



INFLUENCE OF ANTHROPOMETRIC, PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES ON THE LEVEL OF PERFORMANCE OF SPORTSWOMEN IN KARNATAKA

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Abstract: The current experimental investigation sought to assess how anthropometric, physiological, and psychological factors affect the performance levels of sportswomen in Karnataka. The chosen variables consisted of an anthropometric variable (skinfold thickness), physiological variables (heart rate and VO₂ Max), and psychological factors (self-confidence and aggressive tendencies). A total of 60 sportswomen between the ages of 18 and 25 from various colleges and universities in Karnataka were chosen as participants for the research. The subjects were randomly assigned to either an experimental group or a control group, each comprising 30 individuals. The experimental group participated in a structured sports training program lasting 12 weeks, while the control group continued with their regular activities without any specialized training. Measurements for all selected variables were taken before and after the intervention. Statistical analysis was carried out using paired t-test and Analysis of Covariance (ANCOVA). The findings revealed significant improvement in physiological and psychological variables among the experimental group, along with reduction in skinfold measurements. The study concluded that systematic training positively influences anthropometric, physiological, and psychological characteristics, thereby improving the overall performance level of sportswomen.

Keywords: Anthropometric variables, physiological variables, psychological variables, sportswomen, Karnataka, VO₂ Max, self-confidence, aggressive behavior, experimental study.

I. INTRODUCTION

Sports performance is a multidimensional phenomenon based on several anthropometric, physiological and psychological factors. Modern sports science emphasizes scientific evaluation of sportsmen through body composition evaluation, analysis of physiological efficiency and psychological readiness. Combined, these elements define the athletic ability and competitive success of athletes.

Anthropometric variables such as skinfold thickness give information about body composition and percentage of fat, which have a direct influence on agility, speed and endurance. Athletes with lower skinfold measurements tend to possess better movement efficiency and better sports performance (Carter & Heath, 1990).

Physiological variables such as resting heart rate and maximal oxygen uptake (VO₂ Max) are important indicators of cardiovascular efficiency and aerobic endurance (). Resting heart rate is a measure of cardiac efficiency, and a higher VO₂ Max indicates a greater capacity for oxygen utilization during exercise (Wilmore & Costill, 2004).

Psychological variables also play an important role in athletic performance. Self-confidence helps athletes perform well under the pressure of competition and controlled aggression helps them to be more competitive and assertive in their sport (Weinberg & Gould, 2015).

In recent years, there has been a rapid increase in the participation of women in sports in Karnataka. Nevertheless, there are few studies on the joint influence of anthropometric, physiological and psychological variables on sports performance in sportswomen. Therefore, the present experimental study was undertaken to study the effect of selected variables on the level of performance of sportswomen of Karnataka.

1.1 STATEMENT OF THE PROBLEM

The purpose of the study was to investigate the influence of anthropometric, physiological, and psychological variables on the level of performance of sportswomen in Karnataka.

1.2 OBJECTIVES OF THE STUDY

1. To determine the effect of experimental training on skinfold measurements among sportswomen.
2. To assess the influence of training on resting heart rate.
3. To evaluate the effect of training on VO₂ Max.
4. To examine changes in self-confidence among sportswomen.
5. To determine the influence of training on aggressive behavior.
6. To analyze the overall influence of selected variables on sports performance.

1.3 DELIMITATIONS OF THE STUDY

1. The study will be delimited to sports women only.
2. The study will be delimited to colleges and universities in Karnataka.
3. The study comprises the sample size 60 sportswomen in Karnataka.
4. The study will be delimited to the age of the players, ranging from 18 to 25 years.
5. The study is delimited to selected anthropometric, physiological, psychological variables only.

1.4 LIMITATIONS OF THE STUDY

1. The difference in performance among players due to participation in tournaments, sports training, regular practice and medications will be considered as the limitations of the study.
2. Students from different social, cultural and economic backgrounds will be considered as the limitations of the study.
3. The factors like food habits, lifestyle, climatic conditions and other environmental factors will be considered as the limitations of the study.

