PhD Thesis Proposal Form
China Scholarship Council (CSC)/ENS Rennes
Call for projects 2019
FIELD open

Thesis subject title:

Changes in workload, running performance, lower body power, biochemical, physiological and psychological characteristics of professional rugby union players throughout several rugby seasons.

- Laboratory name: Movement-Sport-Health (http://m2slab.com).
- PhD supervisor (contact person):
  - Name: Prioux.
  - Position: Full Professor.
  - E-mail: Jacques.prioux@ens-rennes.fr
  - Phone number: 06.50.93.67.92

- Thesis proposal (max 1500 words):

The rugby is a team sport that is played on a large field (100 x 68 m) in which two teams compete against each other. Each of them tries to score the most points by carrying the balloon, in an oval shape, in the goal or by passing it over the transversal bar (Larousse Dictionary in line). Rugby is also defined as "a collective fighting sport" where physical involvement is extremely important. Thus, the practice of rugby, at a high level, requires various and varied physical qualities: strength, power, resistance, speed, agility and endurance (Gabbett et al., 2011a, 2011b et 2011c ; Smart et al., 2014). The "Rugby Union", the English term for rugby-XV, is the most widespread and media-friendly practice of rugby. It opposes 2 teams of 15 players that can be distinguished in 2 groups: forwards and backs (three-quarters). A rugby XV match takes place over 2 halves of 40 minutes during which the 2 teams oppose each other and try to move the ball forward until the opponent's goal is reached in order to score more points than the opponent thanks to trials, penalties/transformations or drops. The game consists of a dynamic sequence of different phases: the current game (a game of passes requiring players to move) and the physical confrontation game involving actions such as tackle, rucks, mauls and scrums.

In 2015, the world organization "World Rugby" (formerly the "International Rugby Board", (IRB)) counted 7.73 million practitioners in more than 120 countries. In 1995, the IRB, which manages and organizes the development of rugby in its 7- and 15-member states, deleted all references to amateurism from its statutes. Rugby then becomes a professional sport. The media and financial repercussions generated in this way will greatly contribute to the development of the activity. Indeed, the final of the 2015 Rugby World Cup, watched by more than 120 million people, represents one of the largest international sporting events from a media point of view after the Olympic Games, the Football World Cup and the Tour de France.

The practice of rugby at a high level induces important and multifactorial physiological responses. It seems essential to question the effect of the repetition of these states of fatigue.
generated by the frequency of matches and by the length of the competitive period. These concerns are particularly true for players playing in the French "Top 14" (Quarrie et al., 2016) and ProD2 championships, which have a higher hourly volume dedicated to competition than players playing in other major rugby championships. However, measuring the effects of a season on the physiological characteristics of players remains complex. Nevertheless, some studies have looked at changes in the biological and physical characteristics of players, allowing us to glimpse, in part, the effects of a season on the players' organism. A few studies have observed variations in biological characteristics attesting to physiological adaptations induced by a season or a period of prolonged and/or intensive competition in rugby (Banfi et al., 2006; Elloumi et al., 2008; Gorcedupuy et al., 2012; Lindsay et al., 2015). Banfi et al (2006) show variations in haematological parameters (haemoglobin, haematocrit) as a function of the intensity of physical workload related to training and/or competition in Italian international players throughout a season. Lac & Maso (2004) demonstrate the value of following these markers in athletes. These authors propose to use them as markers of the general health of athletes. For Lac & Maso (2004) these markers cannot, however, be used alone to study adaptations to physical activity in team sports. **Therefore, the evolution of these markers remains complex to analyze. The changes observed cannot in themselves represent a state of chronic fatigue induced by prolonged competitive practice.** Endocrine responses (Testosterone, Cortisol) may also be representative of the overall state of the body. Used to symbolize the state of fatigue induced by a match, their evolution over the course of a season can attest to the chronic effects of prolonged competitive practice (Elloumi et al., 2008; Maso et al., 2004; Argus et al., 2009). However, it is important to note that these studies only refer to periods of relatively short duration compared to the length of a professional rugby season in Europe. Therefore, these results should be interpreted with care with a view to transposing them to the European professional seasons. As in the monitoring of post-match fatigue, muscle damage markers ([CK]_sg) also attest to the state of the body. Alaphilippe et al (2012) show a progressive increase in [CK]_sg during the first part of a season in young (≈ 20 years old) top level rugby players. This increase begins in the preparation phase, lasting 7 weeks, and continues during the 1st part of the 1st competition period (3rd week, in a block of 8 weeks). This increase then decreases on the other samplings of the season. It seems to testify of the adaptation of the organism to all the phases of collisions (tackles, rucks, scrums). It thus shows the improvement of recovery processes thanks to this physiological adaptation. Bauduer et al (2011), in a longitudinal follow-up including 3 blood samples taken from professional rugby players of the French club, showed a significant evolution of [CK]_sg in January (middle of the season). In a previous study carried out in the same club, the authors also show that this period corresponded to the annual peak of muscle injuries (Brocard, 2007). In the study by Bauduer et al (2011), the sampling was sufficiently distant from the previous match (more than 48 hours) to avoid distorting the analysis. Therefore, these results can perhaps be explained by the physiological adaptations induced by the repetition of matches and intensive training periods as well as by the type of matches and/or training more oriented towards physical confrontation at this time of the year compared to other times of the year.

