Effect of Playing Position on Anaerobic Power Profile and Back Strength Measures of Trained Male Roll Ball Athletes: A Pilot Study

Soubhory Ganguly[1], Surojit Sarkar[2*], Debmalya Das[3], Tambi Medabala[4]

ABSTRACT

Background: *Roll ball combines aspects of basketball, handball, and skating, offering both anaerobic and aerobic abilities. The relationship between positional variations in anaerobic power and strength metrics is not well established.* ***Methods:*** *Seventeen (n=17) trained male Roll Ball players (4 forwards, 6 midfielders, and 7 wingers) were evaluated with the Wingate (30-sec.) anaerobic test on both lower and upper-limb ergometers. Back strength and heart rate were also recorded. Differences in playing position were investigated using one-way ANOVA, and correlating (Pearson's correlation) the anaerobic variables with heart rate and back strength measures.* ***Results:*** *There was no significant difference in lower-body anaerobic power measures between positions ($p>0.05$). Power Drop ($p = 0.049$) and Maximum Speed ($p = 0.043$) showed significant differences for upper-body power, with forwards exhibiting the highest absolute outputs. Wingers had intermediate profiles, whereas midfielders showed superior fatigue resistance. According to correlation analysis, absolute back strength ($r=0.462$, $p<0.01$) and maximal heart rate ($r = 0.499$, $p<0.01$) were positively correlated with lower-body peak power. Upper-body peak power and fatigue indices showed an inverse relationship with relative back strength.* ***Conclusion:*** *Anaerobic power profiles were mostly consistent across Roll Ball positions. Wingers gain from mixed outputs, midfielders from fatigue resistance, and forwards from increased power. Depending on the function, conditioning should focus on power, endurance, or sustained explosiveness in order to address these inclinations. It needs to do further studies using bigger cohorts and match-based analysis.*

Keywords: Roll Ball, Anaerobic power, Wingate test, Playing positions, Back strength, Heart rate.

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INTRODUCTION

Roll Ball is a modern and evolving team sport that integrates elements from basketball, handball, and inline skating. Originating in 2003, it was conceptualized by Raju Dabhade, a physical education instructor from Pune, India, who aimed to create a sport that merged the agility required in skating with the dynamic nature of ball-based games. Since then, the sport has gained widespread popularity, especially across regions like South Asia, Africa, and Europe. The International Roll Ball Federation (IRBF, 2022). The game features two teams of six players each, including one goalkeeper. Players must use roller skates and handle the ball solely with their hands. The objective is to pass and dribble the ball while skating and ultimately score by throwing it into the opposing team's goal. The gameplay combines the rules of handball and basketball, but skating introduces an added level of complexity, demanding superior balance, speed, coordination, and stamina from participants. (Nathan, Sumathi, & Raaghav, 2024)

From a physiological standpoint, Roll Ball places a broad range of demands on athletes. Competitors must perform quick bursts of movement, sustain high skating speeds, shift directions rapidly, and handle the ball under pressure. These challenges make it a physically rigorous and technically demanding sport, requiring a combination of aerobic and anaerobic capacity. Essential physical attributes include cardiovascular endurance, muscular strength (especially in the lower body), and fine motor coordination (Devi & Kumar, 2024). In addition to physical fitness, players also need strong cognitive skills to make rapid decisions while managing ball control and skating simultaneously. Roll ball is unique team sports combine elements of basketball, handball, skating demanding high level of Physical fitness. The physiological demands of the game based on the playing position as each roles requires different combinations of aerobic endurance, anerobic power, agility and muscular strength. Attackers and wingers rely significantly on speed and anaerobic power, whilst midfielders exhibit the highest aerobic capacity. Designing successful training programs, enhancing performance, and avoiding tiredness or injury all depend on an understanding of these positional distinctions. (Thakur, 2025; Póvoas et al., 2014)

Successful Roll Ball players often exhibit muscular strength in the lower limbs contributes to acceleration, deceleration, and stability. Well-developed core muscles and back strength also play a critical role in maintaining equilibrium during complex skating maneuvers and ball-handling actions. This present study aimed to investigate the effect of different playing position on anaerobic power variable, comparison between upper and lower body power. This study also investigates relative back strength parameter in roll ball game.

