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Validation of the LEAF-Q translation in a sample of Portuguese athletes

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Validação da tradução do LEAF-Q numa amostra de atletas portuguesas

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Dedication

À minha mãe e ao meu pai!

"Quem caminha sozinho pode até chegar mais rápido, mas aquele que vai acompanhado, com certeza vai mais longe" Clarice Lispector

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Resumo

Introdução: A baixa disponibilidade energética (LEA) é uma condição prevalente entre atletas. Contribui para o desenvolvimento de problemas de saúde graves, através do aumento do risco de oligomenorreia/amenorreia hipotalâmica funcional (FHA), bem como, prejudicando a saúde óssea e, entre outras. O Questionário de Baixa Disponibilidade Energética em Mulheres (LEAF-Q) foi desenvolvido com a finalidade de reconhecer casos persistentes de LEA e identificar atletas femininas em risco para a Tríade da Atleta Feminina (Triad). O crescente aumento do risco de desenvolvimento de LEA entre atletas, resultou na necessidade de traduzir e validar uma ferramenta de diagnóstico para a população portuguesa, permitindo avaliar o risco de LEA em atletas portuguesas. A tradução e retro tradução do LEAF-Q para português (europeu) já foi realizada por um grupo de especialistas. Todavia, no nosso melhor conhecimento, e com base numa extensa revisão da literatura, nenhum estudo procedeu à adaptação transcultural, nem testou a reprodutibilidade e validade da tradução deste instrumento, em Portugal.

Objetivos: O principal objetivo da presente dissertação foi investigar a reprodutibilidade e a validade da versão traduzida para português do LEAF-Q, numa amostra de atletas femininas portuguesas.

Métodos: A primeira etapa do estudo consistiu na realização de um pré-teste com um pequeno grupo de participantes para validar a tradução. Atletas femininas federadas ≥ 18 anos foram convidadas a preencher a versão em português europeu do LEAF-Q (*n* = 32), em formato *online* (*Lime Survey*®). Após o preenchimento do questionário, cada atleta foi entrevistada, via videoconferência, pela investigadora principal. Na segunda etapa, para análise da confiabilidade *test-*

retest, as atletas foram convidadas a responder ao questionário em dois momentos distintos, com intervalo de duas a quatro semanas, sem conhecerem o primeiro resultado (confiabilidade intra-observador), o que permitiu retirar conclusões sobre a acurácia do instrumento.

Resultados: Na primeira etapa (pré-teste), foram convidadas a participar 32 atletas femininas, com idades compreendidas entre 18 e 28 anos. Nesta fase, foram acrescentadas quatro palavras, referentes às questões do e-mail e uso de contracetivos orais (OC). A segunda alteração proposta foi modificar a questão referente ao volume de treino, passando-o para o tempo habitual de treino.

Na segunda fase (*test-retest*), a versão final foi aplicada a 125 atletas, que responderam duas vezes ao questionário. Não foram encontradas diferenças estatisticamente significativas entre as duas aplicações. Adicionalmente, a versão portuguesa europeia do LEAF-Q apresentou excelente confiabilidade com um Coeficiente de Correlação Intraclasse (ICC) de 0,969.

Conclusões: No final do estudo, foi possível obter uma versão portuguesa europeia traduzida e adaptada do LEAF-Q para a população-alvo, sem descurar o rigor técnico e científico dos conceitos do questionário. O questionário mostrou-se confiável (confiabilidade *test-retest*) e apresentou clara evidência para a investigação do risco de LEA. Para além disso, os resultados de estudos futuros com este questionário irão permite reconhecer a importância de incluir programas de educação alimentar e formar uma equipa multidisciplinar capaz de apoiar estas atletas, nas suas respetivas modalidades desportivas.

Palavras-Chave: Ingestão Nutricional, Baixa Disponibilidade Energética, Atleta Feminina, Estudos de Validação

Abstract

Introduction: Low energy availability (LEA) is a prevalent condition among athletes. It contributes to negative health impairments, by increasing the risk of oligomenorrhoea/functional hypothalamic amenorrhoea (FHA) and impairing bone health, among other. The Low Energy Availability in Females Questionnaire (LEAF-Q) was created to detect persistent LEA and identify female athletes at risk of Female Athlete Triad (Triad). The increased risk of developing LEA among athletes resulted in the need to have a screening tool translated and validated for the Portuguese population to assess the risk of LEA in Portuguese athletes. The translation and back-translation of the LEAF-Q to Portuguese (European) has already been done by a group of experts. However, to the best of our knowledge, and based on an extensive review of the literature, no study carried out the cross-cultural adaptation, nor tested the reproducibility and validity of this instrument's translation in Portugal.

Aims: The main purpose of the present dissertation was to investigate the reproducibility and the validity of the Portuguese translated version of the LEAF-Q in a sample of female Portuguese athletes.

Methods: The first stage of the study consisted of carrying out a pretest with a small group of individuals to validate the translation. Female federated athletes ≥ 18 years were invited to complete the LEAF-Q European Portuguese version (n = 32) in online format (*Lime Survey*®). After the fulfilment of the questionnaire, each athlete was interviewed, via videoconference, by the main researcher. In the second stage, for the test-retest reliability analysis, athletes were invited to answer the questionnaire in two moments, with an interval between two to four

weeks, without knowing the first result (intra-observer reliability), to draw conclusions about the instrument's accuracy.

Results: In the first phase (pretest), 32 female athletes aged between 18 and 28 were invited to participate. At this stage, four words were added, regarding the email and the oral contraceptive (OC) use questions. The second amendment proposed was modifying the question regarding the training volume, changing it to the usual training time.

In the second phase (test-retest), the final version was applied to 125 athletes, who responded to the questionnaire twice. No statistically significant differences were found between the two applications. Additionally, the LEAF-Q European Portuguese version showed excellent reliability with an Intraclass Correlation Coefficient (ICC) of 0.969.

Conclusions: At the end of the study, it was possible to obtain a translated and adapted LEAF-Q European Portuguese version for the target population, without neglecting the technical and scientific rigor of the questionnaire concepts. The questionnaire proved to be reliable (test-retest reliability) and present evidence to investigate the risk of LEA. Furthermore, the results from future studies with this questionnaire will allow to recognise the importance of including nutritional education programs and educate a multidisciplinary team capable to support these athletes in their respective sports.

Keywords: Nutritional Intake, Low Energy Availability, Female Athlete, Validation Studies

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Acronyms List

ACSM	American College of Sports Medicine
BMD	Bone Mineral Density
CDC	Centers for Disease Control and Prevention
DXA	Dual-energy X-Ray Absorptiometry
DE	Disordered Eating
EA	Energy Availability
ED	Eating Disorder
EDE – 16	Eating Disorder Examination Interview
EEE	Exercise-Energy Expenditure
EHMC	Exercise-Hypogonadal Male Condition
EI	Energy Intake
FFM	Fat-Free Mass
FHA	Functional Hypothalamic Amenorrhoea
FSH	Follicle-Stimulating Hormone
GH	Growth Hormone
GI	Gastrointestinal
GnRH	Gonadotropin-Releasing Hormone
ICC	Intraclass Correlation Coefficient
IGF – 1	Insulin-like Growth Factor 1
LEA	Low Energy Availability
LEAF-Q	Low Energy Availability in Females Questionnaire
LH	Luteinizing Hormone
MD	Menstrual Dysfunction

OC	Oral Contraceptive
RED-S	Relative Energy Deficiency in Sport
RED-S CAT	RED-S Clinical Assessment Tool
SD	Standard Deviation
SEAQ-I	Sport-specific Screening Questionnaire and Clinical Interview
TEE	Total Energy Expenditure
Triad	Female Athlete Triad
Triad CRA	Triad Cumulative Risk Assessment

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Introduction

To meet the energy requirements, it is necessary to have an optimal energy balance (through balancing the calories consumed with the calories expended)[1]. Along with this, a proper nutrient intake is vital to ensure muscle growth and repair, immune function, and decrease the risk of injury and other impairments[2]. In fact, it is well documented in literature that the prevention, treatment, and recovery of injuries are dependent of an adequate energy and dietary intake[3]. Balancing energy intake (EI) and total energy expenditure (TEE) is a dynamic process that requires attention, adjustments, and monitoring. TEE represents the sum of all energy expended by all organic systems (e.g., digestive, immune, musculoskeletal, reproduction), including homeostatic activity and growth[4].

Exercise-energy expenditure (EEE) refers to the amount of energy that an athlete expends during exercise. It is an important concept since EEE can help athletes adapt their training programs, optimize nutrition, and achieve their performance in order to attain an energy balance target[5]. There are several factors that influence EEE, namely: intensity and duration of exercise; body weight and composition; environmental factors; gender and age.

Lying at its core is the concept of energy availability (EA), which reflects a numeric value resulting from the difference between EI and EEE, in relation to fat-free mass (FFM)[6, 7]. According to the literature, it has been established that the minimum values of optimal EA should be >45 kcal/kg FFM/day for female and >40 kcal/kg FFM/day for male athletes[2, 8] for weight maintenance. Restrictive diets with values of EA between 30-40 kcal/kg FFM/day for males and 30-45 kcal/kg FFM/day for females, are considered subclinical LEA[8]. This condition may be tolerated for short periods of time during a well-constructed weight-loss program,

although, it is important to highlight that only can be done under the supervision of a nutritionist and to achieve a specific objective. After that, the athlete must return to optimal EA[9]. Clinical LEA starts with values bellow <30 kcal/kg FFM/day, that brings health implications with impairment of many body systems [2, 8, 9]. Athletes may experience LEA, due to disordered eating (DE), reduced appetite, poor nutritional knowledge or, intentionally, to optimize sports performance[2, 10]. This condition is responsible for a wide range of dysregulations (e.g., metabolic, physiological and, specially, hormonal) triggered by energy deficiency[6, 11-13]. The topic regarding LEA will be described, in detail, in a later section.

