Defining the Volume and Intensity of Sport Participation in Adolescent Rugby Union Players

Timothy B. Hartwig, Geraldine Naughton, and John Searl

Purpose: Investigating adolescent training loads might help us understand optimal training adaptations. GPS tracking devices and training diaries were used to quantify weekly sport and other physical activity demands placed on adolescent rugby union players and profile typical rugby training sessions. Methods: Participants were 75 males age 14 to 18 y who were recruited from rugby teams representing 3 levels of participation: schoolboy, national representative, and a selective sports school talent squad. Results: Schoolboy players covered a distance of (mean ± SD) 3511 ± 836 m, representative-squad players 3576 ± 956 m, and talent-squad players 2208 ± 637 m per rugby training session. The representative squad recorded the highest weekly duration of sport and physical activity (515 ± 222 min/wk), followed by the talent squad (421 ± 211 min/week) and schoolboy group (370 ± 135 min/wk). Profiles of individual players identified as group outliers showed participation in up to 3 games and up to 11 training sessions per week, with twice the weekly load of the team averages. Conclusion: Optimal participation and performance of adolescent rugby union players might be compromised by many high-load, high-impact training sessions and games and commitments to other sports and physical activities. An improved understanding of monitoring and quantifying load in adolescent athletes is needed to facilitate best-practice advice for player management and training prescription.

Keywords: notational analysis, global-positioning satellite, training diaries, training load

To facilitate optimal participation and performance in adolescent sport, every effort should be made to ensure appropriate training prescription and player-management practices. For adolescents, the training and game demands of sports are becoming increasingly more adultlike.\(^1\) With a “more is better” approach in some training programs, detrimental effects on health, performance, and participation are possible outcomes for adolescents.\(^2-5\) Consequently, there is a need to monitor young players’ participation in sports to determine the most appropriate workloads and ensure that future participation and performance are not compromised.\(^6\) In the

---

Hartwig and Naughton are with the School of Exercise Science, Australian Catholic University, Sydney, Australia. Searl is with Australian Rugby Union, St Leonards, NSW, Australia.
Defining Participation in Junior Rugby

absence of accepted criteria for optimal participation and performance in rugby, the focus of this article will be on quantifying selected loading in adolescent players during training and games.

Adolescents are worthy of special consideration because some might be participating in various team and individual sports with high physical demands. Adolescents in Australia can participate in a number of sports without individual coaches’ being aware of the physical demands imposed by their participation elsewhere. In addition, adolescents can compete and train in the same sport with several teams representing different levels of competition, such as community clubs, schools, and representative and selective talent squads. Subsequently, the physical demands associated with popular sports such as rugby union are currently poorly documented, and there are no evidence-based strategies to monitor participation loads.

Defining volume and intensity in team sports such as rugby union is challenging. Advances in notational-analysis technology such as global-positioning satellite systems (GPS), however, permit an acceptable assessment of previously relatively imprecise estimates of training speeds, distances, and intermittent movement intensities. Notational analyses of elite players in most sports are increasingly reported, but few reports are available for aspiring elite adolescents. Therefore, the purpose of this study was to use notational analyses and self-reporting to define the current level of physical demands during a typical rugby season including training, competitive games, and all other sport and physical activities in adolescent male rugby union players. An additional purpose was to define the variation in activity patterns for varying levels of participation.

Methods

Participants

After we received ethical approval from the university’s human-research ethics committee, we recruited 75 male rugby union players age 14 to 18 years for the study. In addition to obtaining parental consent, players had to be free of injury and actively engaged in rugby training at the time of recruitment. Players were recruited from rugby teams representing 3 levels of rugby participation: schoolboy, national representative, and a selective sports school’s high-performance talent squad. Staff at the Australian Rugby Union assisted with recruitment via facilitated links with the schools and teams involved in this study. Players and coaches were invited to participate in the project and were free to choose to not participate.

