



Strength and conditioning practices of high school rugby coaches: A South African context

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Although rugby union as a sport is well established, the strength and conditioning practices of high school level players are not well known. Therefore, the main purpose of this study was to examine the current strength and conditioning practices that coaches implement at South African high school level rugby. A secondary purpose was to compare practices between high schools of different socio-economic status in South Africa. An online survey or in person interview (depending on the school) was conducted and 43 responses were received: from 28 coaches at schools among the top 100 rugby schools in South Africa for 2016 and from 15 coaches at no-fee public schools in the Eastern Cape Province of South Africa. Most coaches (72%) performed some form of physical testing, with the most common parameter tested being 'speed'. The most common strength and conditioning practices utilised included flexibility (stretching), speed (free sprinting), agility (cone drills), plyometric (box drills) and resistance (weight lifting) training. Unlike the no-fee schools, the top 100 rugby schools implemented conditioning practices similar to best-known international practices. Furthermore, no-fee school coaches did not have the qualifications necessary to administer the correct training techniques. Education and upskilling on the best strength and conditioning practices for school level coaches need to be improved, particularly in less privileged schools. Such improvement is crucial to the transformation goals set out by the South African Rugby Union, which would benefit from player development in lower socio-economic schools.

Significance:

- The top 100 rugby playing schools in the country implement similar strength and conditioning practices to the best known international practices.
- Education of coaches is key to the implementation of correct strength and conditioning practices, specifically at underprivileged schools.

Introduction

Rugby union (hereafter referred to as rugby) is a popular sport with over 8.5 million players around the globe. Because of the increasing popularity and high profile of elite rugby, research on the sport has increased with two key objectives: optimising performance¹⁻⁵ and reducing the risk of injury⁶⁻⁸. As a consequence, there is increasing importance on developing the physical characteristics of modern players through the principles of strength and conditioning.^{9,10} Physical characteristics such as improved strength, power, speed, cardiovascular fitness and body composition can contribute towards the success of a player and a team.¹¹ Improving these attributes has thus become a crucial part of training and development; understanding the techniques for an effective physical conditioning programme can give players and teams a competitive edge.¹² Furthermore, rugby has a high incidence of injury due to the physical nature of the game⁸ and in South Africa it presents an above-average overall injury risk (69 injuries in 1000 hours exposure) compared to other popular sports such as cricket (2 injuries in 1000 hours exposure)¹³. The physiological and morphological adaptations of strength and conditioning do not only benefit rugby performance, but also reduce the risk of injury and are thus important to consider within the training paradigm.^{6,8} South African high school rugby is fiercely competitive and reflects the modern professionalism of the sport at an elite level.⁷ Sponsorships, televised matches and bursaries have all increased rugby competition in high schools and schools have made major investments to improve their results.¹⁴ Such investments include hiring professional coaches, with strength and conditioning specialists becoming more frequent in top rugby-playing schools. The expertise provided by such specialists is paramount in developing young players into competitive athletes.

Despite the increasing popularity of rugby in South Africa, the sport is plagued with political interference and racial division.¹⁵ Interventions such as racial quotas have been introduced to reverse the apartheid policies of racial division and systemic disadvantage.¹⁶ However, despite such interventions, the previously disadvantaged people of colour, who represent 90% of the South African population, remain the minority in the elite level rugby teams.¹⁵ There is a distinct lack of black players who fulfil their potential and reach an elite level of rugby. Development of these players needs to start from grassroots level.¹⁷ However, the South African schooling system is steeped in inequalities that favour the minority, and these inequalities are reflected in rugby structures.^{10,18} The majority of school learners, predominantly black learners, face unfavourable socio-economic circumstances at home and have to strive to overcome similar circumstances in school as well.^{10,18} Schools that cater for poverty-struck communities also struggle for educators, resources and facilities.¹⁹ As a result, these schools lack the structures and knowledge to develop their learners into competitive athletes who could pursue a sport as a career. Combining the principles of strength and conditioning with those of nutrition could assist these players to achieve the physical development required to reach an elite level of rugby performance.²⁰ However, the extent to which strength and conditioning exercises have been adopted in a South African high school context is yet to be investigated. If effective transformation is to be achieved, the nation cannot rely on the few top rugby playing schools in the country to provide the players, especially as these teams are represented pre-dominantly by white players.¹⁰ There is much to be learned from the success of the top rugby playing schools. Their expertise can lead adolescent development across the country and the practices of these schools can form a fundamental starting point from which research can expand.

The purpose of this study was therefore twofold: the primary aim was to describe the current strength and conditioning practices utilised by coaches at a high school level and a secondary aim was to compare these practices to those of a smaller sub-sample of rural school coaches.

