Anthropometric Characteristics and Competition Dietary Intakes of Professional Rugby League Players

Bronwen Lundy, Helen O’Connor, Fiona Pelly, and Ian Caterson

This study aimed to describe the physique characteristics and competition nutrient intake of professional Rugby League players and to assess use of a statistical technique for evaluating validity of dietary reporting. Players ($n = 74$) were endomorphic mesomorphs and had a mean weight, height, and BMI of $93.4 \pm 10.9$ kg, $179.9 \pm 7.3$ cm, and $28.5 \pm 2.1$ kg/m$^2$ respectively. Mean sum of eight skinfolds was $78.9 \pm 2.2$ mm (12.4 $\pm$ 2.9% fat). Players ($n = 34$) reported a mean daily energy intake of $17,708 \pm 3,688$ kJ (carbohydrate 51%, protein 18%, fat 25%, alcohol 4%) with 6 and 2.0 g $\cdot$ kg$^{-1}$ $\cdot$ d$^{-1}$ from carbohydrate and protein respectively. Micronutrient intake was adequate but alcohol consumption was high relative to health standards. The dietary records provided a plausible estimate of energy intake however further research is required to evaluate statistical techniques for assessing dietary validity in athlete groups.

Key Words: somatotype, under reporting, skinfolds, diet records, physique

The game of Rugby League was developed in the mid-1890s in England as a professional offshoot from Rugby Union (8). Today, Rugby League is a mass participation sport, played by approximately 58,000 participants in Australia and remains popular in a number of other countries including New Zealand, Papua New Guinea, France, the UK, and the US (2).

In Australia, the National Rugby League competition consists of 15 teams who play for up to 32 wk for premiership honors. The game is 80 min in duration with a 10 min break at half time and additional injury time at the referees’ discretion. Each team consists of 13 players, six forwards (lock forward, second-row, prop forward, and hooker) and seven backs (fullback, wingers and centers, each with right and left sides, five-eighth, and half-back) each having their own specialized role in play (8). In general terms, forwards are responsible for gaining ground on the opposition, occupying the defenses of the other team so that the backs can run through and score a try.

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During a game of Rugby League, low-intensity activity such as standing or walking makes up the majority (84 to 95%) of the game (28). This is similar to soccer (88%) and Rugby Union (85%) (13, 27). Time-motion analysis indicates that backs cover more distance than forwards and during a typical game travel approximately 7336 compared to 6647 m. When analyzed by position, the half-back covers the most distance (8256 m) and the prop the least (2916 m) (28). Bursts of high-intensity activity such as sprints and tackles raise the overall intensity of the game. Backs spend more time than forwards in high-intensity running activities whereas forwards spend more time performing tackles. The overall ratio of high to low-intensity activity has been estimated as 1:8 for backs and 1:6 for forwards (28).

It is surprising that despite the popularity and professionalism of Rugby League football both in Australia and overseas, there is little published information on the physique characteristics or dietary intakes of players. Information about player physique and current dietary patterns is required by the sports science team to develop normative data and provide relevant advice to players and coaching staff. The general differences in player size and demands of the game for forwards and backs mean specialized advice is required for each group.

A major challenge for dietary studies is the accuracy of reported dietary intake (7). The statistical method developed by Goldberg et al. (6, 19) has been frequently used to assess the plausibility of reported energy intake in the general population. Few studies have been conducted in athletic groups to investigate the validity of reported food intake (16, 21, 40). Most descriptive dietary intake studies include an estimate of energy intake from athletes’ food records and report raw means without assessing or adjusting for intakes which are biologically unrealistic. As these records can generate a significant bias in dietary measurement, the prevalence and magnitude of this bias should ideally be identified, discussed, and, then where appropriate the raw data corrected so that realistic, mean energy intake data are reported.

This study aimed to describe the physique characteristics and competition nutrition intake of professional Rugby League players to provide normative data and ensure appropriate advice can be given to players and coaching staff. A secondary aim was to assess the validity of the food diary records of players according to the method described by Goldberg et al. (6, 19) and to determine potential benefits or limitations when using this technique with athletic groups.