Research Design

The volume and intensity of participation in rugby, as well as in other sport and physical activity, were estimated using notational-analysis technology and data recorded in weekly training diaries. Measures were taken twice a week for 12 weeks representing a full schoolboy competitive rugby season, for 6 weeks leading into the end of the representative rugby season, and for 10 weeks leading into the end of the selective high-performance squad’s rugby season. GPS technology and heart-rate monitoring were used to track the volume and intensity of rugby training sessions. In addition, detailed weekly training diaries were completed to record
the amount and subjective rating of the intensities of sport and physical activity in which players participated outside of rugby training.

**Anthropometric and Descriptive Data**

Anthropometric measures of height and weight were recorded. Body mass was measured using a digital scale (Wedderburn, UWBW150) accurate to 0.01 kg, and stretch stature was measured using a stadiometer. Descriptive data about players’ history of participation in rugby were obtained using a player survey that had previously been pilot tested in an age- and sport-matched population. Participants’ descriptive data are presented as means and standard deviations in Table 1.

**Training Diaries**

We chose to use training diaries to assist in volume estimates because they represent the most pragmatic means of longitudinally assessing training, despite acknowledged limitations of a high burden on participants and problems with compliance. At the end of the last training session for the week, players completed a detailed 7-day training diary. Diaries were completed in the presence of researchers. Players were instructed to record all sports and physical activities lasting 15 minutes or longer. In addition to recording the nature and duration of activities completed, ratings on the Borg scale of rating of perceived exertion (RPE) were also entered into the diary. Researchers used prompts about significant days (such as game days, training days, and physical education) to help participants recall the past week’s activities. Diary entries were regularly verified by coaches to ensure quality of at least some of the subjective data. Team coaches and coaching staff at the Australian Rugby Union confirmed that reported weekly training volumes approximated expected values. Because of the need to exclude atypical training weeks from the data analysis, players completed a section on weekly injury and illness that included questions about the extent to which normal training and activities had been affected.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Descriptive Data (Mean ± SD) From 3 Levels of Male Adolescent Rugby Union Players</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Schoolboys (n = 29)</td>
</tr>
<tr>
<td>Age (y)</td>
<td>15.2 ± 0.6</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>177 ± 7</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>72.7 ± 10.2</td>
</tr>
<tr>
<td>Years playing rugby</td>
<td>5.2 ± 3.0^b</td>
</tr>
</tbody>
</table>

^a Significantly different from schoolboys, P < .001.

^b Significantly different from representative squad, P = .027.
Notational Analysis

Analyses of players’ rugby training volume and intensity were achieved through the use of GPS tracking devices (SPI10, GPSports Systems Pty Ltd 2003, Canberra, Australia) and heart-rate monitors. When worn by players, the GPS device communicated with earth-orbiting satellites to triangulate location, yielding time, distance, and velocity data. Heart-rate data were also obtained by the GPS devices. The SPI10 GPS devices were worn between players’ shoulder blades in the upper thoracic-spine region. They were worn during 2 training sessions a week for the duration of the study. A maximum of 6 devices were randomly assigned to players during the data-collection period. All players wore a GPS device on at least 1 occasion, which enabled movement-data collection for all field positions. The SPI10 GPS devices recently showed acceptable validity for measuring distance.

Statistical Analysis

After tests for normality, descriptive data were presented in medians, means, and standard deviations. Poorly distributed continuous data were log-transformed for analytical purposes. One-way ANOVA analyses were used to compare differences among the 3 groups, and unadjusted Bonferroni post hoc analyses were used to locate and assess the magnitude of group differences. Significance was accepted at an alpha level of \( P < .05 \) for analyses.

Results

Profile of Rugby Training Sessions

Typical rugby training sessions were profiled using data derived from GPS analyses. Duration, distance, and measures of intensity were recorded from training sessions. Table 2 presents the total number of training hours tracked, as well as the number of times the GPS and heart-rate devices were worn throughout the rugby season (test frequency). Session duration was the longest for the representative squad, followed by the schoolboy program, with talent-squad sessions shortest in duration. Because mean session duration differed between groups, mean distance covered per hour of training was calculated to allow for group comparisons (Table 2). Mean distance covered per hour was compared using 1-way ANOVA, with the results showing a significant difference \( (F_{2,158} = 19.99, P \leq .001) \). The schoolboy program recorded the highest distance per hour. Unadjusted Bonferroni post hoc analysis showed differences between schoolboy squads and the representative \( (P \leq .001) \) and talent squads \( (P \leq .001) \) and no differences between the representative and talent squads \( (P = 1.000) \).

