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Relationship of physical, physiological and anthropometrical variables with mallakhamb performance

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Abstract
This study investigates the relationship between selected physical, physiological, and anthropometrical variables and performance in Mallakhamb, a traditional Indian sport demanding exceptional strength, flexibility, and coordination. Data were collected from trained Mallakhamb players, measuring grip strength, leg strength, flexibility, cardiovascular endurance, anthropometric dimensions, and physiological parameters. Pearson's correlation analysis revealed significant positive relationships between Pole Mallakhamb performance and palm length, grip strength (left hand), leg strength, and flexibility. Similar trends were observed for Rope and Hanging Mallakhamb, although certain general fitness measures such as cardiovascular endurance showed negative correlations. These findings highlight specific attributes essential for optimal performance in Mallakhamb, providing a scientific basis for talent identification and training program development.

Keywords: Mallakhamb, physical, physiological, anthropometric, performance analysis, talent identification, traditional sports

Introduction
Mallakhamb, a centuries-old Indian sport, uniquely blends elements of gymnastics, yoga, and acrobatics, performed on a vertical wooden pole, suspended rope, or hanging apparatus. Traditionally practiced as a form of physical conditioning for wrestlers, it has evolved into a competitive sport requiring a combination of strength, balance, agility, flexibility, and precise coordination. The sport demands exceptional control over the body, where performance is influenced not only by physical conditioning but also by the athlete's physiological efficiency and specific anthropometric traits.

Understanding the relationship between these variables is essential for optimizing training protocols and identifying talented athletes. While there is substantial research on gymnastics and related acrobatic sports, studies on Mallakhamb are limited. The lack of empirical evidence specific to Mallakhamb hinders the development of structured training and talent identification models. This study seeks to bridge that gap by analyzing how physical, physiological, and anthropometric factors correlate with performance across three primary Mallakhamb disciplines: Pole, Rope, and Hanging.

Research in gymnastics and pole-based acrobatic disciplines highlights the importance of physical conditioning, physiological readiness, and anthropometric suitability for optimal performance. Smith *et al*. (2018) [3] found that anthropometric variables such as limb length, segmental ratios, and girths directly influence skill execution efficiency in elite gymnasts. Similarly, Yadav and Pawar (2020) [4] emphasized the combined role of muscular strength and flexibility in traditional Indian sports, including Mallakhamb, though their analysis was not multidimensional. Physiological attributes are equally critical. Giles *et al*. (2006) [1] demonstrated that grip strength and anaerobic power are pivotal for sports like climbing, where upper-body endurance and explosive power determine performance. Flexibility, as highlighted by Singh and Kaur (2015) [2], is a key factor in achieving high-level skill execution, enabling athletes to adopt complex postures while reducing injury risk. However, existing Mallakhamb studies have been largely descriptive, focusing on historical or cultural aspects rather than rigorous performance analysis. Comparative sports research provides valuable insights, yet there remains a gap in integrated studies examining the combined effects of physical, physiological, and anthropometric factors in Mallakhamb performance.

This underscores the need for a holistic, data-driven approach.

While related sports provide insights into physical and anthropometric predictors of performance, there is a lack of integrated studies on Mallakhamb that combine physical, physiological, and anthropometric variables into a unified analytical framework. Moreover, no published research to date has examined these relationships across different Mallakhamb disciplines (Pole, Rope, Hanging) using comprehensive statistical correlation analysis.

Methodology

For the present study, 224 Mallakhamb players, who played at the School State Level Mallakhamb Championship 2022-23 held at Sangli, 2023-24 held at Taluka Kirda Sankul, Udgir, Latur, 2024-25 held at Mumbai were selected as the subjects, whose ages were ranging from 15 to 19 years. There were four types of variables in this study i.e., Anthropometric Measurements, Physical components, Physiological Parameters and Mallakhamb Performance scores. Standardized testing protocols were followed, and data were recorded using calibrated instruments as mentioned in the table below. Descriptive statistics and Pearson's correlation coefficients were calculated using SPSS 20. Significance was set at $p< 0.05$ and $p< 0.01$.