METHODOLOGY

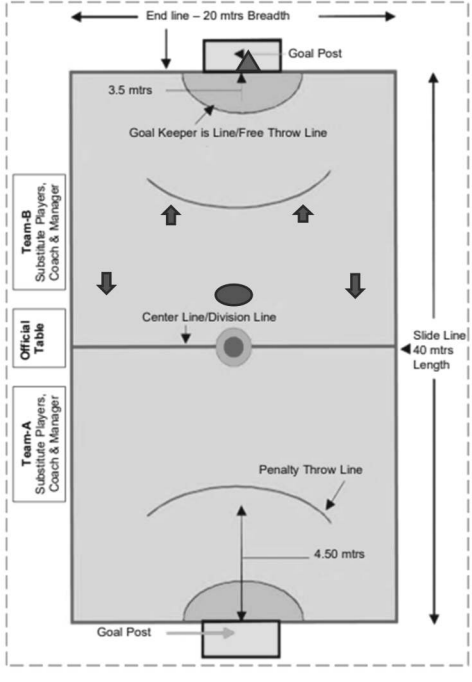
Subjects

A total of 17 young trained male roll ball players coming from three different playing positions i.e., forwards (FD=4, Mean age= 25.25±3.86 years,

height=175.88±5.19 cm, weight=84.10±13.03 kg), midfielder (MD=6, Mean age= 27.17±5.27 years, height=173.23±4.64 cm, weight=70.03±10.35 kg), winger (WN=7, Mean age= 25.14±4.18 years, height=176.07±9.37 cm, weight=74.83±10 kg), were recruited as subjects for the present cross-sectional study. All participants have a minimum 5 years of formal training experience. The study data were collected during the assessment camp at NSNIS Patiala and thus the environmental condition during the study was similar for all athletes. A proper clinical examination was done by the sports physician before commencing the study and only the medically fit athletes were inducted as study subjects.

Training regimen

The training regime of the male roll ball players was the same irrespective of their playing position for 3 hours every day except for Sundays. Daily training was divided into two sessions (morning & evening) with 1.5 hours each session. Thus, the weekly training volume was counted to approx.



The distribution of the Players as follows- One goalkeeper and five Players (Forwards, Defenders, or Center) (Dabhade et al.2021) International Roll ball federation (IRBF) https://www.rollball.org/documents_pdf/Roll_Ball_Rule_Book.pdf

Goalkeeper

Defenders

Forwards

Center

General anthropometric indices

Height and Body weight was measured using the SECA Stadiometer (model 787, Hamburg, Germany) with standard procedure. Muscular strength was measured using the back strength dynamometer (Takei, 5402, Takei Physical Fitness test) and calculating Relative back strength (RBS) with back strength value divided by body weight. Polar heart rate monitor (polar RS800CX, Polar Electro OY, Kempele, Finland) was used to measure the resting and peak heart rate of athletes (Sarkar et. al., 2019).

Estimation of Lower body anaerobic power output

The Anaerobic Power output was predicted by using the 30-sec Wingate Anaerobic Power Test. The Wingate is a maximal exercise test of 30 seconds done on a mechanically braked bicycle ergometer (Monark 894E Peak Bike Ergometer). Subject was warmed up with 1% load of their body weight for 5 mins followed by 3 mins of rest before the test and then the ergometer seat was adjusted as per the player's height and the test administrator added brake weight i.e., 0.075 kg/kg of the total body weight. The player must accelerate maximally and try to maintain the maximal speed for 30 seconds. Absolute and relative (calculated divided by body weight) power output for peak power (PP), average power (AP), minimum power (MP), were measured through the Wingate test (Castañeda-Babarro & A., 2021).

Estimation of Upper body anaerobic power output

Monark 891E was the hand-ergometer to measure the upper body power. The warmup and testing protocol were same as lower body but only the difference was the brake weight was calculated from 0.05 kg/kg of the total body weight. Same as lower body total protocol was for 30 secs single bout. Again, upper body Absolute and relative (calculated divided by body weight) power output for peak power (PP), average power (AP), minimum power (MP), were measured through this test (Šimenko, J., 2024).