Methods

The study was a cross-sectional descriptive study which required participation in an online questionnaire. The online questionnaire was created using www.kwiksurvey.com and is available as [Appendix 1 in the Supplementary material](#). The questionnaire was designed following a narrative literature review of previous strength and conditioning surveys specific to intermittent and contact sports similar to rugby. Questionnaires examining similar issues were given specific attention, particularly those regarding high school strength and conditioning practices and rugby-related research.^{18,21-24} However, due to the limited literature available, particularly that in regard to rugby-specific questions, newly constructed questions were verified for construct validity through pilot testing with local strength and conditioning specialists as well as sports scientists.

The survey itself consisted of four sections:

1. **General:** This section surveyed the background information of the coaches, their degrees and qualifications obtained and their general knowledge of strength and conditioning principles.
2. **Sports conditioning:** This section focused on the coaches' use of physical testing, flexibility development, speed development, agility development, plyometric training, and strength and resistance training.
3. **Rugby specific:** This section dealt with rugby-specific strength and conditioning related questions that gave insight into position-specific practices.
4. **General comments:** This section allowed coaches an opportunity to include any information they might deem useful to the study.

The survey consisted of both quantitative and qualitative questions. Quantitative questions provided specific data that were transformed into useable statistics. These questions included a combination of nominal and interval levels of measurements that reflected the response frequencies. The qualitative questions revealed specific trends or opinions and ensured the participants were not limited in their answers.

Participants were the head strength and conditioning specialists or, in the case of no strength and conditioning specialist, coaches who were responsible for the strength and conditioning of their high school boy rugby teams. Participants were recruited from 12 private schools, 16 public schools and 15 no-fee schools. The private and public high school teams chosen were from the top 100 rugby teams in the country in 2016. Because the no-fee schools are of major interest in the growth and transformation of South African rugby, it was decided that these schools would be approached in the Eastern Cape region surrounding Makhanda (previously Grahamstown) where the researchers were situated and thus comprised a sub-sample of convenience. Most rural schools have no access to computers or the Internet so schools in close proximity were approached for pragmatic reasons. Ethical clearance was granted by the Department of Human Kinetics and Ergonomics Ethical Standards Committee for research involving human participants (Rhodes University). All participants were informed of the benefits and risks of the study before consenting to participate.

The survey was emailed to the strength and conditioning specialist or coach in charge of conditioning for the Under-19 First team of the selected school. Email addresses were obtained via the schools' websites. The email sent contained information on participation and a link to the online survey. It was explained in the email that recipients were under no obligation to complete the questionnaire and could decline or withdraw at any point. If a coach was unavailable via email, a face-to-face interview was arranged where possible. Because of the multilingual nature of the South African education system, it was expected that there would be some language barriers. Thus, face-to-face interviews were also deemed necessary in assisting with the understanding of certain concepts and questions. Participants were not

influenced in any way during the interviews, but explanations were provided for terms where necessary.

The survey consisted of both fixed response (quantitative) questions and open-ended (qualitative) questions. The responses were exported by the survey host (KwikSurveys) to a Microsoft Excel spreadsheet. Quantitative data were analysed using the data analysis tool provided by KwikSurveys. Thematic analysis was used for qualitative data to identify patterns of meaning across the data sets that provide insight into the relevant question being addressed. This analysis was performed using the process of data familiarisation, data coding, theme development and revision. Patterns or themes were identified in accordance with the methods used in previous studies on strength and conditioning principles.²⁴ Braun and Clarke²⁵ identified a six-phase process for thematic analysis that was closely followed in the current study. Answers to the qualitative questions were collated and content analysed for specific major and minor themes. Categorical and ordinal data were reported as percentages of the responses. Univariate analysis was used to describe the basic features of the data and was stratified by the types of schools in the study.

Results

From the list of top 100 South African rugby schools, contact details were gathered for 66 of the schools (15 private and 51 public). Contact details were not available online for 44 of the schools. Of the 66 schools approached, 28 coaches (from 12 private schools and 16 public schools) responded to the survey. This response rate of 42% was deemed acceptable as it was higher than the rate obtained in a previous survey on conditioning practices.^{21,26} Additionally, 15 no-fee schools were included in the study; these surveys were completed via face-to-face and telephonic interviews. The total number of responses was therefore 43 (private = 12, public = 16, no-fee = 15). The basic demographic data of the respondents are shown in Table 1.