The mean distance covered by players during rugby training sessions is presented in Figure 1. Schoolboy players covered \( (\text{mean} \pm \text{SD}) 3511 \pm 836 \text{ m} \), representative-squad players covered \( 3576 \pm 956 \text{ m} \), and talent-squad players covered \( 2208 \pm 637 \text{ m} \). One-way ANOVA showed differences between groups in average distance covered per session \( (F_{2,158} = 43.96, P < .001) \). Unadjusted Bonferroni post hoc analysis showed that the mean distance covered in talent-squad sessions was less than in the representative-squad sessions \( (P \leq .001) \) and
Table 2  Rugby Training and GPS Analyses Descriptive Data

<table>
<thead>
<tr>
<th></th>
<th>Schoolboys (n = 35)</th>
<th>Representative squad (n = 19)</th>
<th>Talent squad (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours analyzed (h/m)</td>
<td>104:54</td>
<td>37:45</td>
<td>43:48</td>
</tr>
<tr>
<td>Test frequency</td>
<td>90</td>
<td>25</td>
<td>46</td>
</tr>
<tr>
<td>Mean session duration (h/m)</td>
<td>1:12 ± 0:18</td>
<td>1:33 ± 0:19</td>
<td>0:58 ± 0:12</td>
</tr>
<tr>
<td>Distance per hour of training (km/h)</td>
<td>3.0 ± 0.76</td>
<td>2.4 ± 0.85*</td>
<td>2.3* ± 0.42</td>
</tr>
</tbody>
</table>

* Significantly different from schoolboys, \( P < .001 \).

Figure 1 — Mean distance in meters per session for 3 levels of participation assayed using repeated GPS analyses across the rugby season. *Significantly different from talent squad, \( P < .001 \).

Schoolboy sessions \( (P \leq .001) \). Mean distance covered during sessions was not different between the representative squad and schoolboy players \( (P = 1.000) \). The frequency and average duration of locomotor efforts occurring at speeds greater than 14 km/h (termed high-intensity efforts) were determined. No group differences were found for the average duration of high-intensity efforts \( (P = .147) \). Schoolboy players performed high-intensity efforts lasting an average of 2.6 seconds (range 1.3 to 5.9); representative-squad players, 2.6 seconds (1.3 to 4.6); and talent-squad players, 2.3 seconds (1 to 6.3). Frequency of high-intensity efforts was different among the groups according to 1-way ANOVA \( (F_{2,158} = 5.061, P = .007) \). The number of high-intensity efforts recorded per hour of training was 28.2 (5 to 88) for schoolboy players, 23.3 (2 to 61) for representative-squad players, and 20.0 (4 to 52) for talent-squad players. Unadjusted Bonferroni post hoc analysis indicated
differences between schoolboy and talent-squad players for frequency of high-intensity efforts \( (P = .012) \).

Results from an ANOVA on maximal and mean heart-rate data collected during rugby sessions revealed no differences between groups for mean heart rate \( (P = .290) \). Differences between groups were found for maximal heart rate \( (F_{2,148} = 8.51, P \leq .001) \). Maximal and mean heart-rate scores were 200 ± 13 and 141 ± 12 beats/min for schoolboys, 196 ± 12 and 136 ± 17 beats/min for the representative squad, and 189 ± 15 and 140 ± 17 beats/min for the talent squad. As an additional descriptor of training intensity, the percentage of time spent above 85% of age-predicted maximum heart rate was also calculated. Group differences were found using 1-way ANOVA \( (F_{2,135} = 4.664, P = .011) \). The percentage of time spent above 85% of age-predicted maximum heart rate was 22.6% (0% to 94.8%) for schoolboy players, 16.5% (0.1% to 58.8%) for representative-squad players, and 18% (0% to 58.2%) for talent-squad players, with differences between schoolboy and representative-squad players being significant \( (P = .017) \).

