Appetite 84 (2015) 316–321

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

# Nutritional responses to acute training sessions in young elite rugby players ☆

D. Thivel [a,*], F. Maso [b], S. Aouiche [b], B. Coignet [a], E. Doré [a], P. Duché [a]

[a] *Blaise Pascal University, EA 3533, Laboratory of the Metabolic Adaptations to Exercise under Physiological and Pathological Conditions (AME2P), Clermont University, BP 80026, Aubière cedex F-63171, France*
[b] *Centre de formation rugby de l'Association Sportive Montferrandaise, 84 Boulevard Léon JOUHAUX, Clermont-Ferrand 63100, France*

ARTICLE INFO

*Article history:*
Received 18 August 2014
Received in revised form 9 October 2014
Accepted 30 October 2014
Available online 5 November 2014

*Keywords:*
Energy intake
Appetite
Energy expenditure
Sport
Adolescents

ABSTRACT

*Background*: Acute exercise has been shown to induce nutritional adaptations in obese and lean inactive youth but it remains unclear whether youth with a high level of physical activity experience such exercise-induced energy intake and appetite modifications. *Methods:* 14 (15- to 16-year-old) male elite rugby players completed sessions on three separate occasions: (1) a control session (CON); (2) an exercise session (EX) and; (3) a rugby session (RUGBY). The energy induced by the rugby and exercise sessions was matched (Polar Team2 pro technology), and participants' energy intake, food preferences (*ad libitum* buffet meals) and appetite feelings (Visual Analogue Scales) were assessed throughout the experimental days. *Results:* The energy intake during lunch and snack time was not different between conditions. Dinner time energy intake was significantly increased after RUBGY compared to CON with respectively 969 ± 145 kcal and 777 ± 183 kcal ($p < 0.05$). The energy intake at dinner time was significantly increased during EX (1185 ± 199 kcal) compared to both CON ($p < 0.001$) and RUGBY ($p < 0.01$). None of the appetite feelings investigated were modified between sessions. *Conclusion:* Adolescent elite rugby players regulate their energy intake differently depending on the nature of their training; independently of the energy expended. This demonstrates the need for energetic and nutritional education to optimize their physical fitness and performance.



## Introduction

The nutritional responses to exercise have been examined over the last 20 years in overweight and obese youth and adults (Blundell, Stubbs, Hughes, Whybrow, & King, 2003; Martins, Morgan, & Truby, 2008; Thivel, Blundell, Duche, & Morio, 2012). The available literature provides evidence that physical activity has indirect effects on subsequent energy intake and appetite feelings, which have to be considered when interpreting and/or modifying energy balance. Although results remain contradictory in youth, it seems that intensive exercise favors reduced subsequent energy intake in obese adolescents (Thivel, Isacco, Rousset, et al., 2011; Thivel, Isacco, et al., 2012) independently of gender (Thivel, Isacco, Taillardat, et al., 2011), which might have important implications in terms of weight loss strategies. In lean youth, however, energy intake is not affected by acute physical exercise, suggesting a weight status effect (Bozinovski et al., 2009; Dodd, Welsman, & Armstrong, 2008; Tamam, Bellissimo, Patel, Thomas, & Anderson, 2012).

Although this interrelationship between physical exercise and energy intake is of particular interest for obesity prevention and weight loss programs, it remains unexplored for trained adolescents who may experience particular energy balance and weight adaptations due to their high level of physical activity. As underlined in young adult athletes, the high level of physical activity is usually accompanied by eating disorders affecting body weight and body composition, which may negatively impact their performances (Anzell, Potteiger, Kraemer, & Otieno, 2013; Dwyer et al., 2012; Kirwan et al., 2012; Papadopoulos et al., 2012). Such nutritional responses to training have been recently demonstrated in adolescent swimmers (da Costa, Schtscherbyna, Soares, & Ribeiro, 2013) and tennis payers (Coelho et al., 2013). Those studies, in both adults and youth, have mainly used self-reported energy intake and eating habits, and the effect of training on objectively measured energy intake remains poorly explored. One research team has recently explored the impact of a one-hour netball training session (47-min effective session) on subsequent energy intake and

☆ *Acknowledgements:* The authors are grateful to the participants and the intendance from the AS Montferrand Rugby for their help. We also particularly thank Miss Nicole S. Fearnback for her assistance in the writing of the paper. *Funding:* There is no financial conflict or interest to disclose. This study has not been supported by external founding. *Conflict of interest:* There is no conflict of interest to declare.

TD, FM and DP designed the study and led the protocol. TD, AS, CB, DE and PD conducted the experimental sessions. TD, FM and PD analyzed the data and wrote the paper.

* Corresponding author.
*E-mail address:* David.Thivel@univ-bpclermont.fr (D. Thivel).

http://dx.doi.org/10.1016/j.appet.2014.10.030
0195-6663/

appetite feelings in 13- to 15-year-old trained adolescents (P. L. Rumbold, St Clair Gibson, Allsop, Stevenson, & Dodd-Reynolds, 2011). According to their results, the adolescents felt hungrier by the end of the training session compared to a non-training day, but energy intake remained unchanged at the test meal that followed the session (P. L. Rumbold et al., 2011; P.L. Rumbold et al., 2013). However, they noticed increased energy intake during the following 48 hours (P. L. Rumbold et al., 2011). Elite athletes have a high level of specialized practice in their sport but also complete more general physical training sessions that might have nutritional implications. This is especially true for rugby players who have a high level of physical training in which gaining weight is considered one of the main performance parameters.