**Methods**

**Subjects**

Seventy-six professional, male Rugby League players (31 backs and 45 forwards) were recruited from three of the fifteen first and reserve grade teams competing in the Australian National Rugby League. Demographic information including age, position played, game experience, and dietary supplement use was collected using a short questionnaire. Data were examined for the whole group, and forwards versus backs to determine whether their specialized role within the game leads to differences in both physique and dietary intake. The study was approved by the Human Ethics Committee of the University of Sydney.
Anthropometric Measurements

A restricted anthropometric profile was obtained using the International Society for the Advancement of Kinanthropometry (ISAK) approved protocol. This included the measurement of nine skinfold sites (triceps, subscapular, biceps, iliac crest, supraspinale, abdominal, front thigh, medial calf, and mid-axilla), five girths (relaxed and flexed arm, waist, gluteal, and calf) and two bone breadths (humerus and femur) (35). Injured players undergoing active rehabilitation were also included.

Body mass was measured to the nearest 100 g using a portable digital scale (Tanita, Wedderburn, Sydney), prior to training, in minimal clothing (football shorts). Stretch stature was measured to the nearest millimeter using a portable stadiometer. Calibrated Harpenden calipers (British Indicators Ltd., St. Albans, England) were used for skinfold measurements and a retractable steel tape (Luftkin model W606PM) for girths and landmarking. Bone breadths were measured using a small bone caliper (Rosscraft Inc., Canada).

All measurements were taken in duplicate on the right side of the body, with the mean of the two results reported. Body fat percentages and somatotype were calculated using the LifeSize computer software. Body fat percentages were obtained using the mean of seven regression equations appropriate to the population and sites measured (14, 17, 22, 41, 44, 46, 47). This method was employed as a predictor of percentage body fat. However, predictions may vary by as much as 10% between different regression equations even when population and site specific equations derived from hydrostatic weighing are used (33). Somatotype was determined using the Heath-Carter method (34). The technical error of measurement (TEM) was calculated for all anthropometric measures (37) except weight.

Measurement of Dietary Intake

Food Diaries. Only two of the three teams were available to participate in the food diary aspect of the study. Subjects were asked to keep a food diary recording all food and drink consumed using household measures to quantify serving sizes. Both written and verbal instruction was given to the subjects, including an example diary page, to demonstrate the level of detail required. The food diaries were kept for 4 d, 2 d prior to a competition game, the day of the game and the following day. This period covered a “home” game, played in the evening. On completion, diaries were checked by a dietitian and where necessary, data were further clarified either by telephone or interview. The food diaries were analyzed using Foodworks version 2.10 (Xyris Software, Queensland) nutrition software with a database of Australian foods (AUSNUT). Adequacy of micronutrient intake was assessed by comparing nutrient data to the Australian Recommended Dietary Intake (29) with values achieving 100% of the recommended value deemed adequate. Macronutrient adequacy was assessed by comparison with accepted sports nutrition targets (1, 24). One sports dietitian analyzed all diaries to reduce possible variability in coding of the data. All food and beverages were analyzed, including carbohydrate and protein powders, liquid meal supplements, sports drinks, and bars. Vitamin and mineral preparations (pill or tablet) were excluded. Where specialized sports foods were not listed in the nutrient database, the nutrient composition was obtained from the product label or from the manufacturer and added to the analysis software. All
data entry were spot checked for accidental errors. Information regarding training was obtained either via the food records or from information supplied by the club. Subjects were excluded if they did not compete during the study period either due to injury, illness, or other reasons.

The pre-game meal and snack included any food or drink consumed within 6 h prior to the start of the game. The post-game meal was defined as all foods consumed after the competition concluded and prior to the end of the day. As the games were played in the late afternoon or evening, this was expected to consist of the post-game snack and evening meal.