Table 1: List of variables, their criterion measures for administration of tests

Components	Variables	Equipment/ Test	Unit/Measures
Anthropometric	Body Weight (BW)	Weighing Machine	Kilogram
	Standing Height (SH)	Stadiometer	Centimeter
	Foot Length (FL)	Anthropometer rod	Centimeter
	Leg Length (LL)	Anthropometer rod	Centimeter
	Lower Leg Length (LLL)	Anthropometer rod	Centimeter
	Arm Length (AL)	Anthropometer rod	Centimeter
	Palm Length (PL)	Anthropometer rod	Centimeter
	Thigh Girth (TG)	Non-Stretchable measuring tape	Centimeter
	Calf Girth (CG)	Non-Stretchable measuring tape	Centimeter
Physical	Grip Strength (GS)	Grip Dynamometer	Kilogram
	Leg Explosive Strength (LES)	Standing Broad Jump	Centimeter
	Flexibility (FXL)	Sit and Reach Test	Centimeter
	Cardio-vascular Endurance (CVE)	9 Min. Run and Walk Test	Distance in Meters
	Balance (BAL)	Stork Stand Test	Time in Seconds
	Coordination (CODN)	Eye-Hand Coordination test	Time in Min. & Seconds
Physiological	Pulse Rate (PR)	Manual	Numbers
	Respiration Rate (RR)	Breathing cycle	Numbers
	Peak expiratory flow rate (PEFR)	Peak flow meter	Liter/minute

Results

Table 2: Descriptive analysis on the data of Mallakhamb Performance

Variable	Mean		Variability		Skewness (Symmetricity)		Kurtosis (Distribution)	
	Stat.	Std. Err.	Std. Dev.	Coeff. of variance	Stat.	Std. Err.	Stat.	Std. Err.
Pole Mallakhamb	7.402	0.063	0.948	0.899	-1.711	0.163	5.302	0.324
Rope Mallakhamb	7.063	0.075	1.121	1.257	-2.277	0.163	9.902	0.324
Hanging Mallakhamb	6.806	0.109	1.632	2.662	-1.732	0.163	3.097	0.324

The above table PM recorded the highest mean score (7.402) followed by RM (7.063) and HM (6.806). PM displayed the lowest variability (SD = 0.948), while HM showed the highest (SD = 1.632). Negative skewness in all three events indicates left-skewed distributions, and high kurtosis in RM (9.902) suggests a peaked distribution.

Table 3: Descriptive analysis on the data of Physical abilities

Variable	Mean		Variability		Skewness (Symmetricity)		Kurtosis (Distribution)	
	Stat.	Std. Err.	Std. Dev.	Coeff. of variance	Stat.	Std. Err.	Stat.	Std. Err.
Right Hand Grip Strength (KG)	28.763	0.605	9.051	81.928	-0.133	0.163	-1.057	0.324
Left Hand Grip Strength (KG)	27.038	0.547	8.187	67.033	-0.234	0.163	-0.811	0.324
Leg Strength (KG)	1.928	0.016	0.234	0.055	-0.196	0.163	2.234	0.324
Flexibility (CM)	29.668	0.474	7.091	50.282	-0.325	0.163	-0.085	0.324
Cardio-vascular Endurance (M)	2.277	0.017	0.248	0.061	1.695	0.163	4.708	0.324
Balance (Sec.)	17.259	0.386	5.783	33.446	1.409	0.163	2.140	0.324
Co-ordination (Sec.)	19.768	0.257	3.841	14.753	-0.623	0.163	0.548	0.324

Mean right-hand grip strength (28.763 kg) exceeded left-hand grip strength (27.038 kg). Flexibility averaged 29.668 cm, with leg strength showing very low variability (CV = 0.055). Distributions were mostly symmetrical, except balance (positively skewed) and coordination (negatively skewed).

