's individual score. The coaches' evaluations were found to be closely correlated with one another.

Statistical Analysis

Means and standard deviations were computed to describe the characteristics of the data. The product-moment correlation coefficient was used to examine the relationship between the anthropometric and psychological variables and batting performance, and stepwise multiple regression analysis was additionally applied to the anthropometric data to derive a predictive equation. The level of significance was fixed at 0.05 throughout. All statistical procedures were carried out using SPSS software.

Results and Discussion

Table 1: Descriptive Statistics of Anthropometric and Psychological Variables with Batting Performance

S.No.	Variables	N	Mean	Std. Deviation
Anthropometric Variables (N = 25)				
1	Batting Performance	25	8.40	.95
2	Age	25	19.16	1.37
3	Height	25	175.84	4.48
4	Weight	25	68.96	5.86
5	Full Arm Length	25	80.82	5.19
6	Hand Length	25	19.22	1.71
7	Full Leg Length	25	96.04	5.44
8	Chest Circumference	25	97.49	7.30
9	Abdomen Circumference	25	82.71	7.62
10	Hip Circumference	25	92.82	8.38
11	Humerus Bicondylar Diameter	25	7.55	.55
12	Wrist Diameter	25	6.13	.44
13	Biceps Skinfold	25	7.91	1.46
14	Triceps Skinfold	25	12.88	3.59
15	Chest Skinfold	25	14.00	1.80
16	Calf Skinfold	25	11.60	2.65
17	Thigh Skinfold	25	11.41	1.91
18	Fat Percentage	25	14.72	5.06
19	BMI	25	22.52	2.01
Psychological Variables (N = 50)				
20	Batting Performance	50	8.41	.87
21	Achievement Motivation	50	24.64	4.98
22	Self-Confidence	50	47.82	2.48
23	Aggression	50	13.28	2.20

Table 1 brings together the descriptive statistics for both variable sets. Among the anthropometric sample (N = 25), the mean age was 19.16 ± 1.37 years, height 175.84 ± 4.48 cm, weight 68.96 ± 5.86 kg, and batting performance 8.40 ± .95. Among the psychological sample (N = 50), the mean achievement motivation was 24.64 ± 4.98, self-confidence 47.82 ± 2.48, aggression 13.28 ± 2.20, and batting performance 8.41 ± .87. The mean and S.D. differences across both variable sets are shown together, picturesquely, in Figure 1.