**Validity of Food Diaries.** The method and equations described by Goldberg et al. were used in an attempt to determine the validity of dietary records (6, 19). This method is based on the principle that, at a stable weight, energy intake should be equal to energy expenditure and as such, weight was recorded at the beginning and end of the recording period. Reported energy intake (EI) was expressed as the ratio of EI to basal metabolic rate (BMR) for each individual and the upper and lower 95% confidence limits or “cutpoints” for EI:BMR likely to represent valid data were calculated. A more recent adaptation by Black (6) of the original method (19) was used in this study as, in addition to the number of subjects and days of recording, it also allows the practical incorporation of other study variables specific to the study in question rather than more generic estimations. These variables include the individual variation in day-to-day energy intake, in BMR, physical activity, and energy requirement. A full description and statistical derivation of the methods and equations can be found in the original works (6, 19).

In the current study, a physical activity factor of “2” was derived using information (duration and intensity of physical activity) obtained from the players’ food diaries and equating this to the categories of “activity levels” provided by Black et al. (6). These guidelines described the energy expenditure of free living people with a range of activity levels and were based on the examination of 574 doubly-labeled water trials including a subset of elite athletes. Basal metabolic rate was estimated using both the Harris-Benedict (20) and Schofield (38) equations. The Harris-Benedict equation has been compared to measured BMR in a population of endurance athletes (24) and was found to be acceptable in its estimation of BMR. The Schofield equation was originally used by Goldberg and Black (6, 19). However, its ability to accurately predict BMR in athletes has not been investigated and for this reason, BMR was calculated using both equations to allow comparison.

Using this method, dietary data can be assessed at the individual level (where \( n \) is equal to 1) or at the group level (where \( n \) is equal to the number of study participants). At the individual level cutpoints can be used to exclude single invalid food records from a study group in order to remove their bias from the group mean. At the group level cutpoints are more stringent and look at the group mean for EI: BMR to determine the validity of the study group as a whole. In the current study both individual and group cutpoints were calculated.

**Statistics**

Results are reported as means ± standard deviation. Statistical analyses were performed using Systat version 7.0 (SPSS Inc., Chicago, IL) with significance set at \( P < 0.05 \). One-way analysis of variance (ANOVA) with Tukey’s post hoc test
was used to compare anthropometric measures between teams and nutrient intake changes over the competition cycle. An unpaired t-test was used for comparisons made for the nutrients between teams, using pooled or separate variance where necessary. Pearson’s correlation was used to examine the relationship between body-mass index (BMI), adiposity, and suspected under-reporting of energy intake. Data were normalized where appropriate.

Results

Demographics

Participation rate was 74% of the two teams which undertook the dietary component and 97% of all three teams for the anthropometric measurements. The lower participation rate for the dietary component of the study was due to the exclusion of athletes not competing during the diet recording period due to injury or illness (15%) and incomplete food records (11%). There was no difference found between the body composition of the players who did or did not complete the food records. Table 1 summarizes demographic and game experience of the players. Players were mainly Caucasian (83%) with a smaller proportion of Polynesian/Maori (13%) or Aboriginal (4%) descent. Competition experience was determined by self-reported duration of competitive play at specified levels.

Anthropometry

The anthropometric characteristics of the players are summarized in Table 2. The relative TEM for the anthropometric data was less than 5% for skinfolds and 2% for girths and breadths. Using the healthy weight range defined as BMI between 18.5 to 25.0 kg/m², 96% of players would be classified as overweight or obese (30).

The mean waist circumference of the players was 86.9 ± 4.7 cm with none greater than 102 cm. Five players had a waist-hip ratio (WHR) greater than 0.9 with a mean measure of 0.86 ± 0.03. The sum of eight skinfolds was 78.9 ± 2.2 (74.5 to 83.4) mm. Backs were shorter (P < 0.05), lighter (P < 0.001), and had

