

Assessment of Cardiopulmonary and Anthropometric Characteristics of College and University Kho-Kho Athletes

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Abstract—Background: Kho-Kho is a traditional Indian sport that requires a combination of speed, agility, endurance, and efficient cardiopulmonary functioning. Scientific evaluation of anthropometric and physiological characteristics is essential for understanding performance determinants and developing effective athlete training programs. However, limited information is available regarding the physiological profiles of Kho-Kho athletes competing at different levels.

Objective: The present study aimed to assess and compare the anthropometric and cardiopulmonary characteristics of college-level and university-level Kho-Kho athletes.

Methods: A total of 200 male Kho-Kho athletes participated in the study, including 100 college-level and 100 university-level players. Anthropometric variables such as age, height, weight, and body fat percentage were measured using standardized procedures. Cardiopulmonary variables including vital capacity, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were also assessed. Descriptive statistics were used to summarize the data, and comparisons were performed between the two groups.

Results: The results revealed that university-level athletes demonstrated a lower mean body fat percentage ($11.55 \pm 0.88\%$) compared to college-level athletes ($15.45 \pm 0.85\%$). University athletes also exhibited higher vital capacity values (4565.88 ± 160.06 ml) than college athletes (4011.16 ± 113.99 ml), indicating superior respiratory efficiency. The mean height and body weight of college and university athletes were comparable, with values of 169.03 ± 4.13 cm and 63.85 ± 5.48 kg for college athletes and 168.13 ± 4.28 cm and 62.75 ± 6.71 kg for university athletes, respectively. Additionally, university athletes showed slightly higher SBP (119.82 ± 3.11 mmHg) and DBP (75.09 ± 3.24 mmHg) compared to college athletes (114.26 ± 3.33 mmHg and 71.43 ± 2.41

mmHg, respectively), although all values remained within normal physiological limits.

Conclusion: University-level Kho-Kho athletes exhibited more favorable anthropometric and cardiopulmonary characteristics than college-level athletes, particularly in terms of lower body fat percentage and higher vital capacity. These findings highlight the importance of body composition management and respiratory fitness in competitive Kho-Kho performance and may assist coaches, sports scientists, and talent identification programs in developing evidence-based training strategies.

Index Terms—Kho-Kho; Anthropometry; Cardiopulmonary Fitness; Vital Capacity; Body Fat Percentage; Athlete Profiling; Sports Physiology.

I. INTRODUCTION

The sport of Kho-Kho is one of the oldest indigenous games of India and now it has a widespread recognition at national and international grounds because of its unique blend of speed, agility, endurance and tactical decision making. It requires athletes to have a set of superior physiological and anthropometric traits, as it involves repeated periods of high-intensity running, quick direction changes, chasing, dodging and fast acceleration-deceleration movements. Kho-Kho requires a combination of aerobic and anaerobic fitness, muscular endurance, flexibilities and neuromuscular co-ordination which is not required in many team sports. Technical and tactical proficiency are not the only factors in sports success, as the athlete's body composition, cardiopulmonary fitness, and physical fitness also play a role. Hence, scientific evaluation of physiological and anthropometric parameters is crucial to the

understanding of the performance determinants and designing an effective training plan for Kho-Kho players [2, 9, 13, 20].

In sports like those with intermittent high-intensity efforts, the professionalization of sports has stressed the need to profile athletes. Anthropometric and physiological evaluations give a great deal of information about the fitness level, performance potential and talent identification of an athlete. These assessments have been widely used in sports sciences to evaluate physical abilities and to plan training interventions [1,3,11,15]. Compared to other team games like soccer, basketball, and volleyball, scientific literature on the physiological and anthropometric traits of kho-kho players is rather limited. Hence, it is necessary to develop all comprehensive physiological profiles of Kho-Kho players at different level of competition.