1. Female and Male Athlete Triad

The American College of Sports Medicine (ACSM) defined the Triad as a clinical entity that refers to the relationship between three inter-related components: EA, menstrual function, and bone health[14, 15]. Thus, the pathophysiology describes a concept that makes athletes move along a continuous spectrum ranging from the healthy athletes with optimal EA, regular menses, and healthy bones, to the opposite end of the spectrum characterized by amenorrhea, low EA, and osteoporosis[16].

Male athletes are also prone to develop the Triad, and the suppression of the hypothalamic-pituitary-gonadal axis (e.g., FHA in females and reduced testosterone levels in males)[17] impairs bone health in both sexes[2, 18, 19]. However, it is important to notice that males seem to be more resilient to the effects of LEA[11], consequently, when they observe alterations, it means that the disturbance might be more severe[20].

It is well known that the main factor underpinning the Triad is an energy deficiency relative to the balance between dietary EI and the energy expenditure required to support homoeostasis, heath, and the activities of daily living, which may be potentially irreversible in the long-term[21].

In its position stand[14], the ACSM established that some conditions put the athletes at higher risk to develop LEA, namely: restricting dietary EI, exercising for prolonged periods or sudden increase in training volume, limiting the types of food that an athlete eat, engaging in athletic disciplines favouring leanness, and having certain types of pathological history (e.g., chronic malnutrition, eating disorders, hypogonadism, and glucocorticoid exposure) or the development of specific injuries (such as stress fractures, ruptures, etc)[14]. It has been suggested that the main cause for athletes having DE can be by unknowingly failing to attain their energy requirements or lack of nutritional knowledge[22]. Additionally, some studies[1, 22-24] reported that athletes often lack the appetite necessary to promote food intake as compensation for energy expenditure, during intense regimens of training.

2. Relative Energy Deficiency in Sports

Relative Energy Deficiency in Sport (RED-S) is a medical and physiological condition that mainly affects athletes[9, 16]. This concept expands on previous understanding of the Triad, which focused on the interconnected concerns of DE, menstrual dysfunction (MD), and bone health in female athletes. RED-S takes a broader perspective than the Triad, acknowledging that these impairments can affect both male and female athletes and encompass a wider range of physiological systems[25].

At its core, RED-S is characterized by an inadequate EI relative to an athlete's energy expenditure, i.e., LEA. This deficiency can result from deliberate caloric restriction, unintentional undernutrition, or a combination of both.

The RED-S affects many aspects of physiological function, health, and athletic performance (10 health outcomes and 10 potential performance effects)[16]. The most prevalent are gastrointestinal (GI) and cardiovascular impairments, immunological suppression, an increased risk of injury, dyslipidaemia, irritability or depression, and reduced muscle strength, sports performance, and appetite[2, 16, 26].

Education and awareness play a pivotal role in the prevention of the RED-S (and the Triad). Furthermore, first-line treatment requires restoring energy and hormone balance, as well as providing personalized nutritional support[16]. Thus, it is imperative to recognize the signs and intervene promptly for the long-term well-being and performance of athletes.

3. Low Energy Availability

As stated above, clinical LEA starts with values of EA below <30 kcal/kg FFM/day, for both male and female athletes[2]. Additionally, it has been established that subclinical LEA ranges from clinical LEA to optimal levels of EA (i.e., 45 kcal/kg FFM/day for female and 40 kcal/kg FFM/day for male athletes)[2, 8].

In the particular case of LEA, Jesus *et al.*[8] observed a prevalence of 64.3% in elite cross-country runners (79.5% in females and 54.0% in males), with 41.3% of the female's athletes reporting an altered menstruation[8]. In addition, more than half of these athletes reported to have been injured during the previous year, of which a total of 39.8% for at least 22 days away from training and competition[8].

Regarding GI function, around 54.1% reported having bowel movements “one a week or more rarely”. Additionally, 41.8% reported being heavier than what they considered to be their “ideal” weight[8].

With respect to other impairments, studies [27-29] reported low bone mineral density (BMD) in 40-45% of athletes.

Information on the prevalence of LEA in male athletes remains scarce. Although the development of studies in male athletes has increased[18, 25, 26, 30], more research is needed to achieve more information about the prevalence of LEA in this population. A study done in both female and male competitive endurance cyclists shown that 90% of the male cyclists had LEA during at least 1 training period, and 70% had LEA across the season[30]. More recently, a study[31] to assess the point-prevalence of LEA in elite male volleyball players report that 36% of the athletes had ≥ 2 surrogate markers of LEA. However, more research is needed to correctly define these markers in male athletes.

In another study[32],which analysed the increasement in EI with the training intensity in elite synchronized swimming athletes, it was possible to verify that, at baseline, they already had significantly LEA (lower than 30 kcal.kg/FFM/day). This study showed that an increased training intensity induced an elevated rate of EEE and, consequently, the athletes increased EI to maintain similar EA. However, after that, they reduced EI again, even in the most intense training phase. This indicates that, despite some awareness of the importance of adequate EI, they quickly returned to values of LEA and did not follow the increase in training volume with EI.

Moreover, in subelite/elite middle and distance athletes the prevalence of LEA was 18-58%[27, 33, 34] and 52% in female runners[35].

Nowadays, it is well recognized that LEA may lead to several negative consequences (e.g., GI, and menstrual impairments), including a significant decrease in sports performance. Thus, LEA can be considered a serious public health problem that must be given attention to[2]. Therefore, it is necessary to identify athletes at risk of LEA and, for this, it is imperative to have a validated diagnostic tool, making the detection easy, practical, quick, and effective[36]. The use of a validated screening tool facilitates the process of early detection of athletes at risk, safeguarding the health status and contributing to the improvement of sports performance[37, 38].

3.1. Health effects of Low Energy Availability

3.1.1. Brain Energy Availability

The concepted of brain energy availability was proposed in 1984, since the impact of exercise on reproductive functions were induced by changes in hypothalamic function[39]. Hypothalamus, which is located on the undersurface of the brain, plays pivotal roles in these interactions between reproduction and metabolism and/or nutrition. This was demonstrated in a study done with dancers[40], where findings suggested that when they were forced to rest due to injury or their schedule training was decreased, their sexual development and menarche were promoted.

According to the literature, Rose Frisch[39] observed that the first menstrual bleeding correlates with the attainment of a body weight of 47 kilograms in most of the women, although in some It may be earlier. Frisch postulated that the brain senses when the "critical" body weight or composition is achieved and completes the processes required for menses. Hence, the brain appears to monitor the

balance between the availability of calories and their utilization when this balance is unachieved, reproductive functions are transiently suppressed, in order to survive[41, 42].

3.1.2. Endocrine Effect

Effects of LEA on the endocrine system has been described in both female and male athletes[26]. The main findings include alterations in thyroid function, changes in appetite-regulating hormones (e.g., decreased leptin and oxytocin, increased ghrelin, peptide YY, and adiponectin), decrease in insulin and insulin-like growth factor 1 (IGF-1)[43], increased growth hormone (GH), resistance and elevations in cortisol [11, 25, 44-47]. These hormonal changes occur mainly to maintain a sufficient energy for vital processes[9, 48, 49]. Additionally, it was found a reduced pulsatility and amplitude in luteinizing hormone (LH) in male marathon runners, possibly due to being at high risk of LEA[50]. Furthermore, a significant difference in pulsatile LH release between male athletes and sedentary subjects[51] was found. Female athletes with LEA were reported to have reductions of LH pulse amplitude and frequency[51, 52]. The latter appeared to have been maintained in the male athletes with LEA.

On the other hand, other findings have shown reductions in basal serum testosterone levels in athletic population when compared with sedentary controls[51]. It appears that serum testosterone levels are influenced by exercise, although these parameters remain inconsistent[51, 53]. Specific hormonal changes in men are not completely understood, therefore more research is needed[54-56].

The main cause of the metabolic and nutritional impairments is the suppression of gonadotropin-releasing hormone (GnRH) secretion from the hypothalamus in the brain[41]. GnRH is an hormone that plays a key role in regulating the

reproductive system by stimulating the release of other hormones, such as LH and follicle-stimulating hormone (FSH), from the anterior pituitary gland[52]. Since the pulsatile secretion of LH reflects the secretion of GnRH, consequently, the secretion of LH reflects the secretion of GnRH[57]. These hormones, in turn, regulate the production of sex hormones like oestrogen and testosterone in the gonads (ovaries and testes)[58, 59].

Additionally, deficient EI and extreme changes in body weight can also affect GnRH secretion. For example, conditions like anorexia nervosa can lead to MD in female athletes.

Leptin is a hormone produced by adipose tissue cells and plays a crucial role in regulating energy balance and appetite[60]. It can indirectly affect the reproductive system by influencing the release of GnRH. When body fat and energy storage are low (i.e., LEA), leptin levels are also low, signalling to the brain that the body is in a state of energy resources deficit[60]. In response to this signal, the hypothalamus decreases the secretion of GnRH, which inhibits the secretion of LH and FSH[25]. Thus, the hypothesis regarding the mechanisms responsible for the reproductive dysfunction seen under LEA conditions can be described as follows: it starts with a marked LEA, that decrease the leptin function (regulation of appetite and reproduction), supressing LH and FSH [42].

