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Physiological and Anthropometric Characteristics of Amateur Women in the Kenya Rugby Union

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Abstract

Rugby is a team body contact sport that is popular in many countries internationally. The team involves two opposing teams trying to carry an oval shaped ball to the end of a rectangular field, while preventing the other team doing the same it has demands broadly characterized by a high frequency of physical contacts and repeated intermittent bouts of high intensity activity. The game is played at amateur, semiprofessional, and professional levels with the players being divided into two groups, according to their on-field positions (forwards and backs). Forwards are roughly considered to be the ball conquerors and are responsible for the dispute of the ball both in static and dynamic moments of the game. They are involved in all the line outs, scrums and in most of the mauls and rucks. Therefore, they are required to have a group of characteristics that enables them to perform in these situations. Forwards are heavier than backs. The assessment of body composition in professional rugby players is frequently performed as part of their routine monitoring procedures in order to optimize competitive performance and to monitor the success of training regimen. For the optimal physical development of female rugby league players', knowledge of positional differences in physical characteristics are vital to inform training practices the data was collected using protocols which the rugby players filled demographic data. The multi-stage fitness test, also known as the PACER test or PACER (Progressive Aerobic Cardiovascular Endurance Run), the 20 m Shuttle Run Test (20 m SRT), or the beep test, is a running test used to estimate an athlete's aerobic capacity (VO2 max). Following institutional ethics approval, A team (Impala ladies Rfc) in the women league of the Kenya rugby union (KRU) was purposively selected from the rest of the teams in the championship league for the study. Thirty (30) women rugby league players from the team were recruited and participated in the study. A total of 30 players were sampled mean age 22.20±3.605. 73.3% (22) of the participants were Students, 16.7% (5) and 10% (3) were in employment. The mean for the caps was .40±.814. There was a significant correlation between the age and primary position of the players (χ^2=14.267, df=8, P<.0075). There was no relationship between the players position and the acquiring of the NHIF cover (χ^2=.370, df=1, P<.543). 178.2 (175.8 to 180.6) cm, 85.8 (80.6 to 91.0) kg, and 18.8 (17.3 to 20.3) % respectively. Forwards were significantly older (p<0.01) significantly heavier (p<0.01) than backs. estimated V~O2MAX scores for all subjects were 38.1 (35.7 to 40.5) cm, 2.58 (2.51 to 2.65) seconds, 6.63 (6.53 to 6.73) seconds, and 38.98 (37.18 to 40.78) ml/kg/min respectively. Scores for vertical jump were not significantly different (p>0.05) between forwards and backs. Although backs were faster than forwards during the 10 m sprint, the difference was not significant (p =0.07). Backs were significantly faster (p<0.01) than forwards during the 40 m sprint. No significant differences (p>0.05) were observed between forwards and backs for estimated V~O2MAX. In conclusion, when compared with professional players, estimates of maximal aerobic power, speed, and muscular power were lower, and percentage body fat higher in amateur rugby league players. Values for percentage body fat, vertical jump, 10 m sprint, and maximal aerobic power were not significantly different between forwards and backs. The results of this study show that the physiological and anthropometric characteristics of amateur women rugby league players are poorly developed.

Keywords: Anthropometric tests, Physiological, Rugby Union, V~O2MAX, Rugby Players.

INTRODUCTION

Rugby is a team body contact sport that is popular in many countries internationally [1]. The team involves two opposing teams trying to carry an oval shaped ball to the end of a rectangular field, while prevening the other team doing the same [2] it has demands broadly characterized by a high frequency of physical contacts and repeated intermittent bouts of high intensity activity [3]. Generally, a typical senior