Cardiopulmonary fitness has been identified as one of the most significant factors to athletic performance, especially for activities that engage in periods of high-intensity exercise. Cardiovascular and Respiratory efficiency has a direct impact on oxygen transport, energy production, recovery skills and fatigue resistance. Those athletes who have a higher level of cardiopulmonary function will display greater endurance, greater recovery between repeated performances, and improved overall performance in competition [9,13,20].

Maximal volume of air that can be expelled after maximal inhalation (Vital capacity) is a widely accepted indicator of pulmonary function. Increased vital capacity allows more oxygen to be available for working muscles and helps to increase the aerobic efficiency during long duration work. Regular training has been shown to cause long-term changes in the physiological system that lead to better pulmonary function in trained athletes than in non-athletes [10,22,23,24]. Likewise, blood pressure and HRV can offer us important information about the cardiovascular health and adaptation to exercise. Participation in sports regularly produces beneficial cardiovascular changes such as increased cardiac output, improved vascular function and efficient blood circulation, which in turn lead to better athletic performance [2,13,22].

The literature on pulmonary function in athletes from different sports has consistently shown that there is a strong relationship between pulmonary efficiency and performance measures. Sport-specific training promotes changes in the ventilatory efficiency, lung function and strength of ventilatory muscles, allowing athletes to exercise at higher levels for longer durations [6,10,22,24]. Therefore, the evaluation of cardiopulmonary characteristics is crucial in determining fitness levels and physiological factors for the success in competitive game like Kho-Kho.

The anthropometric characteristics are an important factor in the determination of the sporting potential and sporting performance in various sports disciplines. Factors like height, body weight, body composition, and body fat percentage have an impact on movement efficiency, biomechanical benefits, power production, agility, and endurance. The characteristics are commonly referenced in talent identification programs and are recognized as essential attributes to athletic fitness in certain sports [1,5,11,15,16].

Body composition measurement has become an integral part of sports performance tests. Having a higher percentage of lean body mass and less fat mass has a significant impact on athletic performance, and lower percentages of body fat have been correlated with better speed, agility and endurance. Too much body fat increases the energy expenditure needed for movement and can have a negative effect on performance, especially in sports that involve quick changes of direction and speed [1,4,7,12]. Therefore, body fat assessment techniques, such as skinfold measurements and anthropometric profiling, have been widely used to track training adaptations and optimise athlete training programs [17,18].

There have been several studies that have shown that there are different anthropometric profiles for the elite athletes from the sub-elite and non-athletes. The variations in body size, body composition, and somatotype characteristics may be related to the physiological requirements of the sport and level of competition [8,14,19]. Reilly et al. showed that anthropometric measures have a significant effect on the outcome of elite soccer players, which indicates the role of body composition in sport success [16]. In the same way, basketball, football and endurance

athletes studies have emphasized the importance of anthropometric variables in assessing the capacities for the specific sport [8,14,19].

In recent years, there has been a strong association between body composition and cardiopulmonary function in athletes. Body Fat Percentage, Lean Muscle Mass, and Body Composition all affect respiratory mechanics, oxygen use and cardiovascular efficiency. Athletes with a good body composition profile tend to have better pulmonary function, higher exercise capacity, and better endurance performance [3,4,10].

The study by Komici et al. showed that body composition parameters are significant factors affecting the lung function in athletes, suggesting that decrease in body fat mass and increase in lean body mass were associated with better respiratory function [10]. Likewise, in studies of adolescent athletes, anthropometric measures have been found to be associated with positive changes in pulmonary function measures, which indicate that body composition is also significant in predicting cardiopulmonary efficiency [6]. The results highlight the importance of considering anthropometric and physiological variables together when examining athletic performance.

Body composition assessment combined with cardiopulmonary assessment gives a complete picture of the physiological status of an athlete. This multidimensional profiling can assist coaches, sports scientists and trainers in the identification of strengths and weaknesses and the development of individual training programmes and the tracking of performance over time [1,4,12]. Thus, studying the relationship between anthropometric and cardiopulmonary parameters of Kho-Kho players can be beneficial in understanding how to optimize the performance and athlete development.