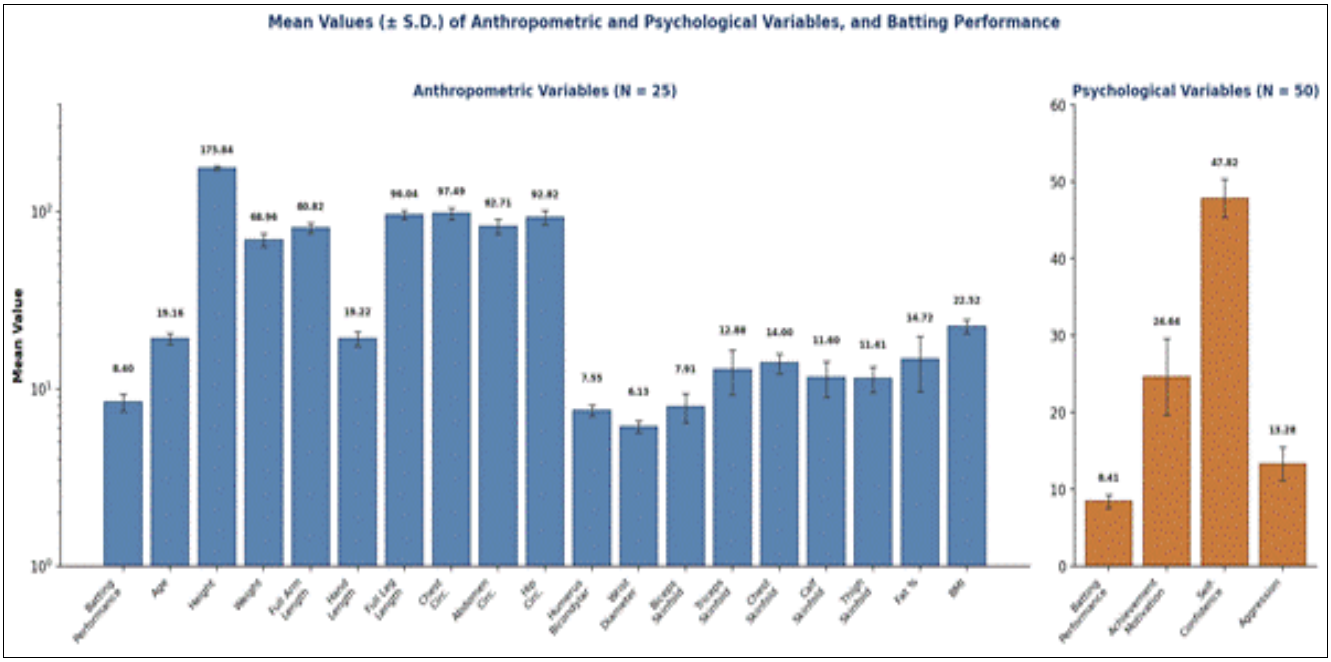

Fig 1: Mean and S.D. of anthropometric and psychological variables, alongside batting performance in each sample.

Table 2 Product-Moment Correlation Coefficients: Anthropometric (X1–X18) and Psychological (Y1–Y3) Variables with Batting Performance

Table 2(a): Factors vs. X1–X10

Factors	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
B.P	.55**	.23	.14	.20	.06	.31	.11	.43*	.19	.09
X1		.03	.04	.23	.16	.17	.01	.22	.02	.20
X2			.34	.46*	.48*	.29	.24	.31	.52	.14
X3				.29	.14	.31	.43	.37	.45	.33
X4					.79	.75	.36	.46	.37	.42
X5						.47	.32	.34	.26	.40
X6							.28	.36	.24	.46
X7								.65	.67	.081
X8									.79	.20
X9										.02
X10										
X11										
X12										
X13										
X14										
X15										
X16										
X17										
X18										
Y1										
Y2										

Table 2(b): Factors vs. X11–X18, Y1–Y3

Factors	X11	X12	X13	X14	X15	X16	X17	X18	Y1	Y2	Y3
B.P	.41*	.35	.21	.50**	.20	.50*	.41*	.10	.407**	.346*	-.008
X1	.37	.31	.05	.25	.25	.15	.26	.31	—	—	—
X2	.10	.02	.53	.24	.05	.21	.00	.12	—	—	—
X3	.05	.32	.51	.06	.43	.25	.17	.18	—	—	—
X4	.51	.11	.25	.07	.34	.08	.20	.09	—	—	—
X5	.43	.09	.20	.08	.37	.10	.10	.04	—	—	—
X6	.56	.37	.05	.14	.07	.13	.14	.31	—	—	—
X7	.00	.47	.48	.27	.14	.08	.52	.00	—	—	—
X8	.16	.55	.51	.24	.10	.21	.88	.00	—	—	—
X9	.09	.42	.73	.00	.12	.29	.63	.03	—	—	—
X10	.56	.28	.35	.40	.44	.25	.14	.19	—	—	—
X11		.07	.19	.24	.38	.01	.13	.32	—	—	—
X12			.18	.46	.15	.10	.52	.17	—	—	—
X13				.03	.13	.53	.45	.06	—	—	—
X14					.18	.07	.34	.05	—	—	—
X15						.00	.09	.21	—	—	—
X16							.24	.06	—	—	—
X17								.04	—	—	—
X18									—	—	—
Y1										-.007	.032
Y2											-.106

X1 = Age, X2 = Height, X3 = Weight, X4 = Full Arm Length, X5 = Hand Length, X6 = Full Leg Length, X7 = Chest Circumference, X8 = Abdomen Circumference, X9 = Hip Circumference, X10 = Humerus Bicondylar Diameter, X11 = Wrist Diameter, X12 = Biceps Skinfold, X13 = Triceps Skinfold, X14 = Chest Skinfold, X15 = Calf Skinfold, X16 = Thigh Skinfold, X17 = Fat Percentage, X18 = BMI, Y1 = Achievement Motivation, Y2 = Self-Confidence, Y3 = Aggression, B.P = Batting Performance. — = not jointly assessed (the anthropometric and psychological variables were recorded on two separate samples, so cross-correlations between the two sets could not be computed). * Significant at 0.05 level; ** Significant at 0.01 level.