rugby union match lasts 60–80 minutes, with frequent intense bouts of running and tackling, interspersed with short bouts of recovery [4-7]. This makes the nature of the game to be tasking to a variety of fitness components like (but not limited to) aerobic capacity, speed and muscular [8-11]. The game is played at amateur, semiprofessional, and professional levels with the players being divided into two groups, according to their on-field positions (forwards and backs). Forwards are roughly considered to be the ball conquerors and are responsible for the dispute of the ball both in static and dynamic moments of the game. They are involved in all the line outs, scrums and in most of the mauls and rucks. Therefore, they are required to have a group of characteristics that enables them to perform in these situations. Usually, forwards are heavier, taller and have a higher fat percentage in body composition than backs. Elite forward rugby players, usually, weight more than 100kg and are over 190cm tall and have less than 16% of body fat [12] but this may not be the case with women rugby players. On the other hand, backs are required to run with the ball, cross the opponents' defensive line and transform into points the territorial advantage conquered by forwards. Therefore, they need to be fast, agile and possess a significant aerobic capacity [12]. Rugby union performance may be determined by the complex interaction of individual players' technical, tactical, cognitive and physical qualities [13]. Each position has a very specific and unique requirement and several studies have documented it [3, 14]. The forwards, who participate in several formations to gain space, and the backs, who primarily try to get the ball through the defenders with quick and agile play [15, 16].

Physical performance is the result of the complex combination of several factors [17] including genetic components, anthropometric features, nutrition and physiological hormonal status that are likely to limit and contribute to effective athletic performance. In fact, the literature is quite limited and outdated and reports different analyses of anthropometric characteristics as well as body composition in relation to physical tests [18-21]. Numerous studies have indicated the difference in body mass, skin fold, speed ability, VO_2 Max, sprinting ability of rugby players in spite of their formal training age [22, 9, 23] although the above studies are from European players it is hypothesized that anthropometric, physiological characteristics and rugby-specific game skills would improve with increasing playing standard (elite vs sub elite vs non-rugby players) [24]. To date, the majority of available research has focused on the physical demands of match-play and the physical qualities of players, which has recently been comprehensively summarized in a review titled 'Applied Sport Science of Rugby League' [25]. Lombard *et al*., [26] deduce that literature explains that adolescent rugby players should be bigger, faster, fitter and more powerful to reflect the collision nature of the sport but more studies need to be conducted to ascertain the issue on women rugby. No such studies have been conducted for Kenyan female rugby players. Therefore, there is limited understanding of the qualities of Kenyan female rugby players playing competitive rugby and how they differ by playing standards.

The assessment of body composition in professional rugby players is frequently performed as part of their routine monitoring procedures [27] in order to optimize competitive performance and to monitor the success of training regimens [28]. For the optimal physical development of female rugby league players', knowledge of positional differences in physical characteristics are vital to inform training practices [29]. These findings may facilitate rugby coaches' understanding of the general attributes contextually important for female rugby players to participate in rugby (sub elite rugby players vs non-rugby players) and the specific attributes in need of training for the attainment of elite rugby status at female rugby players category (elite rugby players vs sub elite rugby players). While investigators have developed physiological and anthropometric profiles of professional rugby league players [30, 9, 31, 8] similar studies have not been performed in amateur rugby league players. Therefore, the purpose of this study was to investigate the physiological and anthropometric characteristics of amateur female rugby union players in Kenya.

Procedure

Instruments

The data was collected using protocols which the rugby players were asked to fill their basic information, i.e. name, address, medical insurance cover and presence or history of injury on the player. A music system was tested for audibility of the cardiovascular with the multistage used for this test. The multi-stage fitness test, also known as the PACER test or PACER (Progressive Aerobic Cardiovascular Endurance Run), the 20 m Shuttle Run Test (20 m SRT), or the beep test, is a running test used to estimate an athlete's aerobic capacity (VO2 max).. Space markers were used to mark the 20meters on a relatively flat surface on the rugby pitch. All the results were recorded on the players' protocol form.