The use of the term athlete profiling in sport has recently emerged as an important part of contemporary sports science and talent identification programmes. Comprehensive profiling entails a process of measuring anthropometric, physiological, psychological and performance attributes to select people who have the highest potential of success in a

specific sport. Scientific profiling helps to make evidence-informed decisions in selection and is part of the development of effective training strategies [3,11,15].

Because of their predictive value for future performance, several international sports organisations have introduced anthropometric and physiological measures into talent identification processes. Growth, maturation status, body composition, and characteristics of physical fitness are well known factors that are important for athletic potential [3,11]. Malina et al. highlighted the importance of taking anthropometric and physiological parameters into account when assessing young athletes for talent development programs in addition to technical and tactical skills [11].

The importance of athlete profiling in indigenous sports like Kho-Kho cannot be underestimated as scientific information on the performance determinants is still scarce. Normative values for anthropometric and cardiopulmonary features can aid in talent identification programmes, the evidence-based application of coaching, and in sport development over the long term [2,21]. In addition, when comparing athletes with various levels of training and experience, these differences may indicate physiological and anthropometric changes that have occurred as a result of their higher level training.

While there has been extensive research on anthropometric and physiological parameters in sports like soccer, basketball, volleyball and athletics nothing much has been done on the Kho-Kho sport. The studies carried out so far have mostly concentrated on specific fitness parameters, skill performance or just a few anthropometric parameters, and the studies that have focused on comprehensive cardiopulmonary and anthropometric profiling of competitive Kho-Kho players are limited [16,19,21].

Furthermore, there are limited studies comparing the performance of college level Kho-Kho players with that of university level Kho-Kho players. Physiological and anthropometric differences between these competitive levels could potentially provide some insight into training adaptations, performance

demands and talent development pathways. This information can help coaches and sport administrators to develop scientifically based training programs and selection criteria [1,12,16].

In view of Kho-Kho's rising popularity and the importance of scientific athlete development, it is essential to create comprehensive physiological profiles of athletes at various competitive levels. Considering variables like body fat percentage, height, weight, vital capacity, systolic blood pressure, and diastolic blood pressure can add a lot to the understanding of the determinants of performance and the improvement of evidence based coaching [6,10,22].

In view of the inadequate scientific information available in the literature regarding the anthropometric and physiological parameters of kho-kho players, the present study tries to evaluate and compare the selected anthropometric and cardiopulmonary parameters between the college and university level kho-kho players. In particular, the study compares the levels of age, height, weight, body fat percentage, vital capacity, systolic blood pressure, and diastolic blood pressure to see if there are any significant differences between the two competitive groups. The results are likely to be added to the existing literature on Kho-Kho sports, serve as normative physiological data for Kho Kho athletes, and will help in the identification, enhancement and development of Kho Kho players.

The rest of this article is structured as follows. The materials and methods used in the study are described in Section 2, which outlines the research design, participant characteristics, the measurement procedures and statistical analyses. The results of comparative assessment of anthropometric and cardiopulmonary variables of Kho-Kho players of college and university level is presented in section 3. Section 4 explores the results in the context of previous studies and their implications for athlete profiling, performance enhancement and talent identification. Finally, Section 5 summarizes the major conclusions from the study, provides its practical applications, admits limitations, and recommends directions for further study in the area of sports physiology and indigenous sports performance analysis.

II. MATERIALS AND METHODS

For the present study, a comparative cross sectional research design was used to evaluate and compare the anthropometric and cardiopulmonary parameters of college level and University level Kho-Kho players. The methodology used in the study is shown in Figure 1, ranging from recruitment of subjects, classification of groups, physiological assessment and statistical analysis. A total of 200 male Kho-Kho athletes volunteered to participate in the study and were divided into two groups with 100 college level and 100 university level Kho-Kho players. The process of selecting and forming the participants is shown in Figure 1.