Statistical analysis

The research data was analyzed using the Statistical Package for the Social Sciences (SPSS), version 18.0 (SPSS Inc., Chicago, IL, USA). All values were expressed using the group mean ± standard deviation (SD). One sample Kolmogorov-Smirnov test and histogram were performed to check the normality, frequency distribution of the data set. Differences between the groups were analyzed using a one-way analysis of variance (ANOVA). Confidence interval for the significance analysis was set at 95% ($P<0.05$).

RESULT

Table 1 depicts the comparative analysis of various general anthropometric variables among various playing positions of Roll Ball players. All the variables were found to be statistically not altered among the various playing positions. Although the RBS (relative back strength) was found to be on a higher grade for forwards and midfielders in comparison to others, but the difference was not statistically significant.

Table 1: General anthropometric variables and back strength among various playing positions of trained male roll ball players.

Variables	Forward (n=4)	Midfielder (n=6)	Winger (n=7)	Combined (n=17)	F value (Sig.)
Age (year)	84.10±13.03	27.17±5.27	25.14±4.18	25.88±4.36	0.259 (0.854^{NS})
Height (cm)	175.88±5.19	173.23±4.64	176.07±9.37	175.02±6.82	0.204 (0.893^{NS})
Weight (kg)	84.10±13.03	70.03±10.35	74.83±10.00	75.32±11.52	1.268 (0.303^{NS})
BS (kg)	143.50±30.45	117.25±15.23	115.14±14.94	122.56±21.78	1.794 (0.170^{NS})
RBS	1.72±0.36	1.70±0.28	1.55±0.21	1.64±0.26	0.366 (0.778^{NS})

Values are in Mean±SD, n= number of subjects, NS= non-significant. Sig.= level of significance, BS= back strength, RBS= relative back strength.

Table 2 represents the comparison of anaerobic power output among various playing positions of trained Roll Ball players. However, across all variables, no significant positional difference were shown when compared among various playing positions. Although relative peak power (RPP) and relative average power (RAP) were found to be highest (statistically insignificant) in midfielders and forwards players, respectively. Whereas, both relative power drop (RPD) and PD% was found to be highest among midfielders. But in terms of max speed and total energy expenditure, forward players show superiority (statistically insignificant).

Table 2: Comparison of lower-body Anaerobic power variables among various playing positions of trained male Roll Ball players.

Variables	Forward (n=4)	Midfielder (n=6)	Winger (n=7)	Combined (n=17)	F value (Sig.)
PP (watt)	820.75±54.24	698.17±97.17	694.78±140.17	725.50±117.50	1.191 (0.330^{NS})
RPP (watt/kg)	9.92±1.39	10.01±0.62	9.31±1.43	9.70±1.17	0.439 (0.727^{NS})
AP (watt)	589.28±49.17	484.81±73.36	506.68±64.74	518.40±73.80	1.900 (0.151^{NS})
RAP (watt/kg)	7.09±0.62	6.95±0.56	6.81±0.63	6.93±0.58	0.183 (0.907^{NS})

Variables	Forward (n=4)	Midfielder (n=6)	Winger (n=7)	Combined (n=17)	F value (Sig.)
PD (watt)	467.75±69.12	429.54±76.08	391.02±128.87	422.67±99.48	0.512 (0.677^{NS})
RPD (watt/kg)	5.68±1.26	6.14±0.58	5.20±1.47	5.64±1.18	0.685 (0.568^{NS})
PD%	56.89±5.92	61.34±4.41	55.31±9.15	57.81±7.19	0.795 (0.506^{NS})
Max speed	129.14±15.49	128.19±11.76	126.76±23.02	127.82±16.97	0.017 (0.997^{NS})
Total Energy	16975.50± 1438.50	13801.67± 2008.06	14607.71± 1758.74	14880.35± 2091.48	2.181 (0.111^{NS})

Values are in Mean±SD, n= number of subjects, NS= non-significant, PP= peak power, RPP= relative peak power, AP= average power, RAP= relative average power, MP= minimum power, RMP= relative minimum power, PD= power drop, RPD= relative power drop, Sig.= level of significance.