Table 1: Basic demographic data of the participants

	Private	Public	No-fee	Total
	n=12	n=16	n=15	n=43 (%)
Gender				
Men	12	16	15	43 (100)
Women	0	0	0	0 (0)
Age (years)				
<30	6	8	2	16 (37)
30–39	6	7	6	19 (44)
>40	0	1	7	8 (19)
Experience (years)				
<5	4	3	2	9 (20)
5–10	5	8	4	17 (40)
>10	3	5	9	17 (40)
Highest level of education				
Matric	0	0	7	7 (16)
Undergraduate	2	0	1	3 (7)
Postgraduate	9	14	6	29 (68)
Other†	1	2	1	4 (9)
S&C Certifications				
NSCA	2	1	0	3 (7)
Other†	1	2	0	3 (7)

S&C, strength and conditioning; NSCA, National Strength and Conditioning Association
†Other refers to additional qualifications, such as certificates or diplomas in health and wellness.

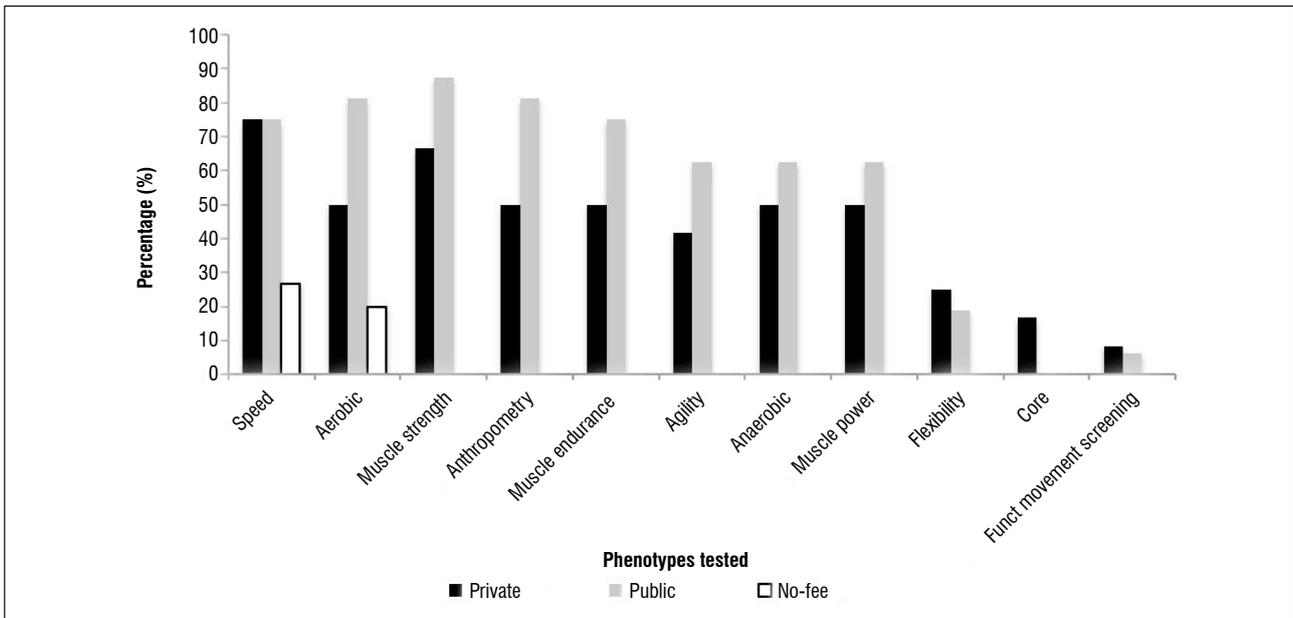


Figure 1: Different physical parameters tested (%) across the schools (n=31).

According to the coaches' responses, the most commonly tested measure was speed (58%), which remained the most popular for private schools (75%) and no-fee schools (27%) alike (Figure 1). The public schools indicated a preference for testing muscular strength (88%), with the only other parameter tested by no-fee schools being aerobic capacity (Figure 1). Overall, the most common tests were for speed (40-m and 100-m sprint tests), aerobic capacity (multi-stage fitness test), anaerobic capacity (repeat sprint ability test), muscular strength (one-to-five repetition maximum test), muscle endurance (maximum push-up, pull-up and sit-up tests), agility (Illinois agility test), muscle power (standing broad and vertical jump tests) and flexibility (sit and reach test).

Flexibility, speed, agility, plyometrics and resistance training were the most common practices. The most common types of equipment used for these training exercises are shown in Table 2.