<table>
<thead>
<tr>
<th>Table 1 Subject Characteristics</th>
<th>Forwards</th>
<th>Backs</th>
<th>All players (^*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n)</td>
<td>44</td>
<td>30</td>
<td>74</td>
</tr>
<tr>
<td>Age (y)</td>
<td>25.4 ± 3.5</td>
<td>25.0 ± 3.7</td>
<td>25.2 ± 3.6 (18.1 - 32.7)</td>
</tr>
<tr>
<td>First grade games played (%)</td>
<td>Less than 50 games</td>
<td>49</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>50-100 games</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Greater than 100 games</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>Competed at State of Origin (%)</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Competed internationally (%)</td>
<td>17</td>
<td>9</td>
<td>14</td>
</tr>
</tbody>
</table>

Note. *range displayed in brackets
a lower level of adiposity as demonstrated by the sum of skinfolds ($P < 0.001$) and percent body fat ($P < 0.001$). Somatotype rating (endomorphy-mesomorphy-ectomorphy) was $2.5 \pm 0.6$, $6.9 \pm 1.2$, $0.9 \pm 0.5$ which describes the physique of the average Rugby League player as endomorphic mesomorph, a predominantly muscular physique with a tendency towards adiposity rather than linearity. Scores for mesomorphy were equal between forwards and backs but backs scored higher for ectomorphy ($P < 0.05$) and lower for endomorphy ($P < 0.05$) than forwards. Using the somatotype scores to give an overall classification of physique, $98\%$ of forwards were classified as endomorphic mesomorphs. Similarly, most backs were classified as endomorphic mesomorphs ($74\%$) but there were a greater variety of physique types with $16\%$ classified as balanced mesomorphs and $10\%$ as ectomorphic mesomorphs.

### Dietary Intake

**Validity of Reported Energy Intake.** Basal metabolic rates calculated via the Schofield or Harris-Benedict equations were similar [8621 ± 584 kJ versus 8599 ± 599 kJ ($P = 0.9$)]. The mean energy intake relative to basal metabolic rate (EI:BMR) was $2.06 \pm 0.42$ (range 1.34 to 3.07). At the group level, EI:BMR was accepted as valid.
using the Goldberg cutpoints calculated, indicating that this should be considered a plausible estimate of the group mean for energy intake (lower and upper EI:BMR cutpoints of 1.86 and 2.15, respectively). At the individual level, no subject fell below the lower EI:BMR cutpoint of 1.32 and only one above the upper cutpoint of 3.04. This outcome was not changed whether the Harris-Benedict or Schofield equations were used to calculate BMR. A weak, but statistically significant, negative correlation was found between adiposity (percent body fat) and EI:BMR ($r = 0.39, \chi^2 = 4.6, df = 1, P < 0.05$). There was no significant change in the start and end weight of the players over the recording period.

**Average Nutrient Intake.** Table 3 summarizes the nutrient intakes over the 4 d measurement period. Macronutrient intake was compared to Australian Recommended Dietary Intakes (29). Macronutrient data was assessed by comparison to accepted sports nutrition targets (1, 24). Diet information was collected from two out of three participating teams ($n = 34$). Mean carbohydrate intake was 6.1 g/kg per day with 24% of players consuming at least 7 g/kg per day. Protein intake met estimated requirements in 99% of players. Fat intake was low but 48% came from saturated fatty acids (10.1 ± 3.2% of total energy intake, ratio of saturated fat to polyunsaturated fat 2.43). Nutrient intakes were not different between position types with the only exception being that the backs derived a greater percentage of energy from fat.

Fiber intake was high (mean 36.4 ± 8.1 g per day, range 23.1 to 55.3 g) with the predominant sources being carbohydrate-based foods such as pasta, breakfast cereal, bread, and potato. The mean alcohol intake was within the upper limit of levels recommended for the general male population when averaged over the 4 d; however, the alcohol was almost all consumed in the 12 h immediately following the game and consisted almost exclusively of beer and spirits. Roughly one-third of the players (34%) consumed alcohol at a level considered heavy (greater than six standard drinks in 1 d) in the post game period.