Table 3 represents the comparison of upper body anaerobic power output of various playing positions of trained Roll Ball players. Where, forward players were found to have significantly ($p<0.05$) the highest absolute power drop and max speed measures. Whereas, RPD, RPP, RAP, total energy was found to be highest among the same forward players, in a statistically insignificant manner.

Table 3: Comparison of upper-body Anaerobic power variables among various playing positions of trained male Roll Ball players.

Variables	Forward (n=4)	Midfielder (n=6)	Winger (n=7)	Combined (n=17)	F value (Sig.)
PP (watt)	639.91±150.35	430.83±95.27	519.24±85.48	516.43±127.98	2.506 (0.078^{NS})
RPP (watt/kg)	7.58±1.12	6.18±1.28	6.94±0.55	6.82±1.08	1.494 (0.236^{NS})
AP (watt)	375.63±59.43	284.56±55.66	370.57±123.51	341.41±96.06	1.132 (0.352^{NS})
RAP (watt/kg)	4.46±0.17	4.06±0.45	4.46±0.36	4.32±0.39	1.390 (0.265^{NS})
PD (watt)	432.74±148.05	243.05±71.97	369.19±63.25	339.62±115.22	2.949 (0.049*)
RPD (watt/kg)	5.08±1.27	4.26±1.99	4.92±63.25	4.73±1.31	0.395 (0.757^{NS})

Variables	Forward (n=4)	Midfielder (n=6)	Winger (n=7)	Combined (n=17)	F value (Sig.)
PD%	66.42±7.08	57.14±13.32	71.22±6.50	65.12±11.01	2.010 (0.134^{NS})
Max speed	145.69±7.86	127.98±10.77	136.76±4.16	135.76±10.10	3.055 (0.043*)
Total Energy	10900.75± 1637.29	8319.50± 1694.78	9643.14± 1186.33	9471.88± 1717.33	2.094 (0.122NS)

Values are in Mean±SD, * =significant, ns= non-significant., PP= peak power, RPP= relative peak power, tPP= time to peak power, AP= average power, RAP= relative average power, MP= minimum power, RMP= relative minimum power, PD= power drop, RPD= relative power drop, Sig.= level of significance.

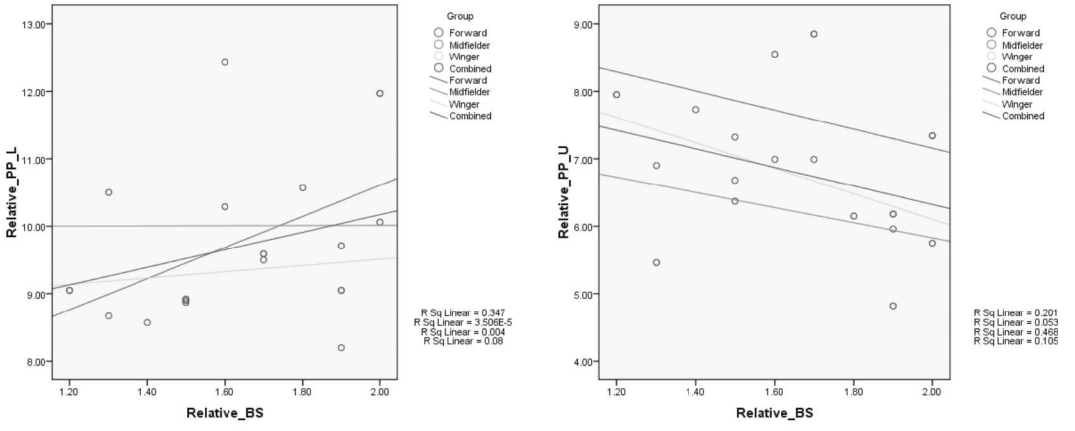
Table 4 represents the Pearson's correlation coefficient among various anaerobic power variables with HRmax and back strength (BS) measures. Absolute back strength and RBS were found to be significantly ($p<0.01$) correlated with PPlower (positive) and PPupper (negative), respectively. Whereas, HRmax (lower) was found to be significantly correlated with all three variables, i.e., PPlower ($p<0.01$), RPPlower ($p<0.01$), and PD%lower ($p<0.05$). Only the HRmax (upper) doesn't show any significant correlation with any selected variables in the table.