Subjects

Following institutional ethics approval, A team (Impala ladies Rfc) in the women league of the Kenya rugby union (KRU) was purposively selected from the rest of the teams in the championship league for the study. Thirty (30) women rugby league players from the team were recruited and participated in the study. Eligibility was considered to all players who were registered with the team and playing for the team at the time of testing. The players were then divided into their playing positions i.e. forwards and backs. All participants received explanation of the current study prior to their written consent was obtained. All the risks

and benefits of this current study were given to the players in detail. All procedures were approved by the institutional ethical review committee.

Statistical Procedures

Standard statistical methods were used for the calculation of the means ± standard deviation (SD). Statistical analysis was performed using SPSS v 25. One-way analysis of variance with repeated measures was used to determine the differences between tests. When a significant F value was achieved, appropriate Scheffe´ post hoc test procedures were used to locate the difference between means. The test–retest reliabilities for the experimental test demonstrated infraclass correlations of R ≥ 0.91. Pearson product–moment correlation coefficients (r) were used to determine associations between variables. Differences in the physiological characteristics of forwards and backs for each team were compared using independent t tests and the Bonferroni adjustment. Multiple logistic regression analysis was performed to determine if any physiological variables could predict the suitability of players as forwards or backs. The level of significance was set at $p<0.05$, and data are reported as means and 95% confidence intervals (CI).

RESULTS

Demographics

A total of 30 players were sampled for the study with the mean age 22.20±3.605. The youngest player was of 18 years old with the oldest 34 Y/O. Majority 73.3% (22) of the participants were Students, 16.7% (5) were in business entities while the minority 10% (3) were in employment. Backs and Forwards were 50% each with the majority 76.7% (23) of the respondents being uncapped players at the national team level and only 1 (3.3%) player had a majority of 3 caps with the rest having lesser than that. The mean for the caps was .40±.814. There was a significant correlation between the age and primary position of the players (χ^2=14.267, df=8, P<.0075). Majority 90% (27) of the respondents did not have the recommended National Hospital Insurance Fund (NHIF) which is a recommendation by the Union for playing rugby. There was no relationship between the players position and the acquiring of the NHIF cover (χ^2=.370, df=1, P<.543).

METHODS

Following institutional ethics approval, thirty-nine women rugby league players from the English Super League were recruited and participated in the study. Players were categorized into playing positional groups (i.e. forwards and backs); 15 backs (age 20.6 ± 4.3 years; body mass 66.0 ± 6.8 kg) and 24 forwards (age 21.5 ± 4.8 years; body mass 82.9 ± 13.1 kg).

Player assessments comprised of anthropometric (body mass), strength (isometric mid-thigh pull) and speed (10 and 20 m sprint times) measures. A standardized warm up protocol was performed prior to all strength and speed testing.

Effect sizes (ES) ± 90% confidence intervals (CI) were calculated to determine the magnitude of differences in absolute and relative strength, speed and momentum characteristics between forwards and backs. Cohen's effect size statistics were calculated with threshold values of d < 0.2 (trivial), 0.2- 0.59 (small), 0.6-1.19 (moderate), 1.2-2.0 (large), and > 2.0 (very large).

RESULTS

Table-1 gives the anthropometric characteristics of the amateur rugby league forwards and backs. The mean (95% CI) height, body mass, and percentage body fat of all subjects was 178.2 (175.8 to 180.6) cm, 85.8 (80.6 to 91.0) kg, and 18.8 (17.3 to 20.3) % respectively. Forwards were significantly older ($p<0.01$) significantly heavier ($p<0.01$) than backs. There were no significant differences ($p>0.05$) between forwards and backs with respect to height, sum of skinfolds, or estimated body fat.

Table-1: Anthropometric characteristics of amateur rugby league forwards and backs

	Forwards	Backs
Age (years)	28.6 (26.7–30.5	24.2 (21.7–26.7) *
Height (cm)	178.4 (174.5–182.3)	178.0 (175.4–180.6)
Mass (kg)	90.8 (86.2–95.4)	79.7 (74.7–84.7) *
Sum of four skinfolds (mm)	52.4 (45.8–59.0)	46.1 (37.0–55.2)
Estimated body fat (%)	19.9 (18.2–21.6)	17.5 (15.0–20.0)

Values are reported as means (95% CI). *p<0.01, compared with forwards.