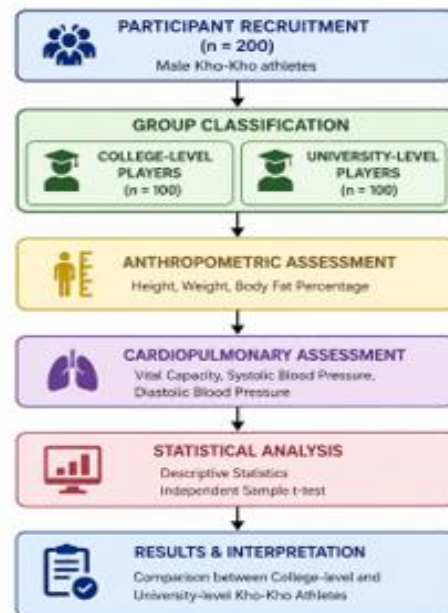


Figure 1 Participant selection and grouping procedure

2.1 Height, Weight, and Body fat Measurement

Anthropometric parameters such as height, weight and body fat percentage were measured based on standardized ISAK guidelines. The study used a complete anthropometric assessment procedure as shown in Figure 2. Standing height was tested using a stadiometer of a 0.1 cm accuracy. The measurement protocol is shown in Figure 2 (Step 1). Body weight was determined with a digital weighing machine with a precision of 0.1 kg with participants dressed in light clothing without shoes. This is illustrated in Figure 2 (Step 2). A Harpenden skinfold caliper was used to measure skinfold thickness at specific sites and body

fat percentage was estimated. The assessment procedure shown in Figure 2 (Step 3) is an illustration.

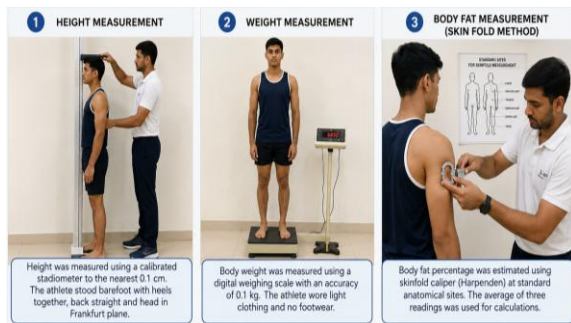


Figure 2 (a) Anthropometric assessment procedure



Figure 2 (b) Collection of sample data

The data collection process used in the present study for the assessment of anthropometric and cardiopulmonary parameters of Kho-Kho athletes is shown in figure 2(b). The figure shows the series of data collection steps starting with them registering and giving informed consent, then measuring their anthropometric data (such as height, weight, and body fat percentage) with standard instruments. Next, the cardiopulmonary examination was carried out, which included vital capacity (VC) measurement using a portable spirometer and BP measurement using a standardized digital sphygmomanometer. The investigator guided the participants throughout the data collection process and all observations were systematically recorded in structured data collection sheets to make it accurate, consistent and reliable. The photos illustrate the application of the experimental protocol, including instructions of participants, physiological testing, data recording and quality control aspects used in the study.

2.2 Cardiopulmonary Measurements

A cardio pulmonary assessment was carried out to assess the respiratory and cardiovascular data of the athletes. The entire protocol for cardiopulmonary testing is displayed in Figure 3. A portable spirometer was used to measure vital capacity. The subjects were asked to inhale to the maximum and then to breathe out with force and the highest value of three attempts was noted. This study uses the following spirometry procedure (Figure 3A). After a standardized period of rest, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were obtained with a calibrated electronic sphygmomanometer. The blood pressure assessment procedure is shown in Figure 3B.



Figure 3 Cardiopulmonary testing protocol

2.3 Data Collection Procedure

The data was collected in controlled lab conditions. Anthropometric measurements were taken prior to any cardiopulmonary measurements to reduce the effects of fatigue on physiological measurements. Figures 1, 2 and 3 provide a summary of the sequence of assessments and data collection workflow, and detailed measurement procedures.