Table 4: Pearson Correlation matrix among various anaerobic power variables with HRmax and back strength measures.

	PP_{Lower}	RPP_{Lower}	$PD\%_{Lower}$	PP_{Upper}	RPP_{Upper}	$PD\%_{Upper}$
HRmax_Lower	0.499**	0.477**	0.408*	0.257	0.219	-0.198
HRmax_Upper	-0.306	-0.260	-0.011	0.131	0.328	-0.220
BS	0.462**	0.000	0.110	0.286	-0.059	0.245
RBS	-0.218	0.283	0.046	-0.469**	-0.324	0.135

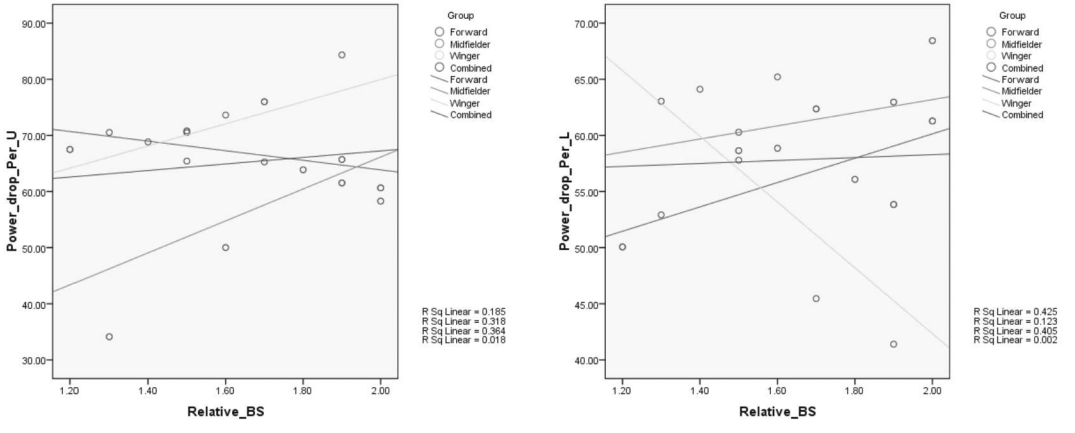
***= significance at 0.05 level, **= significance at 0.01 level; PP_{Lower}= peak power of lower body, RPP_{Lower}= relative peak power of lower body, $PD\%_{Lower}$= power drop percentage of lower body, PP_{Upper}= peak power of upper body, RPP_{Upper}= relative peak power of upper body, $PD\%_{Upper}$= power drop percentage of upper body, BS= back strength, RBS= relative back strength.**

Table 5 depicted the prediction regression based on the linear regression modeling. Where, back strength (BS) was the independent variable against independent variables i.e., HR_{max}, RPP, RAP, and RPD for both lower WAnT and upper WAnT testing. Although in both the cases BS was found to be predicted via the dependent variables, but in insignificant manner (F= 0.454, Sig.= 0.768 for Lower body WAnT; and F= 1.658, Sig.= 0.224 for Upper body WAnT).



1(A) 1(B)

Figure 1: Scatter plot between relative back strength (RBS) vs Relative peak power (RPP) lower body [1(A)] and upper body [1(B)].



2(A) 2(B)

Figure 2: Scatter plot between relative back strength (RBS) vs Power drop % (PD%) lower body [2(A)] and upper body [2(B)].

Table 5: Prediction of Regression Coefficient based on Linear Regression Model.

Variables	R^2	Adjusted R^2	β	t value	Significance
Lower body WAnT					
Back strength	131	-0.158			
HRmax (L)			-0.208	-0.646	0.530
RPP (L)			1.039	0.839	0.418
RAP (L)			-0.381	-0.527	0.608
RPD (L)			-0.382	-0.485	0.636

Variables	R^2	Adjusted R^2	β	t value	Significance
Upper body WAnT					
Back strength	0.356	0.141			
HRmax (U)			-0.392	-1.561	0.144
RPP (U)			-0.289	-0.935	0.368
RAP (U)			-0.055	-0.208	0.838
RPD (U)			0.290	1.110	0.289

WAnT= wingate anaerobic test, L= lower body, U= upper body, HRmax= heart rate maximum, RPP= relative peak power, RAP= relative average power, RPD= relative power drop.