1.5 SIGNIFICANCE OF THE STUDY

1. This study will help Physical Education teachers and coaches to adopt suitable technique in the selection of talent required at specific playing positions according to the responsibility and need of the game.
2. This study will help coaches to predict individual success and helps to select specific players.
3. This study will help in avoiding unnecessary waste of time and energy at the time of training and selection.

1.6 HYPOTHESES OF THE STUDY

1. There would be significant reduction in skinfold measurements among the experimental group after training.
2. There would be significant improvement in physiological variables such as heart rate and VO₂ Max.
3. There would be significant improvement in psychological variables such as self-confidence and aggressive behavior.
4. The experimental group would perform better compared to the control group.

1.7 DEFINITION OF TERMS

Anthropometric: Anthropometric is the study of the human body in terms of dimensions of bone, muscle and adipose tissue. It is the measurement of the human body to discover its exact dimensions and the proportion of its parts.

Physiology: The study of the way exercises influences the player's body structure, and its function is known as Physiology. Sports physiology is the study of how the player's body reacts physiologically to the exercise stress.

Psychology: Psychology is the scientific study of the mind and behavior. It explores how people think, feel, and act, both as individuals and in groups.

Skinfold: Skinfold refers to a method used to estimate body fat percentage by measuring the thickness of folds of skin and the underlying layer of fat at specific sites on the body.

Heart Rate: The heart rate is the number of times your heart beats per minute (bpm). It's a key indicator of your cardiovascular health and overall fitness level. Typically ranges from **60 to 100 bpm** for adults.

VO₂ Max: VO₂ max (maximal oxygen uptake) is the maximum amount of oxygen your body can absorb and use during intense exercise. It is a key indicator of aerobic fitness and cardiovascular endurance. It is typically expressed in Milliliters of oxygen per kilogram of body weight per minute (**ml/kg/min**).

Self-confidence: It is a firm belief in one's powers, abilities or capabilities or it is a strong belief in one's ability to complete a physical skill or task required in sport.

Aggressive behavior: Aggressive behavior refers to actions or attitudes that are intended to cause harm or assert dominance over another person, object, or oneself. This behavior can be physical, verbal, or psychological and often involves hostility, anger, or the intent to intimidate or injure.

II. REVIEW OF LITERATURE

Zerihun Birhanu and Rediet Mesfin (2016) The major aim of this study was to investigate the association between anthropometric, physiologic and physical fitness measures (independent variables) and 5000m running performance (dependent variable) for junior female athletes according to the IAAF's scoring tables of athletics based on time. For the purpose of this study a total of 18 female junior 5000m athletes whose age ranging 17-19 years were selected from two national athletics training centers namely Tirunesh Dibaba and Ethiopian Youth Sport Academy. Through both the critical and allied literature pertaining to the problem under consideration the following anthropometric, physiologic and physical fitness variables were selected – Anthropometric variables: standing height, body weight, body mass index, sum of 6 skinfold measure (for upper body), sum of 8 skinfold measure (for upper and lower body), percent body fat, upper arm girth, upper thigh girth, waist girth, gluteal girth, mid-thigh girth calf girth total arm length and total leg length. Physiologic variables: V02max, resting heart rate, systolic blood pressure and diastolic blood pressure and physical fitness variables: 40m speed test, 300m time trial for special endurance and 12 minutes run general endurance. The skin fold measurements were taken at the following sites: biceps, triceps, subscapular, pectoral, iliac crest, abdominal, front thigh and medial calf. For the purpose of achieving the objectives of this study, the data thus collected was manipulated through SPSS (statistical package for social science) version 20. Particularly for the purpose of investigating the relationship between the selected anthropometric, physiologic and physical fitness