Mean micronutrient intakes were sufficient to meet the Recommended Dietary Intake (RDI), with mean vitamin and mineral intake 283 and 251% of the RDI, respectively (Table 3). Despite this, some individuals had low intakes of vitamin A (11%) or riboflavin (26%). Inadequate consumption of these nutrients was not significantly associated with lower energy intake. Calcium intake was adequate in all but two athletes (6%) who avoided dairy foods. Similarly, thiamin intake was adequate in all but 6% of athletes. Iron intake was high with the primary source being fortified breakfast cereal and meat. More than half of the players (61%) reported that they currently used some form of dietary supplement with 27% taking a vitamin or mineral preparation on a regular basis. Vitamin and mineral preparations were not included in the analysis.

**The Effect of Competition on Nutrient Intake.** Figure 1 describes the changes in contribution of the macronutrients with the competition cycle. Energy intake was similar on pre-competition (18,305 ± 3923 kJ) and competition days (18,745 ± 5707 kJ). Post-competition energy intake (16,908 ± 4157 kJ) was lower than on the pre-competition ($P < 0.05$) and competition days ($P < 0.001$).

Protein contributed less energy on the competition day (1.7 ± 0.6 g/kg or 14.7 ± 4.4%) than before (2.2 ± 0.6 g/kg or 19.1 ± 2.4%; $P < 0.001$) or after competition (1.8 ± 0.7 g/kg or 18.4 ± 4.4%; $P < 0.01$). Similarly, fat contributed less energy on
<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Forwards</th>
<th>Backs</th>
<th>Mean intake</th>
<th>Range</th>
<th>Recommended/RDI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>18</td>
<td>16</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>kJ/d</td>
<td>18,307 ± 3964</td>
<td>17,337 ± 3440</td>
<td>17,708 ± 3688</td>
<td>11,181 – 28,953</td>
<td>16,800 – 21,000</td>
</tr>
<tr>
<td>kJ/kg</td>
<td>184.5 ± 35.2</td>
<td>201.5 ± 42.8</td>
<td>192.5 ± 39.3</td>
<td>129 – 293</td>
<td></td>
</tr>
<tr>
<td>Kcal/d</td>
<td>4309 ± 947</td>
<td>4142 ± 822</td>
<td>4230 ± 881</td>
<td>2671 – 6917</td>
<td></td>
</tr>
<tr>
<td>Kcal/kg</td>
<td>44.1 ± 8.4</td>
<td>48.1 ± 10.2</td>
<td>46.0 ± 9.4</td>
<td>30.9 – 70.0</td>
<td></td>
</tr>
<tr>
<td><strong>Carbohydrate</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>g/d</td>
<td>592 ± 166</td>
<td>529 ± 115</td>
<td>563 ± 146</td>
<td>354 – 1122</td>
<td></td>
</tr>
<tr>
<td>g per kg</td>
<td>6 ± 2</td>
<td>6 ± 1</td>
<td>6 ± 1</td>
<td>4 – 11</td>
<td>7</td>
</tr>
<tr>
<td>% of energy</td>
<td>52 ± 6</td>
<td>49 ± 5</td>
<td>51 ± 6</td>
<td>40 – 63</td>
<td>60 – 65</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g/d</td>
<td>185 ± 42</td>
<td>184 ± 44</td>
<td>184 ± 42</td>
<td>102 – 268</td>
<td></td>
</tr>
<tr>
<td>g per kg</td>
<td>1.9 ± 0.4</td>
<td>2.1 ± 0.5</td>
<td>2.0 ± 0.5</td>
<td>1.2 – 3.2</td>
<td>1.6 – 2.0</td>
</tr>
<tr>
<td>% of energy</td>
<td>18 ± 2</td>
<td>18 ± 2</td>
<td>18 ± 3</td>
<td>14 – 25</td>
<td></td>
</tr>
<tr>
<td><strong>Fat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g/d</td>
<td>113 ± 30</td>
<td>129 ± 38</td>
<td>120 ± 35</td>
<td>69 – 201</td>
<td></td>
</tr>
<tr>
<td>% of energy</td>
<td>23 ± 5</td>
<td>27 ± 5*</td>
<td>25 ± 5</td>
<td>14 – 35</td>
<td>20-25</td>
</tr>
<tr>
<td><strong>Alcohol</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g/d</td>
<td>26 ± 31</td>
<td>19 ± 24</td>
<td>22 ± 28</td>
<td>0 – 90</td>
<td></td>
</tr>
<tr>
<td>% of energy</td>
<td>4 ± 5</td>
<td>3 ± 4</td>
<td>4 ± 5</td>
<td>0 – 16</td>
<td>&lt; 5</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>38 ± 10</td>
<td>34 ± 6</td>
<td>36 ± 8</td>
<td>23 – 55</td>
<td>30^1</td>
</tr>
<tr>
<td><strong>Minerals and vitamins</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>1725 ± 674</td>
<td>1574 ± 492</td>
<td>1654 ± 591</td>
<td>690 – 3484</td>
<td>800^29</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>27.8 ± 8.8</td>
<td>28.3 ± 10.4</td>
<td>28.1 ± 9.4</td>
<td>13.0 – 52.3</td>
<td>7^29</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>593 ± 155</td>
<td>561 ± 96</td>
<td>578 ± 130</td>
<td>322 – 956</td>
<td>320^29</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>21.0 ± 4.5</td>
<td>22.6 ± 8.0</td>
<td>21.8 ± 6.4</td>
<td>11.6 – 42.7</td>
<td>12^29</td>
</tr>
<tr>
<td>Vitamin A (total eq) (mg)</td>
<td>1265 ± 369</td>
<td>1439 ± 465</td>
<td>1345 ± 420</td>
<td>461 – 2155</td>
<td>750^29</td>
</tr>
<tr>
<td>Niacin Eq (mg)</td>
<td>82.5 ± 19.8</td>
<td>83.8 ± 20.2</td>
<td>83.1 ± 19.7</td>
<td>42.7 – 128.5</td>
<td>19^29</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>4.0 ± 1.9</td>
<td>3.8 ± 1.9</td>
<td>3.9 ± 1.9</td>
<td>0.9 – 8.6</td>
<td>2.3 – 4.4^20</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>3.7 ± 1.1</td>
<td>3.9 ± 2.1</td>
<td>3.8 ± 1.6</td>
<td>1.2 – 10.5</td>
<td>1.5 – 2.9^20</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>231 ± 209</td>
<td>175 ± 83</td>
<td>204 ± 162</td>
<td>57 – 987</td>
<td>40^19</td>
</tr>
</tbody>
</table>