Table 2 places the anthropometric and psychological correlations with batting performance side by side in a single matrix (split above into two panels for readability). On the anthropometric side, six variables emerged as significantly correlated with performance: age ($r = .55$, $p = .004$), abdomen circumference ($r = .43$, $p = .030$), wrist diameter ($r = .41$, $p = .038$), chest skinfold ($r = .50$, $p = .010$), thigh skinfold ($r = .50$, $p = .011$) and fat percentage ($r = .41$, $p = .039$).

On the psychological side, achievement motivation ($r = .407$, $p < .05$) and self-confidence ($r = .346$, $p < .05$) were significantly and positively correlated with performance, while aggression ($r = –.008$, $p = .957$) was not. None of the remaining anthropometric variables were found to significantly affect performance. The correlation patterns for only the significantly correlated variables from each set are shown picturesquely, one panel per variable, in Figure 2(a) and Figure 2(b).

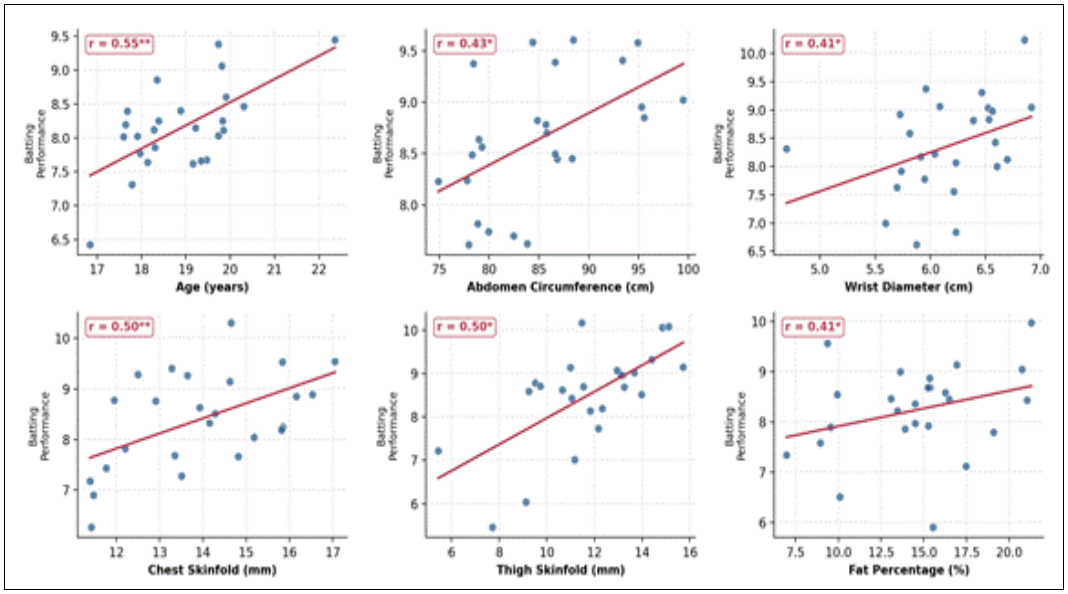

Fig 2(a): Scatter plots of batting performance against each significantly correlated anthropometric variable — age, abdomen circumference, wrist diameter, chest skinfold, thigh skinfold and fat percentage (non-significant variables omitted for clarity).

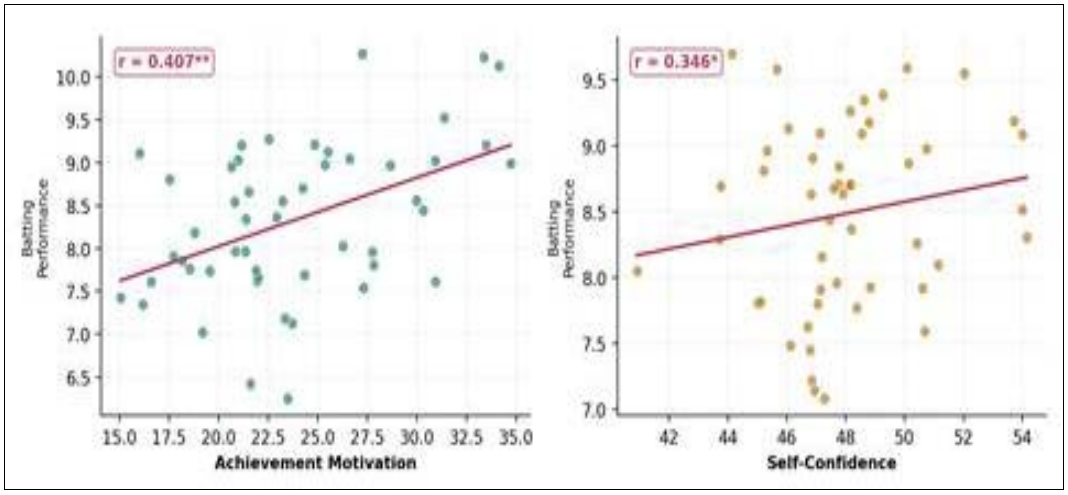

Fig 2(b): Scatter plots of batting performance against each significantly correlated psychological variable — achievement motivation and self-confidence (aggression omitted, being non-significant).