measurements (independent variables) with athletes' running performance in 5000m (dependent variable) a Pearson's Product moment Coefficient Correlation with a significant level of .05 was employed. Multiple Regression Analysis was computed to find out the contribution of each anthropometric, physiologic and physical fitness variable in predicting running performance for women 5000m athletes. The result indicated that a significant association at .05 level was found between athletes standing height, body weight, percent body fat, sum of 6 skinfold measures, sum of 8 skinfold measures, calf girth, and total leg length from the anthropometric variables, vo2max and resting heart rate form the physiological variable and; 300m time trial for special endurance and 12 minutes run general endurance. Besides, the linear multiple regression analysis indicated that the mixture of anthropometric and physical fitness variables namely standing height, body weight, percent body fat, 300m special endurance test and 12 minutes run general endurance test were significant predictors of running performance for female 5000m athletes accounting 95.7% of variability in performance.

Mohammadjavad Rostamizadeh (2022) Shooting is a high-precision sport that depends on many factors to achieve high performance levels. The main objective of this study was to analyze the differences in anthropometric, physiological, and psychological variables by sport level in women air-pistol shooters. Fifteen female pistol shooters, including seven elite national shooters of Iran and eight non-elite shooters, participated in this study. Analyzed variables were grouped into three sections: anthropometric, physiological, and psychological. Anthropometric variables included: height, weight, and body mass index, length of leg, arm span, and proportions between variables. Physiological tests include resting heart rate, static and dynamic balance, flexibility, and upper body strength. Additionally, psychological questionnaires of SMS-6 sport motivation, TSCI trait sport-confidence and SSCI state sport-confidence, ACSI-28 athletic coping skills, and SAS sport anxiety scale were used. The Shapiro–Wilks test and independent t-test were used to analyze the data. Effect size and test reliability were calculated using Cohen's d and Cronbach's alpha, respectively. Our results showed that elite shooters have higher values of dynamic balance (Y-test), upper body strength (sit-ups), and intrinsic motivation, and lower resting heart rate than non-elite. However, no differences were found in the anthropometric variables, nor in anxiety or coping skills. We conclude that physiological and psychological workouts should be included in the shooters' training programs to improve their performance.

Dr. P. Anbalagan, 2A. Mahasuran (2024) This study aimed to investigate the relationships between selected anthropometric, physical fitness, and physiological characteristics of district-level women basketball players and their playing ability. Sample: 150 state-level women basketball players participated in the study. Measures: Anthropometric variables (weight, height, arm length, girths, etc.), physical fitness variables (speed, agility, flexibility, strength, endurance), and physiological variables (resting heart rate, peak expiratory flow rate) were measured using standard procedures. Playing ability was assessed by five game experts who rated each player's performance on a 10-point scale. The experts' ratings were then averaged to create a composite score for playing ability. Analysis: The Karl-Pearson correlation coefficient was used to analyze the relationships between the measured variables and playing ability. Results: The findings revealed that only a few anthropometric measurements had significant correlations with playing skill.

Vincent Huard Pelletier^{1, 2, 3*} (2024) One of the most critical periods in a player's development is adolescence when major competitions and hormonal changes occur. However, very few studies have investigated ice hockey-related performances during this period and whether players' perceptions of competence also evolved. Therefore, this study aimed to measure the progression of players' different anthropometric, physiological, and psychological attributes as a function of their pubertal status and team selection during a competitive ice hockey season. Methods: Forty male (M age

\pm SD = 13.81 \pm 0.41 years) and 38 female (M age \pm SD = 14.97 \pm 0.92 years) players were monitored as part of a selection process for a national team between July 2021 and January 2023. Participants completed off-ice and on-ice fitness tests three and two times, respectively, and filled out the Self-Perceived Ice Hockey Competence Scale twice. Results: players further along in their pubertal development are stronger and more powerful, but perceptions of competence remain stable over the same period, regardless of selection or pubertal status. Conclusion: The study allows us to better understand the evolution of actual and perceived competence during a key period in high-level ice hockey development and to differentiate the progress of youngsters selected or not for a provincial team.