3.1.3. Menstrual Function

The effects of LEA on menstrual function in female athletes has been well described in literature[14, 16, 46]. Current evidence supports a LEA-associated disruption of GnRH pulsatility at the hypothalamus, followed by alterations of LH and FSH release from the anterior pituitary gland, and decreased estradiol and progesterone levels. This is considered a form of FHA[52, 61].

The duration and severity of LEA required to create such disturbances are unclear[11], reflecting both the complex nature of the problem and discrepancies associated with the different methodologies used to study it. For example, Loucks and Thuma[46] studied previously sedentary women in a laboratory setting and identified that well-controlled interventions reducing EA below 30 kcal/kg FFM/day via the short-term (5 day) manipulation of EEE and EI were associated with a dose–response decrease in LH pulsatility[46]. More recently, Williams *et al.*[54] reduced EA via manipulation of EI and EEE over several menstrual cycles in untrained, previously eumenorrheic subjects. The researchers found that the frequency of MD (including luteal phase defects, anovulation, and oligomenorrhoea) was affected by the magnitude of energy deficit (participants were exposed to an energy deficit ranging from -8 to -42% of their typical energy needs) compared with their baseline needs[54]. Moreover, Reed *et al.*[62] performed a cross-sectional analysis of EA in female athletes with eumenorrhea and various MD[62]. They stated that average EA for maintaining the functioning of vital functions was a minimum intake of >30.0 kcal/kg FFM/day in all the groups (amenorrhoeic, oligomenorrheic, ovulatory eumenorrheic, inconsistent subclinical menstrual dysfunction eumenorrheic, and anovulatory eumenorrheic athletes) and EA was lower in amenorrhoeic athletes compared with eumenorrheic athletes (mean 30.9 vs 36.9 kcal/kg FFM/day)[62]. Thus, more research is needed to better understand the interaction between EA and MD.

Additionally, two different types of amenorrhea can be distinguished: primary and secondary. The first one means no menarche by the age of 15 years old, and, according to Mountoy *et al.*[21], affects 7% of collegiate athletes and 22% of cheerleading, diving, and gymnastics[21]. The secondary amenorrhea means

absence of three consecutive cycles post-menarche, and it has been observed in 2% to 5% of collegiate women, 69% dancers, and 65% long-distance runners[21, 22, 63].

3.1.4. Bone Health

LEA has significant consequences for bone health. Peak bone mass occurs around 19 years old in women, and 20.5 years old in men[64]. The hormonal mechanism can be simply described as increased oestrogen uptake of calcium into blood and deposition into bone, whereas progesterone facilitates the action of oestrogen[65]. Even in subclinical ovulatory disturbances with LEA, oestrogen/progesterone imbalance is seen, which may result in negative changes in bone[16].

In male athletes, reduction in the sex hormone testosterone is likely to be of greater health concern, especially due to high volumes of training[66]. In literature, this reduction is known as the exercise-hypogonadal male condition (EHMC)[66, 67]. Although no differences were found in BMD, this condition was associated with osteopenia[68].

3.1.5. Gastrointestinal Effect

GI symptoms and LEA represent two interconnected, yet distinct, challenges faced by athletes[69]. The prevalence of GI symptoms, including nausea, vomiting, diarrhoea, and abdominal discomfort among athletes has prompted significant investigation into their underlying aetiology and impact on performance[70]. Furthermore, constipation and increased intestinal transit time are identified as being a health outcome of LEA[16].

Jesus *et al.*[8] reported that more than half the athletes at risk of LEA had bowel movements once a week or more rarely, indicating a longer-than-expected intestinal transit time. This is in line with what is described in the literature[14, 70].

When comparing between genders, current evidence suggests that male athletes are those who have a longer-than-expected intestinal transit time, which is the opposite of what is found in non-athletes, where female tend to have a longer-than-expected intestinal transit time[71]. This may be due to a state of dehydration, since intestinal constipation occurs, essentially, due to dehydration[72], and athletes frequently present states of hypohydration.

Considering that athletes, especially those in weight-sensitive sports, recur to dehydration to achieve weight loss[73, 74], and are between the ones with a higher risk of LEA, it is important to take preventive measures in order to reach an optimal hydration status and decreased the impairments due to health outcomes of LEA.

3.1.6. Performance Impairments

Long-term LEA can develop nutrient deficiencies (such as micronutrients deficit or even anaemia) that increase the risk of injuries and illnesses, compromising recovery and optimal muscle mass function[14, 16], consequentially compromising health and sport performance[9].

According to the findings of Tenforde *et al.*[75], athletes with LEA were at a significantly higher risk of stress fractures and other bone-related injuries. Furthermore, female athletes with the Triad have a higher occurrence of musculoskeletal injuries compared to those without the Triad[76]. Besides, no improved aerobic capacity compared with eumenorrheic athletes was found[77].

These outcomes collectively highlight the importance of proper EI and the potential negative effects of LEA along with associated conditions on sport performance, clearly indicating the need for more research in this field.

4. Assessment of risk of Low Energy Availability

As mentioned previously, LEA has several harmful side effects for athletes and, therefore, its occurrence should be avoided. Once installed, athletes should receive support from the medical team, and their EA status should be monitored. In this regard, it is vital to have instruments for collecting information adapted to the target population. There are several different and reliable methods for the identification of at-risk athletic populations and, in addition, early detection can prevent health implications[9].

Some examples are the Triad Cumulative Risk Assessment (Triad CRA)[78] and the RED-S Clinical Assessment Tool (RED-S CAT)[79], both designed to take a complex clinical assessment. The last one was developed for all ages and sport modalities and can be adapted for both males and females' athletes. Since there is no single symptom contributing to the diagnosis of the condition, it is difficult to understand the extent of the risk and case decisions[80, 81].

It is possible to use gold standard methods for some situations, for example, diagnosis of eating disorders (ED) through the Eating Disorder Examination Interview (EDE-16)[21, 82], as well as the measurement of BMD using a dual-energy X-Ray Absorptiometry (DXA)[79]. Yet, it is impractical for many applications, and gold standards do not exist for all the EA parameters and consequences.

The most used methods to evaluate EA involve assessing the athlete's eating habits (through a food frequency questionnaire, food records or other) and assessing the EEE (through accelerometers or exercise records)[13, 38]. These methods present problems do to errors in the estimation of EI, even when various techniques are used or multiple time points are analysed (accuracy and reliability, respectively)(13). The measurement of EEE also contributes to a significant error

(e.g., due to the devices or the methods), as well as causing substantial observer and participant burden[13, 38, 83].

The Sport-specific Screening Questionnaire and Clinical Interview (SEAQ-I)[84] is a questionnaire developed specifically for male road cyclists which includes training questions (e.g., years of cycle training, average weekly training hours and off-bike exercise), nutritional information (such as intentional weight loss, number of fasted rides per week, fuelling for rides over 1 hour, post-training recovery nutrition and supplements use) and some medical history. This instrument combines a questionnaire to assess EA with a Clinical Interview. Regarding DE and its prevalence, clinical interviews are viewed as essential, along with individual evaluation (e.g., Periodic Health Examination and Preparticipation Physical Evaluation)[85, 86].

Other available questionnaire is LEAF-Q[36] used in female athletes. The intension of the LEAF-Q was to construct a brief questionnaire focusing only on self-reported physiological symptoms linked to persistent energy deficiency, with or without DE, which could be routinely used to identify individuals at risk of the Triad[36]. Therefore, given the difficulty in measuring and detecting cases with DE, Melin *et al.*[36] developed and validated the LEAF-Q. The instrument was validated for adult elite female endurance athletes and professional dancers with a sensitivity of 78%, specificity of 90% and a test-retest reliability of 0.79[36]. The questionnaire is composed by 25 questions, divided into three different sections: 1) injuries; 2) gastrointestinal symptoms; 3) menstrual function and contraceptive use[36].

Although the assessment of the risk of LEA in athletes is fundamental, currently there is no validated method for the Portuguese population. The original version of the LEAF-Q has already been translated and back-translated into European

Portuguese[87], nevertheless, to the best of our knowledge and based on an extensive literature review, the psychometric properties of this Portuguese version have not yet been verified. This means that a study was never carried out to verify whether the target population expected to understand the questions in the produced version. In other words, this instrument was never adapted based on perspectives or characterizations drawn up by the target population itself. Consequently, the information that would arise from this valid diagnostic tool would help both professionals and athletes to be aware of the impairments due to LEA through a simple and scientifically correct way.

Therefore, the main purpose of the present study was to investigate the reproducibility and the validity of the European Portuguese translated version of the LEAF-Q in a sample of Portuguese athletes. Hence, it was necessary to proceed with the cross-cultural adaptation to validate its translation into the target language, as well as to test its reproducibility.

Objectives

1. Main objective

The main purpose of the research was to investigate the reproducibility and the validity of the European Portuguese translated version of the LEAF-Q, in a sample of Portuguese athletes.

2. Specific objectives

The specific aims of the dissertation were:

1) To proceed with the cross-cultural adaptation by carrying out a pretest with a small group of female athletes;
2) To test-retest the reproducibility and validity of the LEAF-Q, in a sample of Portuguese athletes;
3) To analyse the internal consistency, by comparing the differences of the two applications of the instrument (test-retest);

Methodology

The present study was approved by the Ethics Committee of the Faculty of Nutrition and Food Sciences of University of Porto (Nº 48/2021/CEFCNAUP/2021) and it was conducted in accordance with the ethical principles expressed in the Declaration of Helsinki for human studies[88], the Portuguese law, and the Good Clinical Practice Guidelines. The research team presented the aim and study protocol to the athletes, as well as other additional information and clarifications relevant to the study. Participants signed an informed consent form (Appendix A) and were invited to complete the questionnaire, performed in an online platform (e.g., *Lime Survey*®). The participation in the study was voluntary and was not expected to be remunerated. The participant had the right to withdraw from the study at any time, without any prejudice. To ensure the privacy of participants and guarantee the confidentiality of responses, the questions regarding name, address, email, and telephone number were removed.