The aim of the present work was to assess the nutritional responses (energy intake and appetite sensations) of both a typical rugby session and a high intensity cycling training session in young elite rugby players.

## Methods

### *Population*

14 adolescent males aged 15–16 years old from a youth elite rugby player training center (Montferrand Sport Association Rugby section) volunteered to take part in the study. As members of this training center, the adolescents trained at least 4 times per week (rugby or physical work sessions), played in the highest national division for their age category, and were members of the national team (first team player or substitute). All the participants had been playing rugby for more than 7 years. Participants had to be free of any injury with a healthy body mass index (below the 90th percentile according to international curves) (Cole, Bellizzi, Flegal, & Dietz, 2000). According to the Dutch Eating Behaviour Questionnaire (Van Strien, Frijters, Bergers, & Defares, 1986), all of them were established as unrestrained eaters.

### *Protocol*

Participants underwent validation of their participation by the training center's medical staff to be sure that they could complete the entire protocol. Following validation, the adolescents' anthropometric characteristics, body composition and aerobic fitness were assessed. A food preference questionnaire was also completed by the participants. Using a within-subject, cross over design, energy intake and appetite were compared after: (i) a control session (CON); (ii) a rugby session (RUGBY); (iii) an exercise session (EX). These three sessions were completed in a randomized order for each subject and separated by at least 7 days. Importantly, experiments were conducted during a recovery period, such that during the study the participants only had tactical sessions (such as video analysis). They were also asked to maintain an identical healthy and balanced diet during the 48 h before each experimental day.

*Ad libitum* energy intake was assessed and appetite feelings evaluated at regular intervals throughout each session. As requested by the relevant ethical procedure, the adolescents, their parents, and their staff received information sheets and filled out consent forms.

### *Anthropometric measurements and body composition*

A digital scale was used to measure body weight to the nearest 0.1 kg, and barefoot standing height was assessed to the nearest 0.1 cm using a wall-mounted stadiometer. Body Mass Index (BMI) was calculated as body weight (kg) divided by height squared ($m^2$). To assess body composition, skinfold thickness values were measured to the nearest millimeter in triplicate and by the same experimenter at the biceps, triceps, subscapular and suprailiac points on the right side of the body using a Harpenden skinfolds caliper (British Indicators Ltd., West Sussex, UK). At each point, the mean value for the three skinfold thicknesses was calculated. We used Slaughter's equations (Slaughter et al., 1988) to calculate the estimated percent body fat. Fat-Free Mass was obtained by subtracting the calculated Fat Mass from body weight.

### *Aerobic capacities*

$VO_{2max}$ was measured during a graded exhaustive cycling test performed during a preliminary session at least one week before experimental sessions. The initial power was set at 30 W during 3 minutes followed by 15 W increments every 1.5 minutes. The adolescents were strongly encouraged by the experimenters throughout the test to perform at maximal effort. Criteria for the achievement of $VO_{2max}$ were subjective exhaustion with heart rate above 195 beats·min$^{-1}$ and/or Respiratory Exchange Ratio (RER, $VCO_2/VO_2$) above 1.02 and/or a plateau of $VO_2$ (Rowland, 1996). An electromagnetically braked cycle ergometer (Ergoline, Bitz, Germany) was used to perform the test. $VO_2$ and $VCO_2$ were measured breath-by-breath through a mask connected to $O_2$ and $CO_2$ analyzers (Oxycon Pro-Delta, Jaeger, Hoechberg, Germany). Calibration of gas analyzers was performed with commercial gases of known concentration. Ventilatory parameters were averaged every 30 seconds. ECG was monitored for the duration of testing.

### *Experimental conditions*

#### *Control session (CON)*

The adolescents were asked to remain inactive (not engage in physical exercise) throughout the day. Meetings and discussions with professional referees were organized during the morning and tactical analysis sessions with video projections and analyses were organized with their coaches during the afternoon.

#### *Rugby session (RUGBY)*

By the end of the morning, the participants followed a traditional rugby training session with their usual coaches for an hour wearing the Polar Team Pro technology (described below) to estimate the induced energy expenditure. They were asked to remain inactive (not engage in any physical exercise) for the rest of the day.

#### *Exercise session (EX)*

Similar to the RUBGY session, the participants were asked to remain inactive throughout the day, except during a morning session (1100 am) when they were asked to cycle on an ergocycle at 75% of their individual maximal aerobic capacities (duration individually calibrated as described below).

#### *Energy expenditure*

The Polar Team 2 technology (Polar Electro Inc, Lake Success; USA) was used to assess the energy expended by each participant during the one-hour rugby session. This HR device has been previously validated in quantifying and evaluating training loads and physiological parameters during individual and team sports (Casamichana & Castellano, 2010; Macleod & Sunderland, 2012; Schonfelder, Hinterseher, Peter, & Spitzenpfeil, 2011). This technology also estimates energy expenditure based on estimated maximal heart rate ($HR_{max}$), estimated $VO_{2max}$, age, gender and anthropometric characteristics. Data from the previously completed incremental maximal exercise allowed for objectively measured $HR_{max}$ and $VO_{2max}$ to be entered in the device setting (rather than estimated values) to ensure the validity of the assessed energy expenditure.