Table-2 gives the results of the muscular power (vertical jump), speed (10 m and 40 m sprint), and maximal aerobic power tests (multistage fitness test). The mean (95% CI) vertical jump, 10 m and 40 m sprint, and estimated V~O2MAX scores for all subjects were 38.1 (35.7 to 40.5) cm, 2.58 (2.51 to 2.65) seconds, 6.63 (6.53 to 6.73) seconds, and 38.98 (37.18 to 40.78) ml/kg/min respectively. Scores for vertical jump were not significantly different ($p>0.05$) between forwards and backs. Although backs were faster than forwards during the 10 m sprint, the difference was not significant ($p =0.07$). Backs were significantly faster ($p<0.01$) than forwards during the 40 m sprint. No significant differences ($p>0.05$) were observed between forwards and backs for estimated V~O2MAX.

Table-2: Vertical jump, estimated V~O2MAX, 10 m and 40 m sprint times for amateur rugby league forwards and backs

	Forwards	Backs
Vertical jump (cm)	37.1 (33.7–40.5)	39.3 (36.1–42.5)
10 m sprint (s)	2.62 (2.57–2.67)	2.53 (2.43–2.63)
40 m sprint (s)	6.79 (6.69–6.89)	6.45 (6.35–6.55)*
Estimated V~O2MAX (ml/kg/min)	38.11 (35.41–40.81)	40.04 (37.84–42.24)

Values are reported as means (95% CI). *p<0.01, compared with forwards

Table-3 gives the playing experience, training status, and employment related physical activity levels of amateur rugby league forwards and backs. The mean (95% CI) playing experience of all subjects was 11.2 (8.6 to 13.8) years. Subjects spent 3.5 (3.2 to 3.8) hours a week training for rugby league. They spent less than 3 (2.8 to 3.0) hours a week in team training sessions and about 30 (15.9 to 47.7) minutes a week in individual training sessions. In addition, subjects spent 17.7 (11.0 to 24.4) hours a week in other employment related physical activities. No significant differences (p>0.05) were observed between forwards and backs with respect to playing experience, training status, or employment related physical activity levels.

Table-3: Playing experience, training status, and employment related physical activity

Levels of amateur women rugby players	12.4 (8.5–16.3)
Total training status (hours a week)	3.3 (3.0–3.6)
Team training sessions (number a week)	1.9 (1.8–2.0)
Team training sessions (hours a week)	2.8 (2.5–3.1)
Individual training sessions (hours a week)	0.4 (0.1–0.7)
Employment related physical activity (hours a week)	16.6 (6.3–26.9)

Values are reported as means (95% CI).

Table-3 shows the strength outcomes of women amateur rugby players between backs and forwards high Effect sizes were shown between differences of 17% and 19% in Squat Jump and Counter Movement Jump height. The forwards 2.30 ± 0.24 women depicted a higher Squat jump peak vertical force on body weight as compared to the backs 2.17 ± 0.18. higher ES 1.26 were shown from Countermovement jump height (m) between the backs and the forwards.

Table-4: Selected strength characteristics of the two groups (mean ± SD

	Forwards	Backs	ES
Squat jump height (m)	0.41 ± 0.04	0.35 ± 0.05*	1.14
Squat jump peak vertical force (BW)	2.30 ± 0.24	2.17 ± 0.18	0.63
Countermovement jump height (m)	0.44 ± 0.05	0.37 ± 0.06*	1.26
Countermovement jump peak vertical force (BW)	2.41 ± 0.19	2.33 ± 0.21	0.37
Countermovement jump RSImod	0.54 ± 0.10	0.43 ± 0.09*	1.16

*significantly different ($p < 0.05$) from professional group. Effect sizes (ES) were calculated between the professional and amateur groups using Cohen's d. RSImod = reactive strength index-modified.