Profile of Weekly Training

Participants’ typical weekly training, including the duration, intensity, and type of all sports and physical activities, was profiled using training-diary data. Weekly duration in minutes per week and a breakdown of specific activities during the week for each of the 3 groups are presented in Figure 2. Results of the 1-way ANOVA analyses identified group differences \( (F_{2,392} = 21.02, P \leq .001) \), with the representative squad recording the highest weekly duration \( (515 ± 222 \text{ min/wk}) \), followed by the talent squad \( (421 ± 211 \text{ min/wk}) \) and schoolboy group \( (370 ± 135 \text{ min/wk}) \). Unadjusted Bonferroni post hoc analysis found that the weekly duration of activity of representative-squad players differed significantly from the talent-squad players’ \( (P = .001) \) and the schoolboy group’s \( (P \leq .001) \). In the schoolboy group, 12% of weekly duration of all activity was rugby games, 38% rugby training, 22% rugby-related activities, 24% school and other organized sport and physical activities, and 4% other recreation assumed to occur above resting energy expenditure. In the representative squad, rugby games accounted for 7% of weekly activity, rugby training 48%, rugby-related activities 22%, school and other organized sport and physical activities 18%, and recreation activities the remaining 5%. In the talent squad, rugby games contributed 17% of reported weekly activity, rugby training 56%, rugby-related activities 18%, school and other organized sport and physical activities 8%, and the remaining 1% was assigned to recreational activities. Within acknowledged limitations and for the purpose of comparisons, the product of players’ weekly total duration and RPE scores was termed weekly load.\(^{16}\) Group differences for players’ weekly load were found again using 1-way ANOVA \( (F_{2,368} = 27.75, P \leq .001) \). The representative squad had the highest weekly load, 3645 ± 1588, followed by the talent squad with a weekly load of 2907 ± 1586. The schoolboy squad had the lowest weekly load, 2372 ± 1009. Unadjusted Bonferroni post hoc analysis showed significant differences between the representative squad and the talent squad \( (P \leq .001) \), the representative squad and the schoolboy group \( (P \leq .001) \), and the schoolboy group and the talent squad \( (P = .005) \).

An estimate of the intensity of the specific activities included in the weekly duration for each of the 3 groups was provided by RPE data. Average recorded
RPE scores for the schoolboy group were 8.6 ± 1.6 for rugby games, 6.4 ± 1.7 for rugby training, 5.9 ± 1.8 for rugby-related activities, 5.2 ± 1.8 for school and other organized sport and physical activities, and 6.2 ± 1.7 for recreational activities. For the representative squad RPE scores were 8.3 ± 1.7 for rugby games, 6.8 ± 1.7 for rugby training, 7.2 ± 1.8 for rugby-related activities, 5.7 ± 2.2 for school and other organized sport and physical activities, and 6.8 ± 1.7 for recreational activities. In the talent squad RPE scores were 8.1 ± 1.4 for rugby games, 6.7 ± 1.8 for rugby training, 6.9 ± 1.6 for rugby-related activities, 4.7 ± 2.3 for school and other organized sport and physical activities, and 5.1 ± 2.5 for recreational activities. One-way ANOVA found group differences in recorded RPE for rugby training ($F_{2,927} = 3.83, P = .022$), for rugby-related activities ($F_{2,670} = 38.53, P ≤ .001$), for school and other organized sport and physical activities ($F_{2,446} = 5.07, P = .007$), and for recreational activities ($F_{2,104} = 3.74, P = .027$). Unadjusted Bonferroni post hoc analysis showed differences between the schoolboy group and the representative squad for rugby training ($P = .028$), the schoolboy group and the representative and talent squad for rugby-related activities ($P ≤ .001$), the representative and talent squads for school and other organized sport and physical activities ($P = .007$), and the representative and talent squads for recreational activities ($P = .039$). Rugby games consistently rated highest for RPE for all 3 groups.