DISCUSSION

In the present study, table 2 depicted no statistically significant changes in lower-body anaerobic power characteristics amongst Roll Ball positions (forwards, midfielders, and wingers) for maximum speed, total energy, average power, power drop, or peak power (absolute and relative). Forwards consistently produced more absolute peak power, average power, and total energy, albeit not much. Wingers had intermediate values, whereas midfielders had somewhat greater relative peak power and relative power drop (Sever & Zorba, 2017; Atlı & Koç, 2021). These findings differ from those in other sports, which show clear positional variances. In soccer, offensive players have higher maximal anaerobic power than defenders (dos Santos et al., 2022), but in basketball, centers have more absolute power and guards excel in relative anaerobic power for repeated high-intensity attempts (Pojskić et al., 2015). Such variances are associated with tactical and physiological role demands.

The lack of significant positional differences in Roll Ball could be attributed to the universal high-intensity demands of sprinting, skating, and quick direction changes across roles, as well as limited position-specific conditioning and a small, heterogeneous sample (n=17), reducing statistical power (Bortnik et al., 2023; Oliveira & Pirscoveanu, 2021). Upper-body comparisons indicated only minor differences: forwards had the highest absolute peak and average power in the Wingate test, with significance found only in Power Drop ($p = 0.049$) and Maximum Speed ($p = 0.043$) (Gorostiaga et al., 2005). Forwards thus play a role in explosive tasks such as quick accelerations, offensive runs, and powerful ball delivery.

Midfielders, despite having lower absolute power, demonstrated superior fatigue resistance (lower PD values), indicating greater endurance for transitions and repeated efforts. Similar positioning patterns in handball have been connected to both power generation and fatigue tolerance (Chelly et al. 2010). Wingers had comparatively high peak power and greater fatigue indices (e.g., upper-body PD% = 71.22%), indicating explosive ability but a rapid power decline. Importantly, relative metrics (W/kg) changed less than absolute values, emphasizing body mass as a key factor in power production. This shows that Roll Ball fitness is less position-specific than soccer or handball (Reilly et al., 2000),

with limited findings presumably due to the small sample size and group heterogeneity.

Pearson's correlation study showed HR_{max} (lower body) to be positively associated with PP_{Lower} and RPP_{Lower} which suggest that athletes achieving higher maximal HR may exhibit greater lower-body power output. This could be attributed to superior cardiovascular capacity, enabling more efficient oxygen delivery and energy turnover during explosive lower-body efforts (Midgley et al., 2007). However, the concurrent positive correlation with $PD\%_{Lower}$ indicates that higher HR_{max} athletes also experience greater fatigue-induced power decline, reflecting the trade-off between high-intensity effort and anaerobic energy system stress (Girard et al., 2011). Whereas, absolute back strength (BS) demonstrated a significant positive correlation with PP_{Lower}, reinforcing the role of maximal strength as a foundation for power development (Suchomel et al., 2016; Stone et al., 2003). In contrast, relative back strength (RBS) correlated negatively with upper-body peak power (PP_{Upper}), suggesting that normalizing strength to body mass alters the predictive value for upper-body performance. This may reflect differences in neuromuscular demands between upper- and lower-body tasks, with the lower body more reliant on posterior chain strength while upper-body power depends more heavily on specific musculature and technical skill (Cormie et al., 2011; Loturco et al., 2018). The weaker and inconsistent correlations in upper-body variables [HR_{max} (Upper body), RBS] compared to stronger trends in lower-body variables emphasize movement specificity. Lower-body power relies strongly on systemic cardiovascular function and posterior chain strength, while upper-body power may be influenced by localized adaptations in the shoulders, arms, and trunk that are not fully captured by generalized measures of back strength or HR_{max} (Haff & Nimphius, 2012).