DISCUSSIONS AND CONCLUSIONS

This is the first study to concurrently profile the physiological, anthropometric and performance characteristics, and relationships between these qualities, in women amatuer rugby players in the Kenyan context. To meet the physiological demands of rugby union, players require highly-developed speed, muscular power, and aerobic and anaerobic endurance [3]. When compared with previously published results for professional players [8, 9, 11, 32, 33, 31] estimates of maximal aerobic power (38.98 v 67.5 ml/kg/min), 10 m (2.58 v 1.71 seconds) and 40 m (6.63 v 5.32 seconds) speed, and muscular power (38.1 v 54.2 cm) were lower, and percentage body fat higher (18.8% v 13.0 %) in amateur rugby league players. Values for percentage body fat, vertical jump, 10 m sprint, and maximal aerobic power were not significantly different between forwards and backs. The results of this study show that the physiological and anthropometric characteristics of amateur rugby league players are poorly developed. Furthermore, these findings suggest that position specific training does not occur in amateur rugby league. The poor fitness of non-elite players may be due to a low playing intensity, infrequent matches of short duration, and/or an inappropriate training stimulus. Consistent with results of professional rugby league players [9, 31], the present study of amateur players found that when compared with forwards, backs had lower body mass and greater speed during a 40 m sprint. However, values for muscular and aerobic power and percentage body fat were similar between forwards and backs. The finding of superior 40m speed in backs would be expected given that forwards rarely are required to run further than 10 m in a single bout of intense activity. Rather, these results suggest that position specific training does not occur in amateur

rugby league and, as with professional rugby league, fitness training appears to be uniform for all positions [11].

For the strength characteristics, our hypothesis was accepted as the amateur women forwards jumped significantly higher than the amateur women backs (Table-3). These were large effects and corresponded to differences of 17% and 19% in SJ and CMJ height, respectively. When compared with previously published data from women elite rugby players, both the amateur women rugby players jumped higher than the soccer players in the SJ (0.29 ± 0.04 m) and CMJ (0.34 ± 0.05 m; Suchomel *et al*., [34]. The RSImod values of the amateur women forwards rugby players from the CMJ were 26% higher than the amateur backs women rugby players, reflecting their greater ability to utilise the stretch-shortening cycle [34]. In a study done to female NCAA Division 1 soccer players, the results clearly shown that were previously found to exhibit RSImod values of 0.44 ± 0.09 m [35], similar to the amateur rugby players yet less than the professional women. Although comparable strength characteristics of the participants studied by de Leva [36] and Anderson and Pandy [37] are not available, Harman *et al*., [38] previously reported the peak vertical forces of 18 physically-active females (age = 29 ± 7 years, height = 1.79 ± 0.05 m, mass = 74.7 ± 7.7 kg) for a no-arm-swing SJ (2.13 ± 0.30 BW) and CMJ (2.32 ± 0.42 BW). The strength characteristics of amateur rugby union players, particularly amateurs, should be considered when scaling the strength properties of such musculoskeletal models given these apparent differences and the importance of the muscle model parameters for the prediction of muscle forces. Further objective comparison of the strength characteristics of rugby players against the strength characteristics of populations similar to those of the cadavers who were used in the development these musculoskeletal models are required.

In conclusion, when compared with professional players, estimates of maximal aerobic power, speed, and muscular power were lower, and percentage body fat higher in amateur rugby league players. Values for percentage body fat, vertical jump, 10 m sprint, and maximal aerobic power were not significantly different between forwards and backs. The results of this study show that the physiological and anthropometric characteristics of amateur women rugby league players are poorly developed. Furthermore, these findings suggest that position specific training does not occur in amateur rugby league. The poor fitness of non-elite players may be due to a low playing intensity, infrequent matches of short duration, and/or an inappropriate training stimulus.

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