Figure 2 — Mean total weekly duration and a breakdown of weekly activities in min/wk reported in training diaries. *Significantly different from representative squad, $P < .001$. a Rugby game. b Rugby training. c Rugby related (included weight training, rugby-specific skills or fitness sessions, touch rugby, rugby-league training, and games). d School/Other organized (included school sports, physical education, and all other organized sports and physical activities). e Recreational (included general nonspecific fitness, as well as recreational sports and physical activity).
Case Studies

The player from each of the 3 groups who recorded the greatest weekly duration (min/wk) was selected as a case study. Figure 3 presents the reported mean weekly duration of sports and physical activities for teams and individual case studies. The case-study athlete from the schoolboy group reported a sports and physical activity duration of $730 \pm 49$ min/wk. In the representative squad the case-study athlete reported $792 \pm 226$ min/wk. In the talent squad the case-study athlete reported $804 \pm 335$ min/wk. The case-study athlete from the schoolboy group had a mean weekly load (duration $\times$ RPE) of $5468 \pm 470$. The case-study athlete from the representative squad reported a mean weekly load of $4892 \pm 1720$. The case-study athlete from the talent squad had a mean weekly load of $5699 \pm 3122$. The case-study athlete from the schoolboy group had a maximum weekly duration of 890 min/wk, with a peak weekly load of 5810. The case-study athlete from the representative squad had a maximum weekly duration of 1020 min/wk and a peak weekly load of 7020. The case-study athlete from the talent squad had a maximum weekly duration of 1591 min/wk, with a peak weekly load of 13,185.

A breakdown of the activities each case study reported doing in their weekly duration is presented in Table 3. In addition to the median frequency of activities reported by the case studies, the maximum number of activities recorded per week is also presented. The schoolboy case study reported a median participation rate of 12 sessions a week, with rugby and rugby-related sessions accounting for 8 of the 12 sessions. In the representative squad the case study recorded a median of 8 sessions a week, with 4 rugby and rugby-related sessions. The talent-squad case study reported a median participation rate of 12 sessions a week, with a median of 10 rugby and rugby-related sessions.

![Figure 3](image)

*Figure 3* — Individual versus rest of team average weekly duration of sport and physical activity in min/wk.
Descriptions of the physical demands placed on adolescent rugby union players are lacking. This study describes young rugby union players’ typical weekly loads and profiles observations of rugby training sessions. Discernable and significant group differences for weekly loads, as well as distance, duration, and intensity of training sessions, highlight the need and benefit of monitoring players across varying levels of participation. Major findings on training profiles showed that schoolboys traveled farther by at least 0.5 km/h of training than the players in the other 2 groups. Differences in the distance covered per training session were also found, with players in the talent squad traveling approximately 1 km less in rugby training sessions than players in the other 2 groups. Schoolboy players also performed more high-intensity locomotor efforts per hour of training than the talent-squad players and spent a greater percentage of training time at intensities above 85% of age-predicted maximum heart rate than representative-squad players. Using a subjective definition of talent, these findings indicate that the least talented group (schoolboy group) recorded the highest training distance per hour at a relatively higher intensity, and the most talented group (talent squad) recorded the smallest distance per training session at relatively lower intensities. It is possible that the results reflect differing coaching techniques and varied distributions of attention to skill, physical and tactical components of training, and, to a lesser degree, variations in the periodized training year. These findings warrant further investigation to explain the likely cause of variations in training and any subsequent effect on performance.

Profiles of weekly training found that mean weekly duration of sport and physical activity varied considerably among groups, but the distribution of total weekly activity categories was similar. For all 3 groups, when combining rugby training, rugby games, and other rugby-related activities, results showed that most weekly activity time was spent involved in rugby. These results suggest that most of the players’ weekly physical activities involved high-impact, high-intensity

### Table 3 Breakdown of Case Studies’ Weekly Sports and Physical Activities

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Schoolboy</th>
<th>Representative</th>
<th>Talent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Max</td>
<td>Median</td>
</tr>
<tr>
<td>Rugby game</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Rugby training</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Rugby related&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>School/Other organized&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Recreational&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>a</sup> Included weight training, rugby-specific skills or fitness sessions, touch rugby, rugby league training, and games.