Table 2: Most common (%) equipment used for each type of training

Type of training	Private (%)	Public (%)	No-fee (%)
Flexibility	Resistance bands (100%)	Resistance bands and foam roller (69%)	None
Speed	Resistance bands (75%)	Sled (63%)	Cones (40%)
Agility	Agility poles (88%)	Agility poles (88%)	Cones (33%)
Plyometrics	Boxes (75%)	Boxes (88%)	Cones (33%)
Resistance training	Free weights (100%)	Free weights (100%)	Body weight (53%)

Flexibility training

All 43 coaches reported that their teams did some type of flexibility training. Dynamic exercises were most common overall (n=38; private = 100%, public = 100%, no-fee = 67%). Static exercises were the most common form of flexibility training for no-fee schools (80%) and the second most common overall (n=36; private = 83%, public = 88%).

Speed training

All 43 coaches reported that their teams did some type of speed development training. Most (33) coaches reported holding speed development sessions on a weekly basis (private = 58%, public = 94%, no-fee = 73%) and almost all (39) reported free sprinting as the most common method for speed development (private = 83%, public = 88%, no-fee = 100%).

Agility training

Of the 43 respondents, 37 reported prescribing agility exercises (private = 92%, public = 100%, no-fee = 67%) and 24 prescribed agility exercises on a weekly basis (private = 58%, public = 56%, no-fee = 53%). Only 10 coaches reported using agility training more frequently than once per week (private = 25%, public = 38%, no-fee = 7%), and 3 coaches prescribed agility exercises on a monthly basis (private = 8%, public = 6%, no-fee = 7%). The most common type of agility training exercises were those involving sudden changes in direction (for example, Illinois agility drill, X-agility drill, L-agility drill).

Plyometric training

A total of 34 coaches prescribed plyometric exercises (private = 83%, public = 100%, no-fee = 53%). Various forms of jumping exercises were the most common method of plyometric training for private (58%) and no-fee schools (33%) while box drills were most popular with public school coaches (63%). Overall box drills were most common with 50% of private school coaches and 27% of no-fee school coaches using them. Of the 34 coaches prescribing plyometric training, 26 did so on a weekly basis (private = 67%, public = 75%, no-fee = 40%).

Resistance training

Resistance training was prescribed by 36 coaches (private = 100%, public = 100%, no-fee = 53%). The most common frequency of resistance training sessions was three times per week (n=16; private = 42%, public = 63%, no-fee = 7%). Of the 36 coaches, 35 required their players to take part in resistance training during the pre-season (private = 100%, public = 100%, no-fee = 47%); 32 continued resistance training in-season (private = 92%, public = 94%, no-fee = 40%); and 23 during the off-season (private = 92%, public = 69% and no-fee = 7%).

About half the coaches (n=20; private=58%, public=69%, no-fee=13%) reported using different conditioning practices for different positions (Table 3).

Table 3: Position-specific conditioning results

	Private n=7	Public n=11	No-fee n=2	Total (%) n=20
Front row				
Strength	4	8	2	14 (70)
Core	1	5	0	6 (30)
Scrummaging exercises	2	2	0	4 (20)
Aerobic training	0	1	0	1 (5)
Collision conditioning	1	0	0	1 (5)
Second row				
Strength	3	4	2	9 (45)
Explosive power	3	4	0	7 (35)
Core	0	2	0	2 (10)
Aerobic training	0	1	0	1 (5)
Collision conditioning	1	0	0	1 (5)
Flexibility	0	1	0	1 (5)
Back row				
Explosive power	2	6	0	8 (40)
Strength	2	2	2	6 (30)
Ruck specific exercises	2	3	0	5 (25)
Aerobic training	1	3	0	4 (20)
Anaerobic training	2	1	0	3 (15)
Speed	0	2	0	2 (10)
Half backs				
Passing drills (weighted)	2	2	1	5 (25)
Speed	1	3	0	4 (20)
Aerobic training	1	2	0	3 (15)
Explosive power	0	1	2	3 (15)
Decision-making / reactive agility	1	2	0	3 (15)
Strength	0	2	1	3 (15)
Wrestling	2	0	0	2 (10)
Agility	0	1	0	1 (5)
Flexibility	0	1	0	1 (5)
Centres				
Explosive power	3	6	2	11 (55)
Speed	1	6	1	8 (40)
Strength	1	5	0	6 (30)
Agility	0	1	0	1 (5)
Collision conditioning	1	0	0	1 (5)
Wrestling	1	0	0	1 (5)
Outside backs				
Speed	4	7	1	12 (60)
Power	1	5	2	8 (40)
Agility / reactive agility	1	3	0	4 (20)
Strength	0	1	0	1 (5)

Discussion

We sought to determine the strength and conditioning practices of South African school boy rugby coaches, specifically of those schools ranked highly in rugby performance and those from less privileged, no-fee schools. Overall, the no-fee school coaches were less likely to implement agility, plyometrics and resistance training, which could be explained by a lack of knowledge and limited or no access to equipment and/or facilities. As these exercises are key for injury prevention^{6,8} and performance^{5,21} in rugby, this limitation can have a negative impact on these players. The fact that no-fee schools lack the resources, facilities and skilled coaches to implement specific conditioning practices is somewhat surprising as there has been a big push over the past decade, by the then Department of Sport and Recreation South Africa, to eradicate these problems.¹⁷ However, this scenario needs to be investigated further as these reasons were not explored in this study.