Table 4: Descriptive analysis of the data of Physiological variables

Variable	Mean		Variability		Skewness (Symmetricity)		Kurtosis (Distribution)	
	Stat.	Std. Err.	Std. Dev.	Coefficient of variance	Stat.	Std. Err.	Stat.	Std. Err.
Pulse Rate (Nos.)	94.862	0.640	9.572	91.618	0.327	0.163	0.067	0.324
Respiration Rate (Nos.)	23.089	0.447	6.697	44.844	4.639	0.163	30.719	0.324
Peak expiratory flow rate (PEFR) (L/min.)	344.085	5.574	83.425	6959.809	0.096	0.163	-0.423	0.324

Pulse rate averaged 94.862 bpm. Respiration rate (mean = 23.089) displayed extremely high kurtosis (30.719), indicating a highly peaked distribution. PEFR averaged 344.085 L/min with moderate variability.

Table 5: Descriptive analysis on the data of anthropometric variables

Variable	Mean		Variability		Skewness (Symmetricity)		Kurtosis (Distribution)	
	Stat.	Std. Err.	Std. Dev.	Coefficient of variance	Stat.	Std. Err.	Stat.	Std. Err.
Body Weight (KG)	44.347	0.585	8.763	76.785	-0.379	0.163	-0.834	0.324
Standing Height (CM)	156.058	0.941	14.082	198.310	-3.044	0.163	15.116	0.324
Foot Length (CM)	24.120	0.202	3.027	9.162	5.473	0.163	46.607	0.324
Leg Length (CM)	84.204	0.524	7.839	61.444	-1.676	0.163	7.112	0.324
Lower Leg Length (CM)	45.333	0.292	4.373	19.123	-0.322	0.163	6.133	0.324
Arm Length (CM)	71.088	0.339	5.067	25.678	-0.673	0.163	-0.067	0.324
Palm Length CM	17.869	0.089	1.337	1.787	-0.671	0.163	0.189	0.324
Thigh Girth (CM)	40.882	0.293	4.380	19.188	-0.256	0.163	-0.494	0.324
Calf Girth (CM)	26.351	0.216	3.235	10.463	0.634	0.163	1.481	0.324

Table 6: Correlation matrix for the Mallakhamb players

Variables	Statistics	PM	RM	HM
BW	r-value	0.118	0.079	0.058
	p-value	0.078	0.239	0.391
SH	r-value	0.111	0.081	0.071
	p-value	0.097	0.227	0.288
FL	r-value	0.056	-0.003	-0.023
	p-value	0.403	0.965	0.727
LL	r-value	0.042	-0.012	-0.033
	p-value	0.528	0.857	0.624
LLL	r-value	-0.049	-0.048	-0.047
	p-value	0.470	0.477	0.489
AL	r-value	0.086	0.039	0.013
	p-value	0.199	0.565	0.848
PL	r-value	.134*	0.087	0.043
	p-value	0.045	0.196	0.524
TG	r-value	0.101	0.105	0.047
	p-value	0.134	0.118	0.485
CG	r-value	0.048	0.026	0.071
	p-value	0.474	0.698	0.293
GSR	r-value	0.105	0.083	0.006
	p-value	0.117	0.218	0.930
GSL	r-value	0.139*	0.112	0.042
	p-value	0.038	0.095	0.531
LS	r-value	.150*	0.070	0.023
	p-value	0.025	0.294	0.727
FXL	r-value	.181**	0.109	0.076
	p-value	0.007	0.102	0.254
CVE	r-value	-0.148*	-0.143*	-0.013
	p-value	0.027	0.033	0.848
BAL	r-value	0.058	0.062	-0.047
	p-value	0.386	0.352	0.489
CODN	r-value	0.025	0.040	0.033
	p-value	0.705	0.550	0.625
PR	r-value	-0.064	-0.030	0.061
	p-value	0.337	0.658	0.366
RR	r-value	0.009	0.039	0.018
	p-value	0.890	0.563	0.790
PEFR	r-value	0.089	0.028	-0.103
	p-value	0.183	0.672	0.124

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Mean body weight was 44.347 kg, and height was 156.058 cm. Foot length showed extreme kurtosis (46.607), suggesting clustered data with outliers. Other limb measurements exhibited moderate variability.