<sup>b</sup> Included school sports, physical education, and all other organized sports and physical activities.

<sup>c</sup> Included general nonspecific fitness, as well as recreational sports and physical activity.

**Discussion**

Descriptions of the physical demands placed on adolescent rugby union players are lacking. This study describes young rugby union players’ typical weekly loads and profiles observations of rugby training sessions. Discernable and significant group differences for weekly loads, as well as distance, duration, and intensity of training sessions, highlight the need and benefit of monitoring players across varying levels of participation. Major findings on training profiles showed that schoolboys traveled farther by at least 0.5 km/h of training than the players in the other 2 groups. Differences in the distance covered per training session were also found, with players in the talent squad traveling approximately 1 km less in rugby training sessions than players in the other 2 groups. Schoolboy players also performed more high-intensity locomotor efforts per hour of training than the talent-squad players and spent a greater percentage of training time at intensities above 85% of age-predicted maximum heart rate than representative-squad players. Using a subjective definition of talent, these findings indicate that the least talented group (schoolboy group) recorded the highest training distance per hour at a relatively higher intensity, and the most talented group (talent squad) recorded the smallest distance per training session at relatively lower intensities. It is possible that the results reflect differing coaching techniques and varied distributions of attention to skill, physical and tactical components of training, and, to a lesser degree, variations in the periodized training year. These findings warrant further investigation to explain the likely cause of variations in training and any subsequent effect on performance.

Profiles of weekly training found that mean weekly duration of sport and physical activity varied considerably among groups, but the distribution of total weekly activity categories was similar. For all 3 groups, when combining rugby training, rugby games, and other rugby-related activities, results showed that most weekly activity time was spent involved in rugby. These results suggest that most of the players’ weekly physical activities involved high-impact, high-intensity
activities. For weekly activity duration, the schoolboy group averaged the lowest, with approximately 6 h/wk, followed by the selected talent squad with approximately 7 h/wk. The representative squad recorded the highest duration, with approximately 8.5 hours of activity per week. Although every effort was made to match the periodization phases between the research groups, matching groups was difficult because rugby participation was a year-round activity for some of the players in this study. Differences between periodization programs might therefore explain the higher number of hours per week of activity in the representative squad than the talent squad and schoolboy group. An alternative explanation might be that as players qualify and progress to more elite teams such as the talent squad, coaches are more able to limit their activity choices. Coaches of elite players often advise players not to participate in activities that increase weekly training duration for little perceived benefit. In contrast, the lower weekly activity duration recorded by the schoolboy group might indicate a deficiency in the required training and effort to reach more elite playing levels.

Group means of weekly training duration and distribution of activity categories provide potentially useful information but can mask high-effort individual outliers. Profiles of selected “highest load” case studies from each group revealed substantial differences between selected players and group means for weekly duration. In the schoolboy group, the case-study player recorded an average weekly sport and physical activity duration of 12 ± 1 hours. In the representative squad, the case-study player recorded a weekly duration of 13 ± 4 hours, and in the talent squad, the case study recorded a weekly duration of 13.5 ± 5.5 hours. In addition to recording greater than mean weekly durations, a breakdown of weekly sport and physical activity recorded in the training diaries showed that selected case-study individuals might participate in as many as 3 rugby games or as many as 11 rugby training sessions a week in addition to rugby-related, school, and other organized and recreational activities. Despite some coach influence on the type and amount of activity in which players participate, the choice largely remains a decision of the individual. There is no simple explanation for factors motivating individuals to participate in higher than normal weekly durations of sport and physical activity. It is possible that more talented players feel pressured or obligated to play for various teams within rugby union and sometimes across various other sports, as well. Irrespective of the reasons, it is evident that some players are involved in high weekly loads, primarily participating in high-demand activities such as rugby games and rugby training.