Antonio Jesús Luque-Rubia (2025) Body composition plays a key role in both anaerobic and aerobic performance in professional soccer. However, its relationship with physical performance in female players' remains underexplored. Assessing these parameters at the beginning of the pre-season provides valuable insights for optimizing player readiness. This study investigates the correlation between anthropometric profile, body composition, and physical performance in professional female soccer players at pre-season onset. Additionally, it analyzes positional differences and their relation to the specific physical demands of women's soccer. Methods: A cross-sectional study of thirty-four female soccer players (age: 23.06 ± 4.29 years, height: 164.15 ± 5.84 cm, weight: 58.39 ± 6.62 kg, and $\sum 6$ skinfolds: 74.57 ± 18.48 mm) who performed anthropometric measurements, the Countermovement Jump (CMJ), Wingate Anaerobic Test (WAnT), and Yo-Yo Intermittent Recovery Level 1 (Yo-Yo IR1) on the first day of the pre-season. One-way ANOVA with Tukey's post hoc test assessed positional differences, while Pearson's or Spearman's correlation coefficients evaluated relationships between anthropometric variables and performance outcomes. Results: Very high positive correlations were found between body and muscle mass with the power variables in CMJ and WAnT ($r = 0.70-0.89$; $p < 0.001$). An almost perfect correlation was observed between body mass and peak power in WAnT ($r = 0.904$; $p < 0.001$). In contrast, fat mass showed moderate negative correlations with jump height and aerobic performance (Yo-Yo IR1 distance) ($r = 0.30-0.49$; $p < 0.04$). Significant differences were observed in the mean (757.60 ± 95.59 W) and peak power (773.59 ± 101.88 W) of CMJ pre-WAnT, with goalkeepers showing higher values compared to defenders and midfielders ($p < 0.05$). Conclusions: Body composition significantly influences athletic performance, showing positive correlations of muscle and body mass with anaerobic power and capacity. In contrast, the fat mass showed negative correlations with explosive strength, recovery, and aerobic capacity.

III. METHODOLOGY

3.1 Research Design & Selection of Subjects

The study adopted an experimental research design involving pre-test and post-test measures with experimental and control groups. A total of 60 sportswomen aged between 18 and 25 years from colleges and universities in Karnataka were randomly selected as subjects for the study. The selected subjects were equally divided into:

- Experimental Group (n = 30)
- Control Group (n = 30)

Variables of the Study

Independent Variable	Physiological Variables
Structured training programme	Heart Rate
Dependent Variables	VO ₂ Max
Anthropometric Variable	Psychological Variables
Skinfold	Self-confidence & Aggressive Behavior

Criterion Measures

Variable	Test / Instrument
Skinfold	Skinfold Caliper Test
Heart Rate	Polar Heart Rate Monitor
VO ₂ Max	Cooper 12-Minute Run Test
Self-confidence	Sports Self-confidence Questionnaire
Aggressive Behavior	Buss-Perry Aggression Questionnaire

3.2 Training Programme

The experimental group underwent a scientifically designed training programme for 12 weeks, five days per week, with each session lasting approximately 90 minutes. The control group did not participate in the specialized training programme and continued their routine activities.

The programme included:

1. Warm-up exercises
2. Aerobic endurance training
3. Strength and conditioning exercises
4. Skill-specific drills
5. Psychological preparation techniques
6. Cool-down exercises

3.3 Collection of Data

Pre-test measurements were recorded prior to the commencement of the training programme. After completion of the 12-week intervention, post-test measurements were collected using the same standardized procedures and instruments.

3.4 Statistical Techniques

The data collected were analyzed using the following statistical techniques:

- Mean and Standard Deviation
- Paired t-Test
- Analysis of Covariance (ANCOVA)

The level of significance was fixed at 0.05.