1. Phase I: Pretest

The translation and back translation of the LEAF-Q had already been done by a group of experts[87] (Annex A). The following stages were the cross-cultural adaptation and the LEAF-Q translation validation. These processes were carried out based on recommendations from Guillemin *et al.*[89] and Beaton *et al.*[90]

Firstly, it was necessary to carry out a pretest in a sample of approximately 30-50 subjects through the direct administration of the translated version of the LEAF-Q[91, 92]. The results allowed modifications to the questionnaire and preparation of the final version of the LEAF-Q that best suits the study population. At the end of

this stage, a translated version and a cross-cultural adaptation of the LEAF-Q was obtained[93].

The sample for this stage (sample I) consisted in Portuguese female federated athletes over 18 years old, which train at least five hours/week for competition, and have had menstruation[36]. Athletes were excluded if they were diagnosed with some medical issue that affected their normal training schedule or with an injury that prevented them from training for two weeks, as well as, if they were pregnant or lactating women.

Athletes were recruited by convenience. The sample I comprised 32 athletes[91, 94] belonging to two different modalities: volleyball and basketball.

The questionnaire was available in online format (*Lime Survey*®), and each athlete was interviewed by the main researcher via videoconference after its fulfilment.

The questionnaire was composed by 25 questions, divided into three different sections: 1) injuries; 2) gastrointestinal symptoms; 3) menstrual function and contraceptive use[36].

With reference to range scores, these vary between 1.0 to 8.0 for the injury section, 0.0 to 9.0 for the gastrointestinal section, 0.0 to 11.0 for the menstrual function and use of contraceptive section, and 3.0 to 21.0 for the total score.

As per the LEAF-Q scoring system, athletes were identified as being at risk for each section, according to the score obtained: namely injury risk score ≥ 2, gastrointestinal function risk score ≥ 2, menstrual function and use of contraceptive section risk score ≥ 4 (only for female athletes). A total score ≥8 classifies female athletes as being at risk of LEA.

The interviews allow to obtain information in the most diverse fields[95].For the purpose of this study, it was chosen the semi-structured interview or semi-directive as it is "one of the main instruments of research of a qualitative nature", because it can be used in combination with other methods and because it can have the function of "assessing the adequacy of processes with perspectives or characterizations elaborated by the subjects" – research-control interview[95].

The semi-structured interview meant that there was not a rigid imposition of questions, which, consequently, allowed the interviewee to think about the proposed topic while respecting their background - intentions, values, social class, level of education, age, moments in life, and among others[95].

This process allowed to evaluate the clarity of the questions and difficulty in understanding them by athletes, the way in which the questions were asked, as well as the understanding of concepts described in the questionnaire. This allowed us to assess face validity since the content of the measure appears to reflect the construct being measured through target population reports collected in the interviews. Although face validity has a different objective, it was done at the same time, in order to profit time and resources[91, 96].

Based on the athletes' suggestions during the interviews, four words were added to the questionnaire, regarding the email question and the OC use. In both, the suggestion would be to add two synonyms, in parentheses, for a better understanding. The second amendment proposed was to modify the question regarding the training volume, changing it to the usual training time.

2. Phase II: Test-retest

For the test-retest reliability analysis of the LEAF-Q European Portuguese version, participants were invited to answer the questionnaire in two moments, with an interval of two to four weeks, without knowing the first result (intra-observer reliability). This method allows to draw conclusions about the instrument's accuracy. In this phase, the reliability and internal consistency were evaluated[93, 96].

For the test-retest, it was necessary to recruit a minimum of 5 different participants per question, i.e., a ratio range of 5:1 (example: 50 respondents for a 10-item questionnaire)[89-91, 93, 94]. Thus, a sample size of at least 125 athletes was needed.

The questionnaire was available in an online format (*Lime Survey*®) (Appendix D).

The second sample (sample II) complied with the same inclusion and exclusion criteria as sample I, nevertheless, was more extensive and included 125 athletes from various modalities (athletics, basketball, football, swimming, and volleyball) and different regions of Portugal.

3. Statistical Analysis

The data obtained was processed in IBM SPSS Statistics Software® version 29.0. The normality of each quantitative variable was checked using Shapiro–Wilk test. [97]. Demographic and anthropometric characterization data were submitted to descriptive analysis and results presented as mean and standard deviation (SD) values for parametric variables.

The test-retest reliability was evaluated using the ICC. The recommended ICC value should be the closest to +1, with a minimum acceptable value of 0.70[91, 93, 98]. Furthermore, the Cohen's Kappa Coefficient (k) was performed to assess the

test-retest reliability of the questionnaire as well. For that, k= 0.20 is considered to be poor agreement, k= 0.21–0.40 a reasonable agreement, k= 0.41–0.60 a moderate agreement, k= 0.61–0.80 a significant agreement, and k= 0.81–1.00 an almost perfect agreement[99, 100].

To determine the differences between the two applications, paired-sample t- test was used. To assess the correlation between the two applications, Pearson's Correlation Coefficient (r) was used. The r values range between -1 (perfect disagreement) and +1 (perfect agreement) and the strength of agreement for the *ρ* were classified as negligible (0 to 0.30), weak (0.30 to 0.50), moderate (0.50 to 0.70), strong (0.70 to 0.90), or very strong (≥ 0.90)[101]. The agreement was calculated as the difference mean between test and retest scores.

For all tests, statistical significance was set as $p < 0.050$.

Results

1. Phase I: Pretest

1.1. Sample Characterization

The final sample of the first stage (*n* = 32) comprised athletes belonging to volleyball (48.5%) and basketball (51.5%) teams. The sample characterization is given in Table 1. The mean age was 20.3 (2.9) years. None of the athletes reported smoking habits.

Table 1. Characteristics of the sample I

	Mean (SD)	**Min - Max**
Age (years)	20.3 (2.9)	18-28
Weight (kg)	64.1 (8.3)	52-85
Height (cm)	168.6 (6.8)	155.0-190.0
Education level	***n* (%)**	
High school	12 (37.5)	
University degree	20 (62.5)	
Medication	***n* (%)**	
Oral contraceptives	19 (59.4)	
Specific (Asthma, antihistamines, iron supplements and Levothyroxine)	4 (12.5)	
Training per week (hours/week)	**Mean (SD)**	
Including (3-5 workouts + 1-2 strength and technique training)	9.3 (2.2)	

SD: Standard deviation

1.2. Association Between Risk of Low Energy Availability and Characteristics

A total of 8 female athletes (25%) were identified as being at risk of LEA (risk score ≥ 8). Table 2 shows the sum scores obtained in each section, the prevalence of female athletes at risk for each section, the total score for the whole questionnaire, and the prevalence of athletes at risk of LEA.

Table 2. Sum score and prevalence of athletes at risk for each section and total score of Low Energy Availability in Females Questionnaire (LEAF-Q)

	Mean (SD)	***n* (%)**
Injury section	1.9 (2.6)	13 (40.6)
Gastrointestinal section	1.9 (1.7)	17 (53.1)
Menstrual function and use of contraceptive section	1.4 (1.7)	4 (12.5)
Total (n)	5.2 (3.8)	8 (25.0)

SD: Standard deviation.; n (%): Number and percentage of athletes identified as being at risk: injury risk score ≥ 2, Gastrointestinal risk score ≥ 2, Menstrual function and Contraceptive use section risk score ≥ 4, Total score (i.e., risk of low energy availability) risk score ≥ 8 for female athletes. Range scores were 1.0 to 8.0 for the injury section, 0.0 to 9.0 for the gastrointestinal section, 0.0 to 11.0 for the contraceptive and menstrual function section, and 3.0 to 21.0 for the total score.

1.3. Gastrointestinal Function

Regarding GI function, more than half of the athletes reported rarely or never feeling gaseous or bloated (53.1%, *n* = 17), as well as rarely or never getting stomach cramps or aches (78.1%, *n* = 25). Additionally, some athletes (9.4%, *n* = 3) reported bowel movements twice a week and 1 (3.1%) athlete reported only once a week or more rarely. Half of the athletes reported bowel movements once a day (50.0%, *n* = 16) and all reported that their stools were “normal (soft)”.

1.4. Injuries

During the previous year, less than half of the athletes reported being absent from training or competition due to injury (40.6%, *n* = 13), of which a total of 6 (18.8%) reported being absent for at least 22 days, 2 (6.3%) between 15 to 22 days, 2 (6.3%) between 8 to 14 days, and 3 (9.4%) between 1 to 7 days. Additionally, the most reported injuries included stress fractures (*n* = 9), knee injury (*n* = 8), namely rupture of anterior cruciate ligament (*n* = 5), unspecified foot injury (*n* = 1), and among others.

1.5. Menstrual Function and Contraceptive Use

More than half of the athletes reported menarche at 12 to 14 years old (68.8%, *n* = 22). Only 2 athletes did not report normal menstruation (6.3%), caused by primary amenorrhea (i.e., menarche at 15 years or more). When asked if their menstruation had ever stopped for at least 3 consecutive months, 15.6% (*n* = 5) reported experiencing it in the past. Additionally, some (34.4%, *n* = 11) experienced changes in their menstruation when their exercise load increased, answered positively, with most (45.5%, *n* = 5) reporting bleeding less. More than half of the athletes reported taking OC (59.4%, *n* = 19). The majority of which (63.2%, *n* = 12) reported using OC to regulate their menstrual cycle in relation to performance, while others used them as contraception (52.6%, *n* = 10), 1 (3.1%) to prevent the cessation of menstruation, and 1 (3.1%) to prevent acne problems.