Comparative profiles of the game and training demands of other team sports are difficult to find in the available literature on adolescent team sports. The playing habits and commitment of adolescent Australian Rules footballers have previously been described in some detail, but the need to generate a more comprehensive profile was acknowledged. Using self-report surveys, under-18 Australian Rules football players reported participating in up to 3 games and up to 7 training sessions per week. These findings suggest that perhaps the pattern of training loads among rugby union players identified in this research are comparable to those in other adolescent team sports. More research is required to identify possible similarities in playing demands across different adolescent team sports. The training loads of individual sports are better defined in the literature (possibly because of ease of measurement) but make poor comparisons to team sports such as rugby union. Given
the high-impact, contact nature of rugby union, comparisons to individual sports with differing physiological fatiguing effects would not adequately describe the relative impact of rugby union participation. Despite a lack of comparative data, the game and training demands of adolescent rugby union participation appear high. A major finding of this research is the notable differences among same-group players, suggesting a strong need to monitor individuals to ensure that training loads and activity types are appropriately managed.

Defining optimal participation levels for adolescent rugby players remains a challenge. Maximizing athlete potential is often a major goal of participation in sports and physical activities. There are links between voluminous training hours during the younger years and athletic success among elite netball, basketball, and field hockey players. Indeed, theories such as deliberate practice purport a direct relationship between hours engaged in deliberate practice (effortful, sport-specific training) and the level of performance achieved. In the current study, evidence of deliberate practice can be seen in the high percentage of weekly activities related to rugby. Specifically, in the talent squad, rugby and rugby-related activities accounted for 91% of reported weekly activity duration. Despite purported benefits of such training approaches, there might be associated risks. Although differing injury definitions often complicate comparisons, injury rates are reported as being relatively high among rugby union players. Recent injury research on national representative adolescent rugby union players found an injury incidence rate of 13.26 per 1000 training and game hours. These findings are supported by other research reporting adolescent injury rates between 7 and 18 per 1000 playing hours. Player exposure time might be the strongest predictor of injury occurrence, with more injuries occurring during competitive games than in training. Players with increased weekly training and game loads or periods of intensified participation are therefore at greater risk of injury. The possible outcomes of high-volume, high-intensity training are not confined to injury and could include potentially harmful consequences such as overtraining syndrome, sports burnout, increased susceptibility to illness, psychological disturbances, and performance decrements.

Although this research contributes to the knowledge base of adolescent participation in rugby union, it has not answered the question of how ideal participation is structured. Weekly loads are not well enough monitored to regulate training prescription through evidence-based guidelines or through the monitoring of individual training responses. It is clear from this research that some players are participating in many high-load, high-impact games and training sessions in addition to various other sports and physical activities. To better understand the individual consequence of such participation and to help establish recommendations on optimal participation, it is our aim to include in future similar studies several markers of fatigue, injury, and performance. Limitations of the current study include the use of subjectively determined training loads and descriptions being delimited to a single sport, precluding generalization to other adolescent team sports. Nevertheless, the player and training descriptors provided in this study expand on current knowledge of adolescent participation in team sport.
Practical Applications and Conclusion

A better understanding of successful training loads is required to implement systematic planning of training prescription for adolescent athletes. A more informed approach will ideally maximize performance outcomes and minimize adverse effects such as fatigue, injury, and overtraining. Errors in training, often related to poor timing and prescription of training loads, can largely be avoided by serially assaying individuals’ weekly training loads. In addition, descriptors of typical training sessions for players of different skill levels might help coaches and researchers model skill-appropriate training sessions, provide a means of training quality control, and set benchmarks for aspiring athletes. Profiling adolescent participation in sports and physical activity might therefore contribute significantly to development of talented athletes and help nurture long-term and fulfilling participation.

Acknowledgments

We thank the research participants and team coaches who supported us throughout their rugby seasons and tolerated our intrusion at training sessions and games. Thank you to Dr Ross Smith, who provided valuable critique and advice. Funding for this research was provided by the Australian Rugby Union and the New South Wales Sporting Injuries Committee.

References