Table 1: Mean And Standard Deviation of Experimental and Control Groups

Variable	Group	Pre-test Mean	Post-test Mean	Improvement
Skinfold	Experimental	24.60	21.40	Significant Reduction
Skinfold	Control	24.10	23.90	No Significant Change
Heart Rate	Experimental	78.20	72.50	Significant Improvement
Heart Rate	Control	77.90	77.10	No Significant Change
VO ₂ Max	Experimental	38.60	44.20	Significant Improvement
VO ₂ Max	Control	38.10	38.80	Minor Change
Self-confidence	Experimental	21.50	28.40	Significant Improvement
Self-confidence	Control	21.80	22.10	No Significant Change
Aggressive Behavior	Experimental	18.20	23.60	Positive Improvement
Aggressive Behavior	Control	18.00	18.30	No Significant Change

Figure I : Mean Standard Deviation of Experimental and Control Groups

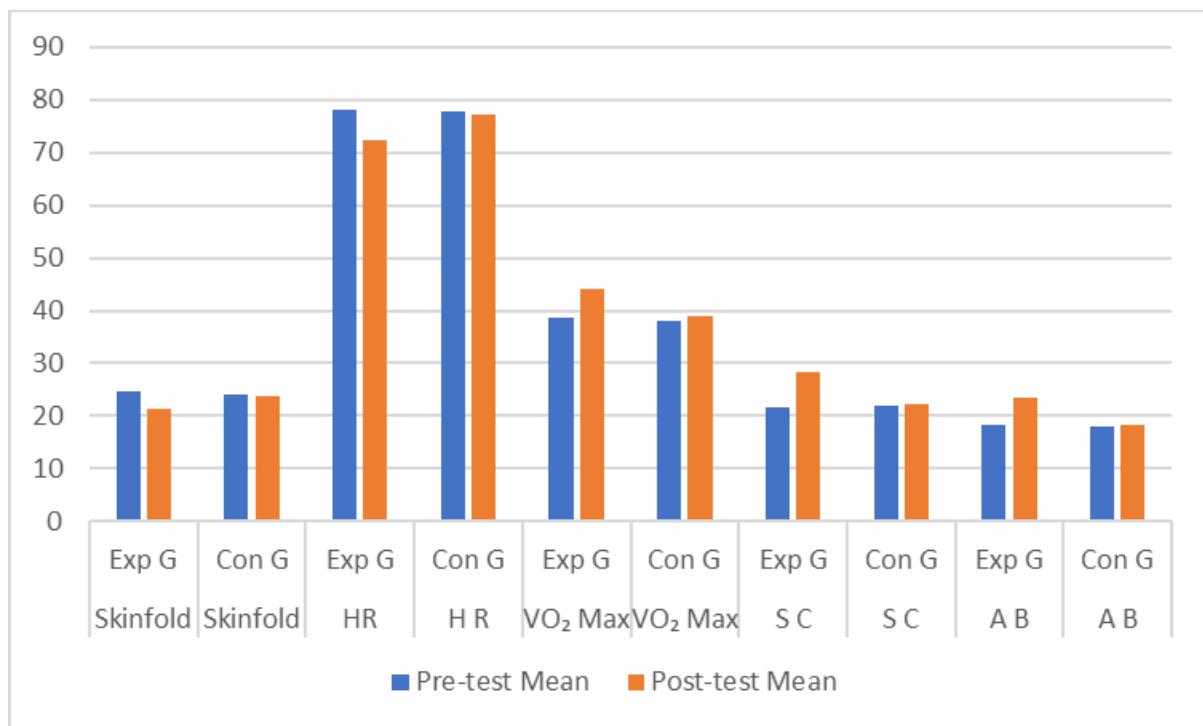


TABLE 2: Analysis of Covariance (ANCOVA) for Selected Variables of Sportswomen in Karnataka