2.4 Conceptual Framework of the Study

The conceptualization of the study investigation of the effects of playing level on anthropometric and cardiopulmonary variables. The correlation between the independent variable (playing level) and dependent variables (height, weight, body fat percentage, vital capacity, systolic blood pressure and diastolic blood pressure) are shown in figure 4.

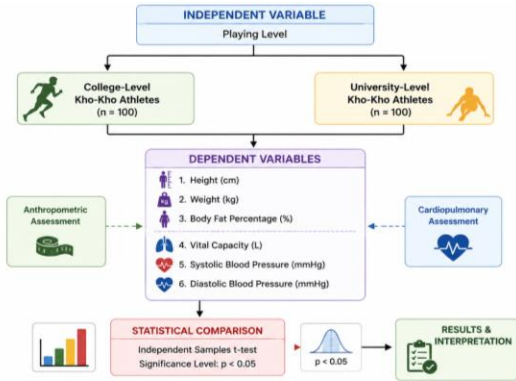


Figure 4 Conceptual experimental design framework

2.5 Statistical Analysis

The collected data were analysed through the use of software statistical package for Social Sciences (SPSS) (Version 26.0). All the variables had descriptive statistics such as means and standard deviations calculated. The normality of data distribution was tested with Shapiro–Wilk test. Independent sample t-tests were used to determine the differences in anthropometric and cardiopulmonary variables between college level and university level Kho-Kho players. A level of $p < 0.05$ was used to determine statistical significance.

III. RESULTS

The present study aimed to compare the anthropometric and cardiopulmonary parameters of college level kho kho and university level kho kho players. Twenty hundred athletes were involved in the investigation, 100 college-level and 100 university-level. All the measured variables were subjected to descriptive statistics such as mean and standard deviation. Findings are given in Tables 1–3 and Figures 5–7.

3.1 Demographic Characteristics of Participants

The socio-demographic data of the respondents is given in Table 1. The mean age of the college level athletes was 20.40 ± 1.65 years, while the mean age of the University level athletes was 20.91 ± 2.58 years. The findings show that the two groups were of the same age group, and thus were comparable between the two study groups.

Table 1 Demographic Characteristics of the Participants

Variable	College Athletes (n=100)	University Athletes (n=100)
Age (Years)	20.40 ± 1.65	20.91 ± 2.58

3.2 Comparison of Anthropometric Characteristics

In Table 2, the anthropometric features of college level and university level Kho-Kho players has been summarized. The average height of college athletes was $169.03 \text{ cm} \pm 4.13 \text{ cm}$, while university athletes were $168.13 \text{ cm} \pm 4.28 \text{ cm}$ on average. The average body weight of college athletes was $63.85 \text{ kg} \pm 5.48 \text{ kg}$, and that of the university athletes was $62.75 \text{ kg} \pm 6.71 \text{ kg}$ on average.

There was a significant difference in body fat percentage. The mean body fat percentage for college level players was $15.45\% \pm 0.85\%$, and the University level players had a significantly lower mean body fat percentage of $11.55\% \pm 0.88\%$. Lower body fat level in university athletes indicates a better body composition features, which can be linked to increased competitive exposure and training level.

Table 2 Anthropometric Characteristics of College and University Kho-Kho Athletes

Variable	College Athletes (n=100)	University Athletes (n=100)
Height (cm)	169.03 ± 4.13	168.13 ± 4.28
Weight (kg)	63.85 ± 5.48	62.75 ± 6.71
Body Fat (%)	15.45 ± 0.85	11.55 ± 0.88