Correlations, though a useful research tool, do not by themselves reveal the predictive power or the underlying nature of the relationship between variables; a positive correlation does not imply that performance improves indefinitely as the predictor increases — it will hold within a specific range only. Regression analysis was therefore additionally used, on the anthropometric data, to build a prediction model best fitting the available data. Having confirmed the underlying assumptions, the researcher applied a stepwise multiple regression analysis to determine whether a parsimonious predictive model could be developed from the anthropometric variables.

Table 3: Regression Analysis of the Predictive Equation of Batting Performance (Anthropometric Variables)

Model	R-Value	R Square	Adjusted R^2	Std. Error of Estimate
1	.551[a]	.303	.273	.81629
2	.694[b]	.481	.434	.72012
3	.783[c]	.613	.557	.63692

a. Predictors: (Constant), Age
b. Predictors: (Constant), Age, Thigh
c. Predictors: (Constant), Age, Thigh, Chest

A stepwise multiple regression was run with batting performance as the dependent variable and all eighteen anthropometric factors entered as candidate predictors. Age, thigh skinfold and chest skinfold emerged as the three strongest predictors. Age alone produced an R^2 of .303, accounting for 27.3% of the variance in performance. The addition of thigh skinfold raised the combined correlation to .694 (R^2 = .481), together explaining 43.4% of the variance. The addition of chest skinfold as a third predictor raised the combined correlation to .783 (R^2 = .613), and the three variables together accounted for 55.7% of the overall variation in batting performance. None of the remaining anthropometric measures contributed further to the prediction of batting performance.

Table 4: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F-Value	Sig. Level
1	Regression	6.675	1	6.675	10.017	.004[b]
	Residual	15.325	23	.666		
	Total	22.000	24			
2	Regression	10.591	2	5.296	10.212	.001[c]
	Residual	11.409	22	.519		
	Total	22.000	24			
3	Regression	13.481	3	4.494	11.077	.000[d]
	Residual	8.519	21	.406		
	Total	22.000	24			

The regression ANOVA distinctly shows the anticipated model with F-values of 10.017, 10.212 and 11.077 across the three steps, with significance levels of .004, .001 and .000 respectively — confirming that each predicted model carried a high, statistically significant F value.

Table 5: Coefficients[a]

Model		B	Std. Error	Beta	t-value	Sig.
1	(Constant)	1.050	2.328		.451	.656
	AGE	.384	.121	.551	3.165	.004
2	(Constant)	4.342	2.377		1.826	.081
	AGE	.339	.108	.486	3.131	.005
	Thigh	-.213	.077	-.427	-2.748	.012
3	(Constant)	8.268	2.566		3.222	.004
	AGE	.275	.099	.394	2.783	.011
	Thigh	-.205	.069	-.411	-2.989	.007
	Chest	-.199	.075	-.375	-2.669	.014

Across the three steps, the standardised beta value for age as a predictor was .551, .486 and .394 respectively. At the second and third steps, the beta value for thigh skinfold was –.427 and –.411, and at the third step the beta value for chest skinfold was –.375. Across the constant and predictor terms, t-values ranged from –2.669 to .451, with significance levels ranging from .014 to .656.

Regression Equation: Batting Performance = 8.268 + .275(X1) – .205(X14) – .199(X16)
Where X1 = Age, X14 = Thigh Skinfold, X16 = Chest Skinfold.
Correlations reveal association but not predictive strength. To place the psychological variables on the same analytical footing as the anthropometric ones, a stepwise multiple regression was additionally run on the psychological data, with batting performance as the dependent variable and achievement motivation, self-confidence and aggression entered as candidate predictors.