2. Analysis from the content of the semi-structed interviews

During the interviews, the athletes made comments regarding their perceived understanding of the questionnaire. Their comments were taken into consideration and, whenever possible, adaptations to the questionnaire were made.

In the first part, concerning personal data, the question referring to "correio eletrónico" *(email)* was not well understood by most of the athletes, and one of them suggested adding the word "e-mail", in parentheses.

A pergunta do correio eletrónico não é percetível, achei que deveria estar mais bem estruturada (..)(E20)

The email question is not understandable, I thought it should be better structured (..) (E20)

Mas tens alguma sugestão? Como é que achas que poderia ficar mais facilmente percetível? (Interviewer)

But do you have any suggestions? How do you think it could be more easily understood? (Interviewer)

(…) na minha opinião se apenas adicionasse o e-mail, entre parêntesis, já ficaria mais direitinha. (E20)

(…) in my opinion, if you just added the email, in parentheses, it would be more accurate. (E20)

Also, in this part, the question "Usa algum tipo de medicação (excluindo contracetivos orais)?" *(Do you use any medication [excluding oral contraceptives])?* raised some doubts in three athletes.

Não tenho a certeza do que são contracetivos orais e (pausa) não sabia se tomar a pílula seria considerado um contracetivo oral (E15)

I'm not sure what oral contraceptives are and (pause) I didn't know if taking the pill would be considered an oral contraceptive (E15)

O que achas que seria necessário para entenderes melhor a questão? (Interviewer)

What do you think would be needed for you to better understand the question? (Interviewer)

…(pausa) talvez se tivesse escrito um exemplo, teria sido mais fácil de chegar lá (E15)

…(pause) perhaps if it had written an example, it would have been easier to get there. (E15)

Não percebi muito bem o que queria dizer contracetivos orais, sei o que são contracetivos, mas orais não. Eu acho que podia ter, entre parêntesis, alguns exemplos de contracetivos orais para facilitar a resposta… (E30)

I didn't quite understand what oral contraceptives meant, I know what contraceptives are, but not oral ones. I think it could have, in parentheses, some examples of oral contraceptives to facilitate the answer …(E30)

Tenho dúvidas se o adesivo (que é o método que uso) é um contracetivo oral, nunca pensei nisso, por isso tive dúvidas (E32)

I have doubts if the patch (which is the method I use) is an oral anti contraceptive, I never thought about it, that's why I had doubts. (E32)

In both questions above, changes were made for a better understanding. In the first one, the word "e-mail" *(email)* was enclosed in parentheses. In the second one, "pílula" *(pill)* was added after OC, to give an example.

The question related to exercise was not clearly understandable. The question was presented as follows: "O seu volume habitual de treino (média) – número de horas por semana e que tipo de exercício, como corrida, natação, ciclismo, treino de força, treino de técnica, etc.:" *(Your normal amount of training (average) – number of hours per week and what kind of exercise, such as running, swimming, bicycling, strength training, technique training etc.:)*

Na pergunta de volume de treino, demorei um pouco a perceber o que queria dizer, mas depois de ler melhor percebi o que significava e fui fazer as contas do volume de treino (E2)

In the training volume question, it took me a while to understand what it meant, but after a better reading I understood what it meant and went to do the training volume calculations (E2)

Achas que deveria estar estruturada de forma diferente? (Interviewer)

Do you think it should be structured differently? (Interviewer)

Acho que sim, (pausa) mesmo que fosse uma palavra diferente para conseguir entender e descrever o tempo e treino… (E2)

I think so, (pause) even if it was a different word to be able to understand and describe the time and training... (E2)

After discussion, the researchers agreed to change the sentence, improving its understanding. The previous sentence was “O seu volume habitual de treino (média)”, and after undergoing the change it was as follows “O seu tempo de treino habitual (média)”

Regarding third section (i.e., menstrual function and use of contraceptive) two words were added. The first one was in question 3.1 A, the example "pílula" *(pill)* was added at the end of the question. Furthermore, the second word was added in the question C3, namely, "habitualmente" *(usually)* in the middle of the question, to facilitate its understanding.

Table 3. Changes made to the translated questionnaire

Correio eletrónico **(e-mail)**
Usa algum tipo de medicação (excluindo contracetivos orais, **pílula**)?
O seu ~~(volume)~~ **tempo de treino habitual** (média) – número total de horas por semana e que tipo de exercício, como corrida, natação, ciclismo, treino de força, treino de técnica, etc.:
Usa contracetivos orais **(pílula)**?
Se sim, quantos dias dura **habitualmente** a sua hemorragia menstrual?

According to the athletes, the entire group C, regarding menstrual function and use of contraceptive section, raised many doubts. For instance, in the question C1 “Se respondeu “sim”, quando teve a sua última menstruação?” (*If you answered “yes”, when did you have your last period?).*

Na pergunta aparece apenas os meses, na pergunta que fala sobre a última menstruação, e facilitaria se aparecesse as semanas também. Fiquei confusa ao responder a esta questão (…) (E20)

In the question only appears the months, in the question that talks about the last period, and it would be easier if the weeks also appeared. I was confused when I was answering this question (…) (E20)

Another example is the following question C2 “Se sim, os seus períodos são regulares? (A cada 28 a 34 dias)” *(If yes, are your periods regular? [Every 28th to 34th day]*).

> *Na questão de o ciclo ser regular ou não, vai induzir em erro pelo facto de tomar a pílula o período fica sempre regular, (pausa) é uma sugestão minha, penso que essa questão deveria estar mais explícita ou com esse ponto bem esclarecido* (E17)
>
> *In the question of menstrual cycle is regular or not, it is misleading to take the pill and the period is always regular, (pause) it is my suggestion, I think this question should be more explicit or with this point well clarified* (E17)

It raises doubts since the athlete takes the pill, and the period is regular because of it and not because her period is, effectively, regular. What becomes difficult to understand is whether this question remains if the athlete really takes the pill or, on the contrary, when she takes it, she should not answer. The suggestion was to appear the indication that if the pill is taken correctly, your period will be regular. However, no changes were made since it would change the structure in relation to the original questionnaire.

The interviewers reported being confused by the beginning of the sentences in group C of third section. Many of them suggested adding the word of the initial question to questions related to the previous one, so that it would be easier to understand. After discussing, the authors agreed that the understanding of the entire group C of the third section could be improved, however it was not possible to make the change, as it would change the structure of the questions, and it is not possible to make such profound changes.

As described below, the athletes stated that it is difficult to understand the questions from group C because the questions do not include the statement of the question to which it refers. Such as question C3: "Se sim, quantos dias habitualmente dura a sua hemorragia menstrual?" *(If yes, for how many days does your menstrual bleeding usually last?)*.

É o "se sim", engana porque parece da questão anterior e ainda é relativo a antes dessa (E16)

It's the "if yes", it's misleading because it seems like the previous question and is still relative to before that (E16)

(...) aparece ao início o "Se sim", isso é sempre bastante confuso. Acabo por pensar que se refere à pergunta anterior, quando na verdade se refere à inicial. Podiam estar feitas de maneira diferente (…) (E22)

(…) "If yes" appears at the beginning, this is always quite confusing. I end up thinking it refers to the previous question, when in fact it refers to the initial one. They could be done differently (…) (E22)

Regarding the question C5: "Se sim, quantas menstruações teve no último ano?" *(If yes, how many periods have you had in the last year?)*

Senti mais dificuldade em saber quantas menstruações tive durante um ano, pela dificuldade de contagem (E1)

I felt more difficult to know how many menstruations I had during a year, due to the difficulty of counting (E1)

Tinha colocado mal porque (pausa) depois pensei melhor e, no ano passado, houve um mês que não tive menstruação (no mês de julho), mas depois fui ao ginecologista e ele mandou-me tomar a pilula e desde aí nunca mais falhou (E2)

I had put it wrong because … (pause) then I thought better of it and, last year, there was a month when I didn't have my period (in the month of July), but then I went to the gynecologist, and he told me to take the pill and since then it has never failed (E2)

Mas achas que essa falha se deveu ao facto de não comeres o suficiente ou treinares demais? (Interviewer)

But do you think that failure was due to not eating enough or training too much? (Interviewer)

Não, acho que foi pela ansiedade e stress que tinha, por ser época de exames (…) pelo menos foi o que o ginecologista me disse (E2)

No, I think it was due to the anxiety and stress I had, because it was exam season (…) at least that is what the gynaecologist told me (E2)

Another example, is the following question C6 "Se respondeu "não" ou "não sei", quando teve a sua última menstruação?" (*If you answered "no" or "I don't know", when did you have your last period?*).

Na questão em que se refere ao "não" ou "não sei" é difícil de lembrar qual era a pergunta da questão C inicial. Na minha opinião, seria mais claro se o enunciado da pergunta de partida estivesse na questão (…) (E18)

In the question referring to "não" or "não sei", it is difficult to remember what the question was in the initial question C. In my opinion, it would be clearer if the wording of the starting question was in the question (…) (E18)

The answers above point to consider that the question is well structured, however its understanding is what raised doubts. The authors' adjusted the questionnaire to:

"Se respondeu "não" ou não sei" à pergunta C (Tem uma função menstrual normal?), quando teve a sua última menstruação?" (Authors)

If you answered "no" or I don't know" to question C (Do you have normal menstrual function?), when did you have your last period? (Authors)

The feedback from the interviewees was positive, which proved to be crucial for the process to be completed successfully.