**Note.** *P < 0.05; dietary analysis was conducted on two out of three potential teams and excludes pill or tablet vitamin or mineral preparations. Australian Recommended Dietary Intakes are designed with a generous safety factor added^29*
competition day (20.0 ± 7.1%) than the days before (26.4 ± 5.7%) or the day after
competition (28.8 ± 8.5%; P < 0.001). Carbohydrate contributed the most energy
on all 4 d however the relative contribution was lower on the day after competition
(4.5 ± 1.4 g/kg or 43.0 ± 10.1%) than on pre-competition (7.0 ± 1.6 g/kg or 26.4 ± 5.7%)
or competition (6.8 ± 2.3 g/kg or 53.9 ± 9.8%) days (P < 0.001). Alcohol
contributed more energy on competition day (8.4 ± 11.6%; P < 0.0001) and the
day after (7.7 ± 13.5%; P < 0.01) than on the pre-competition day where virtually
no alcohol was consumed. Total carbohydrate intake for the pre-game meal and
snack was 2.4 ± 1.3 g/kg. Post competition intake provided 8.1 ± 3.3 MJ and 2.6
± 0.9 g/kg carbohydrate.

Discussion

This study provides normative data on the anthropometric characteristics and
competition dietary intakes of professional Rugby League players and examined
the use of the Goldberg strategy to evaluate the validity of food intake records in
an athletic population.