In view of all these results, it remains difficult to draw obvious conclusions about the effects of an entire season of rugby on the physiological characteristics of the players. The results seem to depend on different factors such as the type of population, the length of the competitive period and the type of rugby. Nevertheless, changes in certain biological parameters (oxidative stress, inflammatory state, cortisol, etc.) tend to show that the sequence of matches and the length of the competitive period have an influence on the physiological characteristics of rugby players. In addition, some results (Gabbett, 2005) suggest a state of non-functional over-reaching at the end of the season illustrated by a decrease in physical performance associated with an increased risk of
injury (Meeusen et al., 2013). The most striking developments in terms of biological characteristics seem to occur as a result of intensive periods of competition and/or training. Nevertheless, the different markers studied return to their initial level when the workload level decreases (Filaire et al., 2003; Banfi et al., 2006), thus attesting to the influence of workload on the physiological characteristics of high-level team sport players. In the end, these effects still seem to be insufficiently known and established. Consequently, it seems relevant to conduct longitudinal monitoring of both the TCs imposed on the players and the physiological adaptations taking place throughout a professional season or even throughout several professional seasons. This is the main objective of our science project. This project fits perfectly in the continuation of the work already carried out within the M2S laboratory (Ref publications of the laboratory). The Vannes Rugby Club (http://www.rugbyclubvannes.bzh) will be a partner in this PhD project. It’s first men's team plays in ProD2, i.e., the highest level of play in France after that of the Top 14. All the players on this team are either professional or semi-professional.

- Publications of the laboratory in the field (max 5):

- Joint PhD (cotutelle) : YES
- Co-directed PhD : NO

In case of a co-directed or a joint PhD, please detail:

On the French side this PhD would be directed by two teacher-researchers:

- Jacques Prioux, full Professor at ENS Rennes, Member of the M2S laboratory and responsible for the Sport/Performance axis of the M2S laboratory.

- Anne Le Cunuder, PhD in Physics. PhD supervised by Sergio Ciliberto in the physics laboratory of the Ecole Normale Supérieure de Lyon. Anne Le Cunuder is also an associate researcher at the M2S laboratory.

On the Chinese side the PhD would be directed by Professor Shichang Li.
Partner university name: East China Normal University (ECNU) of Shanghai and particularly the «School of Physical Education and Health» (SPEH) with its Key Laboratory of Adolescent Health Assessment and Exercise Intervention (KL-AHAEI).

- Laboratory name and web site: http://www.ahaei.ecnu.edu.cn/main.htm

- PhD co-director (contact person):
  - Name: Shichang Li.
  - Position: Full Professor.
  - E-mail: schli@tyxx.ecnu.edu.cn
  - Phone number: 86-13023156711

- Provisional duration and timetable of the PhD student’s stay at ENS Rennes:
  2020-2024
  48 months

- If previous collaborations with the Chinese co-director/university, please detail:
  No previous collaborations with Pr Shichang Li.

- Interest of the Joint PhD for the French co-director, for his/her laboratory, for ENS Rennes:

The M2S laboratory has two main areas of research. The first is the Sport/Performance axis and the second is the Sport/Health axis. This PhD project is totally in line with the Sport/Performance axis. Indeed, 3 research themes structure the Sport/Performance axis: the first item is called «Quantification of physical activity », the second item is called «interactions between materials and complex environments » and the third item is called «Training load». The training load/workload concept is therefore one of the 3 main research themes of the Sport/Performance axis of the M2S laboratory. This concept is one of the parameters that will be studied throughout sporting seasons.

Date: 30.01.20.

Signature of the PhD director
Jacques Prioux

Name and signature of the M2S Laboratory director
Benoit Bideau