Achei que a linguagem utilizada e a forma como as perguntas estão feitas é clara e simplificada (E1)

I found the language used and the way the questions are asked, clear and simplified (E1)

Achei que foi fácil de responder (E2)

I thought it was easy to answer (E2)

Não senti nenhuma dificuldade em entender nenhuma das questões, achei todas fáceis de entender (E5)

I did not feel any difficulty in understanding any of the questions, I thought they were all easy to understand (E5)

Achei que foi um questionário simples e rápido (…) consegui fazer tudo muito rápido (E8)

I thought it was a simple and quick questionnaire (…) I managed to do everything very quickly (E8)

Sim, consegui entender tudo bem e achei fácil de entender (E21)

Yes, I managed to understand everything well and found it easy to understand (E21)

The answers above pointed to the fact that the instrument has a clear language, and the nature of the questions was considered easy.

2.1. The Athletes' Perspective on the LEAF-Q

Individual interviews with the athletes brought diverse contributions. Most athletes considered the LEAF-Q European Portuguese translated version a questionnaire that is easy to fill out, with no difficult questions or complicated words to understand. They indicated that the instrument is clear, which allow us to trust the reliability of the results. On average, athletes took 7.3 (0.9) minutes to fill the questionnaire.

3. Phase II: Test-retest

3.1. Sample Characterization

The final sample of the second phase (i.e., test-retest) consist of 125 athletes (different from the athletes who participated in phase I) belonging to the following Portuguese national teams: football (36.8%), athletics (23.2%), volleyball (16.8%), basketball (16%) and, swimming (7.2%). The sample characterization is given in Table 4. The mean age was 23.2 (4.6) years. Also in this sample, none of the athletes reported smoking habits.

Table 4. Characteristics of the sample II

	Mean (SD)	**Min - Max**
Age (years)	23.2 (4.6)	18-41
Weight (kg)	61.8 (9.8)	40-100
Height (cm)	165.8 (7.1)	155.0-190.0
Education level	***n* (%)**	
High school	58 (46.4)	
University degree	67 (53.6)	
Medication	***n* (%)**	
Oral contraceptives	59 (47.2)	
Specific (asthma, antihistamines, antidepressant, multivitamin, iron supplements, levothyroxine, isotretinoin, bisoprolol)	12 (9.6)	
Training per week (hours/week)	**Mean (SD)**	
Including (3-5 workouts + 1-2 strength and technique training)	12 (5.0)	

SD: Standard deviation

3.2. Association Between Risk of Low Energy Availability and Characteristics

A total of 49 female athletes (39.2%) was identified as being at risk of LEA in the first application of the LEAF-Q. Whereas, in the second application of the questionnaire, the number of athletes at risk of LEA decreased to 44 (35.2%). Investigating the data by section, it was possible to verify that it was in the GI function section that the questionnaire results were higher in the first and second

application, 68 (54.4%) and 69 (55.2%), respectively. Table 5 shows the sum scores obtained in each section, the prevalence of female athletes at risk for each section, the total score for the whole questionnaire, and the prevalence of athletes at risk of LEA.

Table 5. Sum score and prevalence of athletes at risk for each section and total score of Low Energy Availability in Females Questionnaire (LEAF-Q) in the first and second application

		Mean (SD)	*n* (%)
Injury section	1st Application	2.1 (2.6)	60 (48.0)
	2nd Application	2.1 (2.6)	58 (46.4)
Gastrointestinal section	1st Application	2.2 (2.1)	68 (54.4)
	2nd Application	2.2 (2.1)	69 (55.2)
Menstrual function and use of contraceptive section	1st Application	2.6 (2.4)	42 (33.6)
	2nd Application	2.6 (2.3)	43 (34.4)
Total (*n*)	1st Application	6.9 (4.5)	49 (39.2)
	2nd Application	6.9 (4.4)	44 (35.2)

SD: Standard deviation.; n (%): Number and percentage of athletes identified as being at risk: injury risk score ≥ 2, Gastrointestinal risk score ≥ 2, Menstrual function and contraceptive use section risk score ≥ 4, Total score (i.e., risk of low energy availability) risk score ≥ 8 for female athletes. Range scores were 1.0 to 8.0 for the injury section, 0.0 to 9.0 for the gastrointestinal section, 0.0 to 11.0 for the contraceptive and menstrual function section, and 3.0 to 21.0 for the total score.

4. Reproducibility

The reproducibility of this screening tool was tested by comparing the application of the translated European Portuguese version of LEAF-Q at two different moments (separated by two to four weeks) to each participant. The table 6 shows de correlation between the two applications and the association between them, according to each questionnaire score section and the total score. For all the variables, the strength of the agreement was very strong ($r \geq 0.90$, $p < 0.001$).

Table 6. Correlation between the score sections and the total score of the questionnaire, in the first and second application

	r	*p*
Injury section	0.975	< 0.001
Gastrointestinal section	0.939	< 0.001
Menstrual function and use of contraceptive section	0.917	< 0.001
Total (*n*)	0.955	< 0.001

p: Level of significance. r: Pearson's correlation coefficient between the two applications.

The three sections of the questionnaire did not show statistically significant differences between the two applications. In addition, the correlation between the final scores of the two applications was very strong, which indicates that higher scores in the first application are related with higher scores in the second one.

Table 7 presents the average values of the scores obtained in the two questionnaire applications, comparing each of the three sections and the totals.

Table 7. Differences between the first and second application, in the three sections and in the total score of the questionnaire

	1st application (*n* = 125) MEAN (SD)	2nd application (*n* = 125) MEAN (SD)	t	*p*	*k*
Injury section	2.10 (2.6)	2.06 (2.6)	0.616	0.539	0.930
Gastrointestinal section	2.18 (2.1)	2.19 (2.1)	-0.122	0.903	0.768
Menstrual function and use of contraceptive section	2.63 (2.4)	2.65 (2.3)	-0.185	0.854	0.791
Total (*n*)	6.91 (4.5)	6.90 (4.4)	0.067	0.947	0.767

SD: Standard deviation; *p*: Level of significance of the difference between the two applications with the paired-sample t- test, *k*: Cohen´s Kappa coefficient

According to the values above, there were no statistically significant differences between the two LEAF-Q applications (all $p > 0.05$). Furthermore, it was found an excellent agreement in the final score (K_w = 0.896, 95% CI = 0.854-0.938),

suggesting acceptable reproducibility of the LEAF-Q European Portuguese version when repeated over a two to four weeks interval.

Through the ICC it was possible to test the reliability of the test-retest. The European Portuguese version of the LEAF-Q showed excellent reliability with an ICC of 0.969.

Discussion

The validation of the LEAF-Q European Portuguese version performed in this study provides strong support for the use of this questionnaire as a reliable and valid screening tool for assessing LEA in female athletes. The questionnaire demonstrated robust psychometric properties, including high internal consistency, test-retest reliability, and face validity. The questionnaire, in its European Portuguese version, does not present linguistic or cultural biases and, consequently, enables the identification of female athletes at risk of LEA.

1. Risk of Low Energy Availability

The results from the LEAF-Q European Portuguese version in this study indicate that 25% of the participants of phase I (*n* = 32) were identified as being at risk of LEA, similar to the 23% (*n* = 332) reported among Irish recreational active females[102]. Furthermore, a recent study carried out in recreational female runners (18-39 years) showed that 19% (*n* = 89) had symptoms of LEA[103]. Regarding phase II, the prevalence of athletes at risk of LEA were higher, either in the first application (39.2%, *n* = 49) and in the second application (35.2%, *n* = 44). Even though the results were different, they were not different enough to affect the ICC or other statistical tests. Nevertheless, these findings were lower than the ones reported in the majority of previous studies[102, 104-107]. It was found a prevalence of 45% (*n* = 38) and 63% (*n* = 109) in recreationally active females in New Zealand[12, 108]. Additionally, in a population of Chinese female aesthetic athletes, a total of 41.6% (*n* = 69) of participants were at increased risk of LEA[109]. Perhaps, our findings are lower due to the fact that the sample (sample I) was

small, since it appears that larger samples demonstrate higher LEA prevalence rates.

2. Consequences of Low Energy Availability

One of the most concerned consequences of LEA is the increased risk of injuries, compromising sports performance. In our study, we found that 40.6% (*n* = 13) of phase I athletes reported being absent from training or competition due to injury, in the last year.

The most reported injury was stress fractures, with 9 (28.1%) athletes reporting it. Additionally, all athletes that reported stress fractures were identified as being at risk of LEA. These results are compared to the findings from the study carried out in the 26th European Cross-Country Championships[7] in which 10 athletes reported stress fractures. LEA, by itself, is associated with low BMD[55, 56]. This decrease in bone health, along with bone stress caused by overtraining, can lead to bone fractures, hence their direct relationship[16, 110]. Thus, our findings are in line with the ones reported in the literature[110]. More recently, a study that explore the ability of LEAF-Q to detect these negative impairments, demonstrated that injury and menstrual function sections scores identified low BMD (100% sensitivity, 95% confidence interval [15.8%, 100%]) and MD (80.0% sensitivity, 95% confidence interval [28.4%, 99.5%]), respectively. This indicates a direct relationship between the highest score in these two sections and low BMD [111].