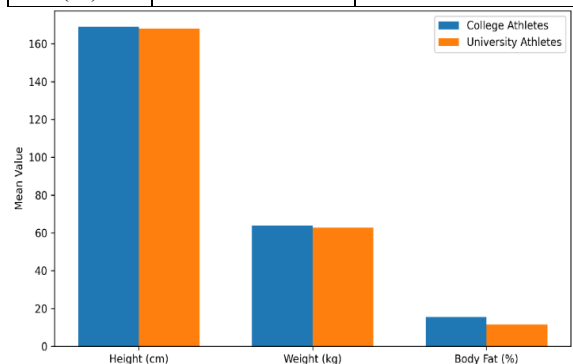


Figure 5 Comparison of Anthropometric Characteristics

Table 2 and Figure 5 show the anthropometric feature of college and university level Kho Kho players respectively. The two groups had similar height and weight characteristics as seen in Figure 5, but the university level athletes' body fat percentage was significantly lower than that for the college level athletes, which meant that the body fat percentage was more favorable and the training adaptations were more favorable in the university level athletes. The study results showed that university-level athletes had a significantly lower body composition profile than the control group, despite having similar heights and weights.

3.3 Comparison of Cardiopulmonary Characteristics

Table 3 reports the cardiopulmonary features of the athletes in this study. The mean vital capacity of the college athletes was 4011.16 ± 113.99 ml, and the mean vital capacity of the university athletes was significantly high as 4565.88 ± 160.06 ml. The difference indicates better pulmonary efficiency and respiratory capacity in university level players.

In terms of cardiovascular measures, the mean systolic blood pressure was 114.26 ± 3.33 mmHg for college athletes and 71.43 ± 2.41 mmHg for their mean diastolic blood pressures. The mean systolic and diastolic blood pressure of the university athletes were 119.82 ± 3.11 mmHg and 75.09 ± 3.24 mmHg, respectively.

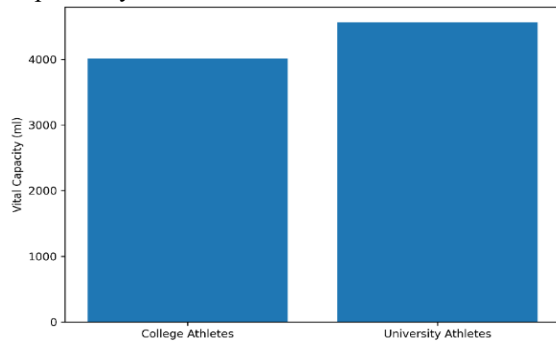


Figure 6 Comparison of Vital Capacity

The comparison of vital capacity of college level Kho Kho players and university level Kho Kho players is presented in figure 6. The results showed that university level athletes had a significantly higher mean vital capacity than college athletes, implying that there are cardiopulmonary adaptation gains that are linked to increased competitive participation and training exposure.

Table 3 Cardiopulmonary Characteristics of College and University Kho-Kho Athletes

Variable	College Athletes (n=100)	University Athletes (n=100)
Vital Capacity (ml)	4011.16 ± 113.99	4565.88 ± 160.06
Systolic Blood Pressure (mmHg)	114.26 ± 3.33	119.82 ± 3.11
Diastolic Blood Pressure (mmHg)	71.43 ± 2.41	75.09 ± 3.24

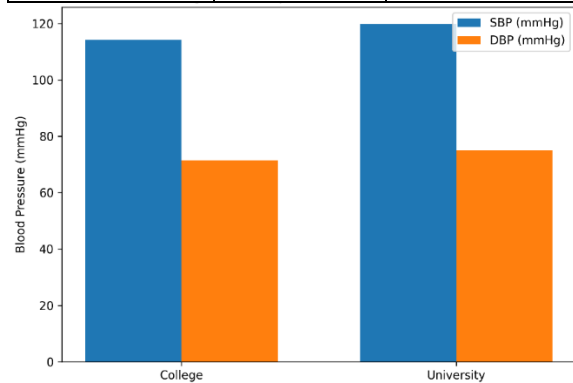


Figure 7 Comparison of Blood Pressure

Cardiovascular characteristics comparison was shown in Figure 7 between both groups. As shown, the Kho-Kho athletes at the University level had higher mean systolic and diastolic blood pressure values compared to those of college level athletes, possibly due to cardiovascular adaptations due to the advanced level of training exposure and competitive experience of university level athletes. The higher values of vital capacity among university level athletes suggest better respiratory efficiency, which can be beneficial in terms of increased endurance and recovery in competition. Similarly, the cardiovascular parameters indicate adaptations related to increased training and competition.