Anthropometry

Using the healthy weight range defined by BMI between 18.5 to 25 kg/m², 96%
of players were classed as overweight or obese despite body-fat percentage and
sum of skinfolds values to the contrary, suggesting that the sole use of BMI can
be misleading in athletes (30). The current study supported a previous finding that backs tend to be lighter than forwards (28) and also suggests that they are shorter and leaner. This suits the role of backs where agility and speed are required, and forwards, where greater mass provides momentum to break through tackles and gain ground (8).

Rugby League players in this study were most similar in adiposity to soccer players (26) and were leaner and fatter than elite Rugby Union players (12) and Australian Rules players (11) respectively. Excess body fat may impede speed and mobility but conversely cushions players against injury (8). One of the very early studies on young, non-professional players suggested that muscular individuals may be cushioned in collision (5) and that the incidence of injury might be associated with underdeveloped muscularity (45). Studies in Rugby Union found that players carrying more body fat were injured more often than leaner players (23). However, in trials of this nature, confounders such as skill or fitness level are difficult to control. Studies investigating the relationship between injury and anthropometric indices in Rugby League are needed.

**Dietary Intakes**

**Validity of Food Records.** The validity of food records has often been questioned. Unfortunately, most studies reporting the dietary intakes of athletes have not examined the data with respect to under- or over-reporting. This is one of a few studies in athletes that have attempted to assess and respond to these issues.

Perhaps the lack of dietary assessment is understandable when the obstacles to determine validity are considered, particularly in athletes. In the current study, training records were used to estimate the physical activity level and equations to estimate the resting metabolic rate. More direct measures, such as the use of an accelerometer for energy expenditure or a ventilation hood for resting metabolic rate, could have improved the accuracy of estimation of these parameters. It is important to consider, however, that the increased time and burden on the athletes was likely to be unacceptable, particularly in the competitive phase (10) of the season.

Accurate measurement of dietary information in athletes is complex as they often have extremely high or low energy intakes, unusual or unconventional eating patterns and may consume a range of special or “sport specific” foods. Accuracy of reporting energy intake may also be reduced with increasing energy expenditure possibly due to the difficulties estimating large portion sizes or the increased number of foods that need to be recorded (3).

Although the Goldberg strategy is considered a valuable approach for determining the validity of diet records, it is rarely used or evaluated in athletic populations. By their nature, studies involving athletes tend to be small, meaning that under- or over-reporting needs to be excessive before the cutpoints exclude the data. The wide range in calculated EI:BMR (1.34 to 3.07) in the current study indicates that perhaps not all records were valid despite being accepted using the Goldberg cutpoints.

Two basic principles of the Goldberg strategy are that at a stable weight, energy intake will balance with energy output and also that people have a relatively stable energy intake from day to day. In athletic groups, changes in fluid balance can alter body mass significantly and athletes are often chronically...
dehydrated (18). This means that day-to-day variations in weight may often be more related to hydration status and less to energy intake. Athletes have highly variable eating behaviors surrounding competition and may either eat more than normal to enhance glycogen stores or eat less due to nervousness, concerns about body weight, or gastric upset. The assumption of a “habitual” dietary intake is also problematic. While energy balance may be achieved long-term, this is not always the case over specific phases of competition or training. Recent research with female road cyclists (25) reported them to be in positive energy balance during light training or recovery but in negative balance during heavy training and competition. This occurred due to changes in both energy intake and expenditure. This “periodization” of energy balance complicates the assessment of dietary record validity.

In this study, an association was found between EI:BMR and adiposity with greater under-reporting observed in the players with higher body fat. Under-reporting of energy intake has been shown to occur more often in sports such as gymnastics than in less physique-focused sports such as soccer (16). It is interesting therefore to find a weak association in Rugby League players in this study. In non-athletic populations, under-reporting has been found in 28.5% of subjects with most under-reporters being females with a high BMI (42).