Table 6: Regression Analysis of the Predictive Equation of Batting Performance (Psychological Variables)

Model	R-Value	R Square	Adjusted R^2	Std. Error of Estimate
1	.407[a]	.166	.148	.80295
2	.536[b]	.287	.257	.74989

Achievement motivation entered first, producing an R^2 of .166 and accounting for 14.8% of the adjusted variance in performance. The addition of self-confidence as a second predictor raised the combined correlation to .536 (R^2 = .287), together explaining 25.7% of the adjusted variance. Aggression did not enter the model at any step, consistent with its negligible and non-significant correlation with batting performance.

Table 7: ANOVA[a] (Psychological Variables)

Model		Sum of Squares	df	Mean Square	F-Value	Sig. Level
1	Regression	6.142	1	6.142	9.524	.003[b]
	Residual	30.946	48	.645		
	Total	37.088	49			
2	Regression	10.658	2	5.329	9.478	.000[c]
	Residual	26.430	47	.562		
	Total	37.088	49			

The regression ANOVA confirms that both psychological models were statistically significant, with F-values of 9.524 and 9.478 across the two steps and significance levels of .003 and .000 respectively.

Table 8: Coefficients[a] (Psychological Variables)

Model		B	Std. Error	Beta	t-value	Sig.
1	(Constant)	6.658	.579		11.503	.000
	Achievement Motivation	.071	.023	.407	3.087	.003
2	(Constant)	.795	2.139		.372	.712
	Achievement Motivation	.072	.022	.409	3.326	.002
	Self-Confidence	.122	.043	.349	2.833	.007

Regression Equation: Batting Performance = .795 + .072(Y1) + .122(Y2)
Where Y1 = Achievement Motivation, Y2 = Self-Confidence.
Note: Unlike Tables 3–5, which were computed directly from individual raw scores, Tables 6–8 were derived analytically from the correlation matrix reported in Table 2(b) and the descriptive statistics in Table 1, using standard multiple-regression-from-correlations procedures, since individual-level raw scores for the psychological sample were not available for re-analysis. The reported values are mathematically consistent with the correlations already presented in this paper but are best treated as close estimates rather than a literal re-run of the original SPSS output, and it is recommended that these be verified against the original raw data before final submission.

Findings

1. A significant relationship was found between batting performance and several anthropometric factors: age ($r = .55$; $p < .05$), abdomen circumference ($r = .43$; $p < .05$), wrist diameter ($r = .41$; $p < .05$), chest skinfold ($r = .50$; $p < .05$), thigh skinfold ($r = .50$; $p < .05$) and fat percentage ($r = .41$; $p < .05$).
2. No significant relationship was found for height ($r = .23$), weight ($r = .14$), full arm length ($r = .20$), hand length ($r = .06$), full leg length ($r = .31$), chest circumference ($r = .11$), hip circumference ($r = .19$), humerus bicondylar diameter ($r = .09$), biceps skinfold

(r = .35), triceps skinfold (r = .21), calf skinfold (r = .20), and BMI (r = .10).

3. Only three variables — age, chest skinfold and thigh skinfold — entered the final regression model, jointly explaining 55.7% of the variance in batting performance.
4. A significant relationship was found between batting performance and achievement motivation ($r = .407$, $p < .05$) and self-confidence ($r = .346$, $p < .05$).
5. No significant relationship was found between batting performance and aggression ($r = –.008$, $p > .05$).
6. Achievement motivation and self-confidence together, entered stepwise, explained 28.7% of the variance in batting performance ($R = .536$, $R^2 = .287$); aggression did not enter the model.

Conclusion

Taken together, the anthropometric and psychological findings of this study point to batting performance in cricket as an outcome of twin pillars — physical build and psychological make-up — considered here as one combined picture rather than two separate stories. On the physical side, although age, chest skinfold and thigh skinfold were the only anthropometric variables retained in the regression model, this does not mean the remaining variables play no role at all; they may influence performance through pathways not captured by this model. The three retained variables nonetheless explain 55.7% of the variance in batting performance, which suggests the model generalises reasonably well, and in a broader sense these three variables may be regarded as meaningful influences on batting performance. On the psychological side, batting performance was found to share a positive relationship with achievement motivation and self-confidence, while bearing no significant relationship with aggression — suggesting that a batsman's drive to achieve and belief in their own ability matter more to their batting than their aggressive tendencies. Overall, the study reinforces the view that the making of an accomplished batsman rests as much on physical conditioning — particularly age-related maturity and lean body composition — as on a well-developed motivational and confident mindset, and that talent identification and training programmes for batsmen would benefit from attending to both dimensions together, side by side.

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