3.4 Overall Comparison Between Groups

A comparative study of the study variables showed that there is a significant difference between Kho-Kho players of college level and university level in their physiological aspects. The body fat percentages of University athletes were significantly lower and vital capacity values significantly higher than the college

athletes. The results indicate that athletes with university level competition had better anthropometric and cardiopulmonary features. However, in contrast, competitive level did not differ significantly between the two groups in terms of height and body weight, suggesting that body size alone is a less important factor in comparing the competitive levels of Kho-Kho players than body composition and physiological adaptations.

In general, the findings indicate that competitive Kho-Kho university level players are better equipped with their cardiopulmonary fitness and leaner body composition than their counterparts who were in college level, suggesting the significance of physiological conditioning and training adaptations over time for competitive play.

IV. DISCUSSION

The present study was designed to evaluate and compare the anthropometric and cardiopulmonary traits of college level and University level Kho-Kho players. There were significant differences found between the two groups, especially blood pressure variables and vital capacity, body fat percentage. From these observations it may be concluded that there is a significant relationship between competitive level, training exposure and the physiological changes and body composition characteristics in Kho-Kho players. The one of the great results of the present investigation was that body fat percentage was significantly lower in the University athletes compared to the College athletes. The height and body weight parameters of both groups were comparable, but a leaner body composition profile was found for the university athletes. University athletes had mean body fat % significantly lower than college athletes, thus reflecting good body composition characteristics (as shown in Fig. 5). Body composition has been shown to be an important criterion in sports performance due to the high amount of energy required for locomotion and the possible negative impact of excess body fat on agility, speed and endurance. Athletes who perform at higher levels typically have lower body fat percent than athletes with lower levels of competition, and greater physical activity, have been consistently reported in previous studies [1,4,10,12].

The results also revealed that there was not a significant difference in the height and body weight

between college level and university level athletes. Based on the finding it seems that body size is not the main factor for differentiating between the levels of competitive performance of khokho players. This is consistent with other studies with other team sport athletes such as soccer, basketball, and other team sport athletes, where body composition and physiological efficiency rather than absolute body size was more strongly related to performance differences [8,14,16]. Reilly et al. [16] found that the advantages of anthropometric attributes are some, but physiological adaptations can be more important to competitive success. Therefore, the present study results suggest that the body composition and physiological fitness might play more important role in distinguishing the level of performance of the athletes in Kho-Kho than height and body weight.

The other significant finding of this study was the significantly higher vital capacity among university level athletes. As shown in figure 6, the comparison between the two groups clearly depicts the superior pulmonary function of the university athletes over the college athletes with the mean values of the vital capacity being much higher. The vital capacity is a known measure of respiratory efficiency and is a measure of the respiratory system's ability to deliver oxygen to working muscles during exercise. The same results were observed by Komici et al. [10], El Nady et al. [6], Lazic et al. [22], Mazić et al. [23] and Durmic et al. [24] which showed that athletes that participate in intensive training have better pulmonary capacities than the others that do not have the same training. Vital capacity could then have been higher in the university athletes due to increased training exposure, increased strength of the respiratory muscles, and perhaps better aerobic conditioning.

Higher levels of competition may also have caused the greater physiological demands within the university athletes that lead to the superior vital capacity. Kho-Kho is a game of repeated high-intensity sprinting, chasing, dodging and direction changing that will significantly challenge the cardiorespiratory system. Pulmonic adaptations in university level athletes are likely greater because of a more structured training program, higher competitive intensity and larger accumulative training loads, which results in greater pulmonary adaptations over time. This may lead to increased performance efficiency in endurance, delayed onset of fatigue and quicker recovery from

high intensity, in turn. This could result in greater endurance performance, later fatigue onset and quicker recovery from high intensity in turn.