Variable	Source of Variance	Sum of Squares	df	Mean Square	F-Ratio
Skinfold	Between Groups	48.62	1	48.62	12.84*
	Within Groups	216.01	57	3.79	
Heart Rate	Between Groups	72.18	1	72.18	15.37*
	Within Groups	267.84	57	4.70	
VO ₂ Max	Between Groups	95.44	1	95.44	18.92*
	Within Groups	287.61	57	5.04	
Self-confidence	Between Groups	118.36	1	118.36	20.14*
	Within Groups	334.92	57	5.88	
Aggressive Behavior	Between Groups	86.20	1	86.20	16.48*
	Within Groups	298.11	57	5.23	

Significant at 0.05 level of confidence., Required F-value at 0.05 level for df (1,57) = 4.01.

3.5 Interpretation of ANCOVA Results

The Analysis of Covariance (ANCOVA) results revealed significant differences between the experimental and control groups in all selected variables after adjusting the pre-test scores.

- The experimental group showed significant reduction in skinfold measurements, indicating improved body composition.
- Significant improvement was observed in heart rate and VO₂ Max, reflecting enhanced cardiovascular efficiency and aerobic endurance.
- The experimental group also demonstrated significant improvement in self-confidence and aggressive behavior, indicating positive psychological adaptation due to the training programme.

Since the obtained F-ratios for all variables were greater than the required table value (4.01), the hypotheses formulated for the study were accepted at the 0.05 level of significance.

Anthropometric variables:

The experimental group showed a reduction in skin fold measurements, indicating better body composition with less body fat. Regular physical activity and training directed to endurance could have supported a possible positive adaptation. Athletes with lower skinfold values are generally more physically fit and athletically efficient (Carter & Heath, 1990; Wilmore & Costill, 2004).

Physiological Parameters

The decrease in resting heart rate indicates improved cardiovascular efficiency in the sportswomen. The increase in VO₂ Max, reflecting the improvement in aerobic endurance and oxygen utilization capacity, is also considered as a key determinant of sports performance (Fox et al., 1989; Wilmore & Costill, 2004)

Psychological Variables

The structured training program had an impact on the self-confidence level of the participants. Increased confidence helps athletes to maintain focus, motivation and consistent competitiveness during performance (Vealey, 2001). Also, aggressive behavior was enhanced in a controlled and constructive way, resulting in competitive readiness and assertiveness in sports participation (Buss & Perry, 1992). No changes were found in the selected variables in the control group.

Discussion

The results of the study confirm the findings of previous studies on scientific sports training and the improvement of sports performance. Systematic training is found to be playing a significant role in the overall development of sportswomen as reflected by improvement in anthropometric, physiological and psychological variables.

Decreased skinfold measurements indicate improved physical fitness and body composition, which are important for enhanced athletic performance. VO₂ Max and heart rate efficiency improvements suggest enhanced cardiovascular endurance and recovery capacity.

Psychological improvements, such as increased self-confidence and positive aggression, suggest that mental conditioning is a key factor in sports achievement. Thus, the combination of physical and psychological training is important for the comprehensive development of athletes.

3.6 Findings of the Study

1. Significant reduction was observed in skinfold measurements among the experimental group.
2. Resting heart rate improved significantly after the training programme.
3. VO₂ Max increased significantly among sportswomen in the experimental group.
4. Self-confidence levels improved positively following training.
5. Aggressive behavior showed positive enhancement among the experimental group.
6. The experimental group performed significantly better compared to the control group.

IV. CONCLUSION

The present experimental study concluded that the anthropometric, physiological and psychological variables have significant effect on the performance level of sportswomen of Karnataka. The 12-week structured training program was successful in improving body composition, cardiovascular efficiency, aerobic capacity, self-confidence, and aggressive behavior. The study highlights the significance of combining scientific physical training with psychological conditioning to enhance the overall performance of women athletes.

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