The scatter-plot graphs in Figures 1(A) and 1(B) suggest a positive association between RBS and RPP, indicating that athletes with higher RBS tend to exhibit greater PP in both lower- and upper-body movements. This aligns with prior findings that maximal strength contributes significantly to power generation, as stronger athletes are able to recruit a larger pool of motor units, particularly type II fibers, which are critical for explosive actions (Suchomel et al., 2016; Stone et al., 2003). Moreover, relative strength – normalized to body mass – is especially important in weight-bearing sports, where force must be produced efficiently relative to the athlete's size (Comfort et al., 2012). On the other hand, Figures 2(A) and 2(B) show an inverse trend between RBS and PD%, with stronger athletes demonstrating a lower decline in power across repeated efforts. This suggests that individuals with higher RBS possess greater fatigue resistance and are better able to sustain power output during repeated bouts. The findings are consistent with the notion that maximal strength not only influences peak power but also enhances the efficiency of neuromuscular recruitment, energy utilization, and buffering capacity (Haff & Nimphius, 2012; García-Ramos et al.,

2018). In particular, strong athletes may have greater phosphocreatine availability and improved tolerance to lactate accumulation, delaying fatigue during high-intensity repeated efforts (Girard et al., 2011). Similar patterns are seen across both upper- and lower-body measures, the lower-body relationships appear slightly stronger, likely reflecting the central role of back and hip strength in movements requiring large muscle group coordination such as sprinting, jumping, or cycling (Cormie et al., 2011). Conversely, upper-body power production, though related to back strength, may rely more heavily on specific technical and muscular adaptations in the shoulder and arm musculature, explaining potentially greater variability in the scatter plots. This observation reinforces the concept of movement specificity in strength–power relationships (Loturco et al., 2018).

The regression analysis (Table 5) revealed that none of the tested variables significantly predicted back strength in either lower or upper body models, although the upper body model showed comparatively better explanatory power ($R^2 = 0.356$, Adjusted $R^2 = 0.141$) than the lower body model ($R^2 = 0.131$, Adjusted $R^2 = –0.158$). In the lower body, relative peak power ($\beta = 1.039$) showed a positive but non-significant trend, while in the upper body, HR_{max} displayed a negative association ($\beta = –0.392$) and relative power drop a positive trend ($\beta = 0.290$), both also non-significant. These findings suggest that back strength performance is not strongly predicted by the selected physiological and power-related variables, indicating the likely influence of additional neuromuscular, biomechanical, and training-specific factors beyond those included in the present model.

The present study has certain limitations. Firstly, the small sample size, especially when divided into positional groups, the athlete numbers look even more limited. A greater number of subjects might predict stronger statistical significance when compared among positional differences.

CONCLUSION

The present study examined strength–power relationships and positional differences in anaerobic capacity among trained male Roll Ball players. Overall, anaerobic power profiles were largely consistent across positions, with forwards displaying higher absolute power and speed, midfielders greater fatigue resistance, and wingers' intermediate values. Lower-body peak power showed significant positive associations with maximal heart rate and back strength, underscoring the role of cardiovascular capacity and maximal strength in explosive performance, while stronger athletes demonstrated reduced fatigue indices. These findings suggest that although positional variations are subtle due to the sport's uniformly high-intensity demands and non-specialized training, tailored conditioning may enhance performance—emphasizing power and speed for forwards, repeated high-intensity endurance for midfielders, and explosive maintenance for wingers. Future studies with larger cohorts and match-play analyses are needed to refine position-specific training strategies in Roll Ball.

Practical application

Although anaerobic power profiles are largely consistent across positions in Roll Ball, subtle trends suggest tailored conditioning can be valuable. Forwards should emphasize speed and maximal power, midfielders repeated high-intensity endurance, and wingers' explosive maintenance. Strength and cardiovascular training remain essential across all roles to enhance resilience and overall performance.

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Ethical approval

The present study has been conducted by following the guidelines of the 'Declaration of Helsinki'. Proper informed consent was signed by each athlete before the commencement of the study.

Conflict of Interest

All authors depicted NO conflict of interest for the publication of the article.

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