The difference in principles and techniques prescribed by coaches is related to the coaches' education, the schools' level of rugby play, and the socioeconomic standpoint of the school and the community which it serves. The no-fee school coaches, who have no formal education in strength and conditioning, arguably have less understanding of the advantages of physical development. Additionally, they may not have adequate knowledge or the appropriate facilities to implement effective strength and conditioning programmes for their players. Furthermore, the players from these schools are often plagued with socioeconomic disparities which can hinder general health and well-being.²⁷ A coach cannot prescribe the same physical training for those who are malnourished as for healthy adolescents who are well nourished.²⁸ Furthermore, children from no-fee schools are already expending more energy by virtue of the fact that they walk to school and do physically demanding chores at home such as collecting water and firewood.²⁹ These factors need to be taken into consideration when determining training programmes.

The coaches surveyed in the top 100 rugby schools for 2016 were also from the nation's best rugby playing schools historically. These schools employ specialised strength and conditioning coaches who tend to align their practices with the best-known international trends in rugby.¹⁸ The no-fee schools cannot be expected to achieve the same level of strength and conditioning expertise with fewer resources and coaches who have no background in strength and conditioning. This highlights the complexities of sport and athletic development in a country such as South Africa where inequality and poverty prevails.

The majority (18 or 64%) of the top 100 rugby school coaches implemented different conditioning practices for different positions, compared with only two (13%) of the no-fee school coaches. The purpose of position-specific conditioning practices is to train the player according to the physical demands of their position, which is crucial in rugby, which has varying positional requirements.³⁰ The principles of 'specificity' and 'individualisation' are key aspects of developing an effective strength and conditioning programme to suit the needs of each player.¹⁸ In no-fee schools, the lack of importance in developing each individual could be due to time constraints and/or an absence of knowledge. To achieve a high level of success in rugby, every individual in the team needs to reach their peak physical capabilities to meet the demands of their position and benefit the team as a whole.

In the top rugby schools, strength training was indicated as the largest focus for the front row (67%) and second row (39%) which makes sense as these positions require large amounts of force production at low velocities during scrums – a crucial aspect of their gameplay.³¹ Explosive power was reported as the most important aspect of training for the back row (39%) and centres (50%) as these positions require a great capacity for power in tackling, scrumming, rucking, mauling and breaking through tackles.³² The main focus for half backs was weighted passing drills (22%), despite the fact that a previous study in youth rugby players indicated no significant differences in passing performance variables between weighted ball and non-weighted ball training interventions.³³ Despite this lack of evidence, coaches seem to believe in an added benefit of performing weighted passes for half back positions. There might be a



case for progressive implementation of weighted ball passes to reduce shoulder injuries in half backs, for whom frequent forceful passing actions are required. This possibility is addressed in the survey in the subsequent questions on injury prevention; however, weighted ball exercises are not specifically mentioned. The biggest focus for outside backs by coaches was on speed development (61%), which is crucial as they often are required to beat the opposition by means of speed.³⁴

Conclusions

This study provides a rich source of ideas to improve current training practices and expand on current knowledge on high school boys' rugby. It is clear from the lack of adequate conditioning in no-fee schools that methods need to be created to provide opportunities for learning for the coaches less resourced than those at wealthier schools. The South African Rugby Union should employ qualified individuals to promote player development among the no-fee schools and educate the coaches. Failing that, structures should be implemented to allow qualified strength and conditioning specialists in the top rugby playing schools to assist coaches at underprivileged schools. But first it should be determined whether no-fee schools are not administering adequate strength and conditioning practices due to a lack of knowledge or a lack of access to facilities, equipment and resources.

Authors' contributions

B.R. was responsible for conceptualising research goals and aims, developing the methodology, administering the survey and applying statistical techniques to analyse the data. L.P. was responsible for conceptualising research goals and aims, developing the methodology, preparing and creating the published work (initial draft) as well as reviewing and revising the writing. C.C. was responsible for conceptualising research goals and aims, developing the methodology, validating the experimental process and results, student supervision, writing revisions as well as overall project leadership and management.

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