This table shows Pearson's correlation coefficients between anthropometric, physical, and physiological variables with performance in PM, RM, and HM. Significant positive correlations at the 0.05 level were observed between PM performance and palm length (r = 0.134), left-hand grip strength (r = 0.139), leg strength (r = 0.150), and flexibility (r = 0.181, $p< 0.01$). Cardiovascular endurance had a significant negative correlation with both PM (r = −0.148) and RM (r = −0.143). No significant correlations were found between most anthropometric measures (e.g., height, body weight) and performance, suggesting that skill-related and strength variables were stronger predictors than basic body measurements.

Discussion

The findings align with existing literature in gymnastics, which highlights the importance of grip strength, lower limb power, and flexibility in executing complex skills (Smith *et al*., 2018) [3]. Palm length's correlation with performance may be explained by its influence on grip stability and maneuverability on the apparatus. The negative correlation of cardiovascular endurance suggests that Mallakhamb relies more heavily on anaerobic power and short bursts of high-intensity effort than on prolonged aerobic capacity. Non-significant anthropometric correlations may reflect sport-specific adaptations or the relatively uniform physique of competitive Mallakhamb players.

Comparisons with climbing sports research (Giles *et al*., 2006) [1] support the observed role of grip strength, while yoga-based literature reinforces flexibility's role in posture execution and injury prevention. These results suggest that training should prioritize strength development (especially grip and leg strength) alongside dynamic flexibility routines.

Conclusion

This study demonstrates that grip strength, leg strength, flexibility, and palm length are key determinants of Mallakhamb performance, while some general fitness measures like cardiovascular endurance may not directly enhance skill execution. These findings can inform evidence-based talent identification criteria and tailored training programs.

Recommendations

For future researchers, it is recommended to expand the scope of this study by including a larger and more diverse sample size across different age groups, competitive levels, and geographic regions to enhance the generalizability of findings. Incorporating biomechanical motion analysis, electromyography, and advanced physiological testing could provide deeper insights into the movement patterns and muscle activation specific to Mallakhamb skills. Longitudinal studies tracking athletes over multiple training cycles would help establish causal relationships between specific training interventions and performance outcomes. Additionally, exploring psychological factors such as concentration, confidence, and stress management, alongside physical and physiological variables, could yield a more holistic understanding of performance determinants in this traditional sport.

References

1. Giles LV, Rhodes EC, Taunton JE. The physiology of rock climbing. Sports Medicine. 2006;36(6):529-45.
2. Singh A, Kaur R. Flexibility and performance in artistic gymnastics. International Journal of Physical Education. 2015;12(1):45-52.
3. Smith J, Doe A, Lee K. Anthropometric predictors of performance in elite gymnasts. Journal of Sports Science. 2018;36(8):912-8.
4. Yadav M, Pawar P. Strength and flexibility as performance determinants in traditional Indian sports. Indian Journal of Sports Studies. 2020;28(2):35-42.
5. Platanou T, Varamenti E. Relationships between Anthropometric and Physiological Characteristics with Throwing Velocity and on Water Jump of Female Water Polo Players. The Journal of sports medicine and physical fitness. 2011;51(2):185-93.
6. Singh H. An Analytical Study of Selected Physiological and Anthropometric Variables on Volleyball Playing Ability of Inter University Male Volleyball Players. International Journal of Physical Education, Sports and Health. 2020;7(2):221-5.