**Nutrient Intakes**

Generally the nutrient intakes of the players were adequate, meeting both sports nutrition and public health guidelines (Table 3). There was a large range in carbohydrate intake with the mean levels falling below theoretical sports nutrition recommendations of 7 g/kg per day (9) and well below the recommendation when expressed as percent energy (1). The intake of fiber was high and is likely to be reflective of both the large volume of food consumed and the relatively large proportion of the diet made up of carbohydrate. Servings of breakfast cereal and pasta ranged between 2 to 4 cups, providing as much as 18 g fiber in a single sitting. Backs consumed a greater proportion of their energy from fat but the reasons for this remain unclear.

Nutrition practices were best in the lead up to competition and worst in the period following its conclusion. On the day after competition, energy intake was low with a smaller proportion of energy coming from carbohydrate and a greater proportion of energy coming from fat and alcohol than on the other days. The carbohydrate intake on this day was approximately half the recommended level (Table 3). This finding is similar to that described for Australian Rules players who consumed less carbohydrate post-competition than pre-competition (39). This may reflect the difficulties the players have in consuming such large quantities of carbohydrate, (10) the need to reward themselves after the weeks training and competition or simply a lack of understanding about the role of nutrition in recovery.

Mean saturated fat intake was high, representing 10.1 ± 3.2% of total energy intake and with a saturated to polyunsaturated fat ratio of 2.43. This is greater than the national target which suggests Australians should aim for less than 8% total energy from saturated fat and a ratio of saturated to polyunsaturated fat of 1 (32). The mean vitamin A and riboflavin were below the recommended levels (Table 3) during the study period (4). Food intake after competition was seen as a
reward for many players, resulting in a high consumption of takeaway foods that contributed to the saturated fat intake. The low levels of vitamin A and riboflavin may reflect the short duration of the food records rather than actual inadequacies in the diet (4, 7). The assessment of 7 d of the competition cycle may present a better picture of nutrient intakes than the 4 d used in the current study but is likely to be a trade-off with the quality of reporting. Further, the recommended dietary intake values for Australians are designed to exceed the actual requirement of most healthy people so the levels reported here may not actually represent a deficiency for those individuals (29).

The relative health risk of alcohol intake in Australia is assessed using both the number of standard drinks consumed (36) and the proportion of total energy derived from alcohol intake each day (31). When the average alcohol consumption is considered, intakes fall at the top end of the recommended “safe” level. It should be noted, however, that that the entire amount of alcohol recorded was consumed in one or two sittings. This exceeds health recommendations to limit alcohol intake to provide no more than 5% of energy and may be regarded as heavy drinking (31, 36). Excessive alcohol intake after competition may be detrimental to food choices for recovery, negatively impact on the hydration status of the players, and exacerbate soft-tissue injuries sustained during the game (9). As with other football codes, post-game alcohol consumption appears to be an important part of the culture of Rugby League with consumption occurring in quantities well above the recommended levels for good health. Heavy drinking has been defined as more than six standard drinks per day in males (based on 10 g of alcohol per standard drink) (31). Acute consumption at these levels has been associated with increased risk of motor vehicle and other accidents while chronic consumption is implicated in hypertension, some types of cancer, and cirrhosis of the liver (31). It is a concern that a substantial proportion of players (34%) reported consuming significantly more than the safe level after the game.

Conclusions

This is the first study to provide a detailed anthropometric description of National Rugby League players and information on their dietary intake. Rugby League players in this study were predominantly classified as endomorphic-mesomorphs with forwards being taller, heavier, and fatter than the backs. The dietary intake for players of both positions was generally nutritionally adequate however a better focus on post-competition choices could enhance recovery. Alcohol intake was typically consumed in the immediate post-game period and was substantial. Approximately one-third of players consumed amounts above what is considered to be safe. A limitation of the study was the small number of athletes (n = 34) participating in the diet record component.

The validity of reported energy intake is difficult to assess in athletic groups and further research is needed to improve the current statistical methods used to detect under- or over-reporting. Detailed information regarding energy expenditure assists in this evaluation but this is not always easy to obtain. It was a limitation of this study that energy expenditure was not directly measured. The diet and physique characteristics of Rugby League players remain relatively unexplored in the literature and there is scope for future study.
References