Altered GI function is one of the negative impairments described in the literature for the RED-S model[16, 21]. The alterations seem to occur since the energy restriction can reduce bowel movements and increase intestinal transit time[16, 21]. Taking this into account, our results corroborate these inferences, since our

findings showed that more than half of the participants reported bowel movements once a week or more rarely, indicating a longer-than-expected intestinal transit time. Similar results were found by Jesus *et al.*[7]. Additionally, when comparing female athletes with adequate EA with those with LEA, gastrointestinal impairments were found in those with LEA (OR = 1.50, 95% CI: 1.19-1.92; p = 0.001)[70].

On the other hand, MD is frequent among female athletes, particularly those engaged in leanness sports[112, 113]. It ranges a spectrum of disorders from eumenorrhea to oligomenorrhea/FHA and to luteal deficiency and anovulation[14]. In our study, 2 athletes (6.3%) reported experiencing primary amenorrhea (i.e., menarche at 15 years or more)[70, 114]. Moreover, nearly 16% of the participants (n = 5) reported experiencing secondary amenorrhea in the past (i.e., absence of menses for more than 90 days[14]).

Furthermore, some of the athletes reported having regular periods by taking OC, which means that they have monthly withdrawal bleeding and believe that this is having a regular period. However, it is important to highlight that they themselves mentioned that before they did not have regular periods and that they had a few months to menstruate.

Considering the studies presented, LEA has a great influence on MD. Thus, dietary and training interventions are vital, both in aesthetic sports athletes (e.g., rhythmic gymnastics) but also in cycling, winter sports or team sports disciplines (e.g.,[63, 75, 115, 116]).

3. Validation

In certain situations, it is possible adapt existing ones to other populations instead of developing new instruments[90]. However, the practical value of an instrument depends on reproducibility (the data collected can be reproduced) and validity (measures what is intended to be measured) of the information that is collected[93].

Despite lack of consensus, some aspects are identified as important in translating and adapting process of an instrument: 1) It is necessary that the translation process be carried out by more than one person, with a great knowledge of the source language as well as the target language, and who is familiar with both cultures[117]; 2) the role of the expert committee is essential in reviewing all translated versions, in making decisions to reach a consensus on the discrepancies found and in consolidating the process to give rise to the final version in the mother tongue of the new population, in this particular case, is intended for European Portuguese language[118]; and 3) the instrument developed must be tested on the target population, to ensure the scope, objectivity, simplicity, clarity, credibility, semantic and idiomatic breadth of the content based on the impressions of this population (this means cross-cultural adaptation)[119-121].

The first two aspects were previously done[87]. For this work, it was necessary to investigate the psychometric criteria of the questionnaire, namely, face validity and perform the test-rest method to analyse reliability.

During LEAF-Q European Portuguese version cross-cultural adaptation and face validity, some changes were made, namely, the introduction of other words and some expressions were replaced for a better understanding by the Portuguese population. Similar changes were observed in a study, where it was intended to

adapt the LEAF-Q for the New Zealand population[108]. Furthermore, the same was observed in a study carried out in Brazilian female athletes, in which it was possible to successfully complete the process of translation, cultural adaptation and validation of the instrument's content[121]. Likewise, Meng *et al.*[109] applied the LEAF-Q in Chinese athletes but did not mention performing translation and adaptation of the instrument for this population.

Moreover, face validity aims to support the ability of the instrument in measuring what it is designed to measure and can be evaluated from predefined assumptions, such as expected differences in scores among "known" groups[91, 96, 122]. Thus, the questionnaire should include all directions (personal and training information, injuries, GI function, menstrual function and contraceptive use) of the subject (LEA knowledge) to be measured to ensure face validity[37]. Known groups validity assesses whether the questionnaire designates dissimilar scores between groups[123].

The test-retest reliability of the LEAF-Q European Portuguese version, in an interval of two to four weeks, had an excellent ICC of 0.969. This goes in line with the results obtained by Maria and Juzwiak for cultural adaptation and LEAF-Q validation for the Brazilian population (0.92)[121]. Furthermore, the original version, created and validated by Melin *et al.*[36], obtained an adequate ICC of 0.79, which agrees with our results.

Reliability means that the questionnaire can be used in different times. Test-retest method is used to guarantee reliability[96, 124, 125]. In this study, there were no statistically significant differences between the two applications of the LEAF-Q European Portuguese version.

There are valid and reliable instruments measuring LEA and/or RED-S of athletes and coaches in different countries[126-128]. Some of these were developed for the athletes who were in different modalities, such as track and field athletes[126] and, ultra-endurance athletes[128]. To correctly classify female Portuguese athletes with LEA or at risk, it is essential to have a valid tool for the population in question, transversal to all sports modalities.

The original LEAF-Q had a sensitivity of 78% and a specificity of 90% obtained by analysis of criterion validity, which was not performed in this study, but which is suggested for future psychometric evaluations of the instrument.

The assessment of the risk of LEA in athletes is fundamental, however, currently there is not any validated method for the Portuguese population. Hence, the most used methods involve assessing the athlete's eating habits (through a food frequency questionnaire, food records or other) and assessing the EEE (through accelerometers or exercise records)[13, 38]. These methods present problems do to errors in the estimation of EI, even if, when its used various techniques or analysing multiple time points (accuracy and reliability, respectively). The measurement of EEE also contributes to a significant error (e.g., due to the devices or the methods), as well as, causing substantial observer and participant burden[13, 38, 83]. Nevertheless, the chance of using a validated questionnaire for this purpose will make detection more effective, quicker, and practical. The information that would arise from this validation diagnostic tool would help both, medical team professionals and athletes to be aware of the impairments due to LEA, through a simple and scientifically correct way.

4. Prevention and Education Programmers

The Centers for Disease Control and Prevention (CDC) Foundation declares "Public health is the science of protecting and improving the health of people and their communities (…) public health is concerned with protecting the health of entire populations. These populations can be as small as a local neighborhood, or as big as an entire country or region of the world." Taking these into account, the investigation of the reproducibility and validity of the LEAF-Q European Portuguese version and the chance to apply to all female athletes is extremely important and useful[129].

Knowledge of LEA and its implications for sports performance is low among coaches and athletes[37]. Therefore, it is of the utmost importance to raise the awareness of coaches, physical trainers and other professionals in order to prevent numerous injuries, some of them irreversible, and the preservation of the normal function of the reproductive system in female athletes [21, 37]. Thus, it is necessary to educate the medical team so that detection and treatment are effective.

This was first demonstrated in this paper by Logue *et al.*[130] that a clear communication and collaboration between athlete, coach, and the multidisciplinary team, as well as, proper and individualized nutrition focusing on performance is warranted based on athletes and coaches' perspectives[130]. The prevention of these syndrome refers to the development of educational programs including, but not limited to, motivate, enable, and support athletes to change behaviour it is well recognized[130, 131]. The main challenges highlighted was that athletes are especially prone to develop ED or DE due to a pressure to obtain and/or maintain a lean and small physique.

Nowadays, it is well recognized that LEA may lead to several negative consequences (e.g., GI, and menstrual impairments), including a significant decrease in sports performance. Thus, EDs are a serious public health problem that must be given attention[2].

It is necessary to identify athletes at risk of LEA and, for this, it is imperative to have a translated and validated diagnostic tool, making the detection easier, practical, quicker, and more effective[36]. Afterwards, in the future, it will be possible to develop educational programs and involve a multidisciplinary team, in order to prevent and minimize LEA, and its effects on the body physiological functioning. Therefore, the use of a validated screening tool will facilitate the process of early detection of athletes at risk, safeguarding the health status and contributing to the improvement of sports performance[37, 38].

5. Treatment Strategies

Coaches and medical teams also lack knowledge about the consequences of LEA and the role in daily life[12]. The inadequacy of athletes' nutrition knowledge may affect their performance negatively[13]. Thus, assessing nutrition intake properly is crucial, yet challenging. Therefore, designing measurement instruments are required to assess EA.

According to Mountjoy *et al.*[16, 21], the first thing to do is to optimize EA throughout a progressive increase in EI by 300-600 kcal/day[16].

It may require a reduction, or even a cessation of exercise, changes in food choices, and other dietary characteristics. When LEA is associated with MD, it is necessary to have an increase in EI to above 30 kcal/kg FFM/d or reduce energy expenditure until menses resume[9, 16]. In this particular case, weight gain is the

strongest predictor of recovery of normal menstrual function[21]. Regarding bone, the recent literature states an increase in EI above 45 kcal/kg FFM/day[21, 44]. As mentioned above, gaining weight is the main indicator of bone formation and resorption and improves BMD[44, 75].

The findings of this study have important implications for researchers, sports medicine professionals, and coaches. The LEAF-Q European Portuguese version can aid in early identification of athletes at risk of LEA, allowing for timely interventions to mitigate potential health consequences and optimize performance. Regular monitoring of EA using the LEAF-Q can facilitate individualized interventions tailored to athletes' specific needs, including adjustments to training loads, nutrition education, and psychological support. Nevertheless, the questionnaire contains sensitive and personal questions, such as GI function (including stool frequency and consistency) as well as reproductive function, which can be considered offensive if not asked properly. Therefore, its use must be carefully administered and evaluated by clinic and sport nutritionists[36].

6. Methodological Considerations: Strengths and Limitations

Future research should consider validating the European Portuguese version of LEAF-Q in sport-specific samples to enhance its applicability across different contexts, considering the differences in energy demands and training characteristics. Additionally, the generalizability of the findings to non-athlete populations or specific subgroups (e.g., elite athletes or different age groups) warrants further investigation.

On the other hand, the sample consisted of female athletes from various sports modalities, which introduces strength and variability to the results. This is positive, as it is possible to analyse the results of several female athletes and not just a specific sport. Hence, it was possible to distinguish the differences between the modalities, in terms of EI, energy expenditure, and contribution of physical image to performance.