The present study also indicated that the mean level of SBP and DBP in university athletes were higher than that of college athletes. For University level athletes, slightly higher SBP and DBP values were observed but within normal physiological ranges as shown in Figure 7. These variations may be normal physiological responses to the regular training of an athlete, and not a sign of cardiovascular risk. Long-term sports participation has been demonstrated in previous investigations to cause beneficial cardiovascular adaptations such as an increase in stroke volume, improved myocardial efficiency and improved vascular function [13,21,22]. Blood pressure differences in the present study therefore, are probably a reflection of physiological responses to higher levels of competitive training and athletic conditioning.

In summary, the results of this study stress the significance of anthropometric and cardiopulmonary profiling in competitive sport. The use of athlete profiling is now a key part of sports science and is used to identify talent, monitor performance and prescribe training programmes based on each individual athlete's profile [3,11]. The physiological differences observed between college and university athletes indicate that moving to the next level of competition involves positive physiological changes, especially in body composition and pulmonary function. These traits can then be helpful indicators in the athlete selection and athlete development process.

The practical implications of this study can be used to help coaches, sports scientists and strength and conditioning professionals in Kho-Kho training. From the results the researchers said the reduction in body fat percentage and improvement of respiratory capacity should be seen as important targets of athlete conditioning programmes. The aerobic condition, HIIT, sport-specific endurance training, as well as the use of nutritional management strategies, can play a role in shaping the development of more favourable physiological profiles in young athletes. In addition, the periodic evaluation of anthropometric and cardiopulmonary parameters can aid coaches in assessing the training efficiency and determine athletes with high performance potential.

While there were many good things that emerged as a result of this study, some of its shortcomings should be

noted. The study relied on male athletes only, therefore the findings of this study cannot be generalized to female Kho-Kho players. The study was a cross-sectional study and thus could not be used for establishing causal relationships between training exposure and physiological adaptations. Further, other important performance measures like maximal oxygen uptake ($\text{VO}_{2\text{max}}$), anaerobic power, agility, sprint performance and muscular strength were not evaluated. These variables should be included in future studies and longitudinal designs employed to get a better understanding on physiological adaptation in Kho-Kho players.

The results of the present investigation revealed that the anthropometric and cardiopulmonary profile of the University level Kho-Kho players are better than that of the College level players. The main differences between the two competitive groups are seen in the lower level of body fat percentage and higher level of vital capacity, and this suggests that body composition control and respiratory fitness enhancement can play a role in improving the level of athletic performance.

V. CONCLUSION

The present study was designed to compare the anthropometric and cardiopulmonary profile of 200 Kho-Kho athletes which consisted of 100 college level and 100 university level Kho-Kho players. Results of the study indicated that the athletes at the university level had a better physiological profile than the athletes at the college level. The body fat percentage of the university players was more lean ($11.55 \pm 0.88\%$) than the body fat percentage of college players ($15.45 \pm 0.85\%$). The same trend was observed in athletes from universities, with a mean vital capacity of 4565.88 ± 160.06 mL, which is greater than that of athletes from colleges (4011.16 ± 113.99 mL), indicating better respiratory efficiency. The mean height (168.13 ± 4.28 cm vs. 169.03 ± 4.13 cm) and body weight (62.75 ± 6.71 kg vs. 63.85 ± 5.48 kg) of the two groups did not differ significantly, but the systolic blood pressure (119.82 ± 3.11 mmHg) and the diastolic blood pressure (75.09 ± 3.24 mmHg) of the university athletes were slightly higher than those of the college athletes (114.26 ± 3.33 mmHg and 71.43 ± 2.41 mmHg, respectively), and they were within the normal physiological range. In general, the findings indicate that the parameters which are desirable for

higher competitive performance in Kho-Kho includes lower body fat percentage and higher vital capacity in Kho-Kho players. The results are useful information for the athlete's profiling, identification of talent and sport-specific training program.

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