7. Future Directions

According to the results, it is possible to verify a high prevalence of female athletes at risk of LEA. Therefore, it is important to have instruments developed especially for this purpose, validated for the target population.

Although there is still no validated questionnaire for this purpose for male athletes, the LEAF-Q and its translated version can be used through the adjusted score[20, 127]. This means that it can be transposed to males, while there is no validated version. Taking this into account, it is expected that future investigations in this area can effectively continue the work already done.

Conclusions

In sum, the LEAF-Q European Portuguese version showed contextual and cultural adequacy, proving to be reputable, in terms of reliability test-retest, and it also has validation evidence to identify the risk of Triad/RED-S in Portuguese female athletes.

The LEAF-Q European Portuguese version is brief, easy to administer, and appropriate as a complement to existing validated DE screening instruments, when screening female athletes at risk for the Triad/RED-S, in order to enable early detection and intervention. The validated instrument resulting from the present study, will allow to understand the accurate prevalence in future investigations in Portugal, along with enabling the development of educational programs specifically directed to the Portuguese athletes, as well as their parents and other members of the multidisciplinary team that accompany them, by clarifying, raising awareness and alert the athletes, in the most correct way.

In recent years, sports performance, and the need to achieve unrealistic physical beauty by athletes have contributed to the food intake inadequacy in relation to the EEE, but also to the development of ED or DE, often with irreversible consequences. Fortunately, nowadays, it is well recognized that athletes who are in this condition have serious health impairments.

Although the consequences are physical, mental health is also seriously damage, making the recovery process difficult. Then, these athletes should be accompanied by a multidisciplinary team, to treat and/or minimize LEA effects (e.g., injuries, GI, and menstrual impairments), as well as to educate them and prevent similar situations to others.

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Appendices

Appendices Index

Appendix A - Informed Consent

U.PORTO
FACULDADE DE CIÊNCIAS DA NUTRIÇÃO E ALIMENTAÇÃO
UNIVERSIDADE DO PORTO

TERMO DE CONSENTIMENTO INFORMADO

Conforme a lei 67/98 de 26 de Outubro e a "Declaração de Helsínquia" da Associação Médica Mundial (Helsínquia 1964; Tóquio 1975; Hong Kong 1989; Somerset West 1996, Edimburgo 2000; Washington 2002, Tóquio 2004, Seul 2008 e Brasil 2013)

Por favor, leia com atenção todo o conteúdo desta declaração. Não hesite em solicitar mais informações ao investigador se não estiver completamente esclarecido.

Declaro que compreendi a explicação que me foi fornecida acerca da investigação no âmbito do projeto "Validação da tradução do LEAF-Q numa amostra de atletas portugueses".
Foi-me ainda dada a oportunidade de fazer as perguntas que julguei necessárias e, de todas, obtive resposta satisfatória.
- Tomei conhecimento de que, de acordo com as recomendações da Declaração de Helsínquia, a informação ou explicação que me foi prestada versou os objetivos, os métodos, os benefícios previstos, os riscos potenciais e o eventual desconforto.
- Compreendi que os dados serão armazenados apenas pelos investigadores, não associados ao participante.
- Consinto no tratamento dos meus dados pessoais recolhidos (email e respostas ao questionário) para as finalidades do estudo de investigação.
- Compreendi que tenho o direito de recusar a minha participação no estudo a qualquer momento, sem nenhum tipo de prejuízo. Percebi que a não participação no estudo não terá quaisquer consequências.
Assim, consinto que me sejam aplicadas as intervenções propostas pelo investigador.

☐ Aceito participar no presente estudo.

O Investigador responsável:
Teresa Cláudia Mendes Ferreira

Appendix B - Participant Information - Step 1

U.PORTO
FACULDADE DE CIÊNCIAS DA NUTRIÇÃO E ALIMENTAÇÃO
UNIVERSIDADE DO PORTO

INFORMAÇÃO AO PARTICIPANTE

Validação da tradução do LEAF-Q numa amostra de atletas portugueses

Investigador responsável: Teresa Ferreira, mestranda em Nutrição Comunitária e Saúde Pública, da Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto

As atletas de diversas modalidades associadas a vários clubes desportivos, serão convidadas a participar no presente estudo.

O objetivo deste estudo é validar a tradução de um questionário, sobre a prevalência de atletas em risco de baixa disponibilidade energética da população portuguesa.

A prevalência de atletas em risco de baixa disponibilidade energética é elevada, sendo superior em determinadas modalidades, nomeadamente: desportos de salto ou de categorias de peso, ginástica, atletismo ou endurance. Abarca inúmeras consequências negativas, como disfunção fisiológica, gastrointestinal, óssea, menstrual, assim como, um aumento do risco de lesão, menor predisposição para o treino e diminuição do rendimento desportivo. Para além disso, estas acompanham o atleta na sua vida presente e futura, sendo fundamental a salvaguarda da saúde. Contudo, não existe nenhuma ferramenta validada para a população portuguesa, para tornar a deteção mais rápida, simples e eficaz.

O resultado deste estudo permitirá obter uma ferramenta válida e em português para diagnosticar atletas em risco de baixa disponibilidade energética, que será útil para a realização de investigações futuras na área das doenças do comportamento alimentar e da disponibilidade energética deficitária no âmbito da nutrição no desporto.

A participação no estudo é voluntária e não está prevista remuneração para a mesma. O participante tem o direito de, a qualquer momento, desistir do estudo, sem qualquer prejuízo.

Tratamento dos dados pessoais

Os dados recolhidos, serão codificados e analisados exclusivamente no âmbito deste projeto. Os dados serão armazenados em local restrito apenas pelos investigadores, ao qual apenas os investigadores terão acesso, e serão apenas utilizados para o presente projeto, sendo que os dados não serão associados ao participante. Deste modo, será garantida a confidencialidade e a privacidade do participante.

O e-mail, enquanto dado pessoal necessário para efeitos de participação, será conservado apenas no período de tempo em que será desenvolvido o estudo. Após este período o seu email será eliminado.

Protocolo do estudo

Após o preenchimento do consentimento informado, o participante será convidado a preencher um questionário sobre o risco de baixa disponibilidade energética que demorará cerca de 15 minutos, numa entrevista em formato online. Após o preenchimento do questionário online o participante será convidado a responder a algumas questões gerais sobre a compreensão e clareza das questões. O investigador principal estará disponível para retirar quaisquer dúvidas que possam existir no momento do seu preenchimento.

Appendix C - Participant Information - Step 2

U.PORTO
FACULDADE DE CIÊNCIAS DA NUTRIÇÃO E ALIMENTAÇÃO
UNIVERSIDADE DO PORTO

INFORMAÇÃO AO PARTICIPANTE

Validação da tradução do LEAF-Q numa amostra de atletas portugueses

Investigador responsável: Teresa Ferreira, mestranda em Nutrição Comunitária e Saúde Pública, da Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto

As atletas de diversas modalidades associadas a vários clubes desportivos, serão convidadas a participar no presente estudo.

O objetivo deste estudo é validar a tradução de um questionário, sobre a prevalência de atletas em risco de baixa disponibilidade energética da população portuguesa.

A prevalência de atletas em risco de baixa disponibilidade energética é elevada, sendo superior em determinadas modalidades, nomeadamente: desportos de salto ou de categorias de peso, ginástica, atletismo ou endurance. Abarca inúmeras consequências negativas, como disfunção fisiológica, gastrointestinal, óssea, menstrual, assim como, um aumento do risco de lesão, menor predisposição para o treino e diminuição do rendimento desportivo. Para além disso, estas acompanham o atleta na sua vida presente e futura, sendo fundamental a salvaguarda da saúde. Contudo, não existe nenhuma ferramenta validada para a população portuguesa, para tornar a deteção mais rápida, simples e eficaz.

O resultado deste estudo permitirá obter uma ferramenta válida e em português para diagnosticar atletas em risco de baixa disponibilidade energética, que será útil para a realização de investigações futuras na área das doenças do comportamento alimentar e da disponibilidade energética deficitária no âmbito da nutrição no desporto.

A participação no estudo é voluntária e não está prevista remuneração para a mesma. O participante tem o direito de, a qualquer momento, desistir do estudo, sem qualquer prejuízo.

Tratamento dos dados pessoais

Os dados recolhidos, serão codificados e analisados exclusivamente no âmbito deste projeto. Os dados serão armazenados em local restrito apenas pelos investigadores, ao qual apenas os investigadores terão acesso, e serão apenas utilizados para o presente projeto, sendo que os dados não serão associados ao participante. Deste modo, será garantida a confidencialidade e a privacidade do participante.

O e-mail, enquanto dado pessoal necessário para efeitos de participação, será conservado apenas no período de tempo em que será desenvolvido o estudo. Após este período o seu email será eliminado.

Protocolo do estudo

Após o preenchimento do consentimento informado, o participante será convidado a preencher um questionário sobre o risco de baixa disponibilidade energética que demorará cerca de 15 minutos. Após a sua conclusão, dentro de duas a quatro semanas, será novamente convidado preencher o questionário, de forma a garantir a confiabilidade do mesmo. Poderá ser necessário repetir o questionário quantas vezes forem necessárias.

Appendix D - Final version of the translated LEAF-Q validation

LEAF-Q

O questionário de Baixa Disponibilidade Energética no sexo feminino (LEAF-Q) foca-se nos sintomas fisiológicos de ingestão energética deficitária.O seu preenchimento tem a duração aproximada de 8 minutos.

Contacto telefónico: 918809828

E-mail: teresaclmferreira@gmail.com

As próximas páginas contêm questões sobre lesões, função gastrointestinal e reprodutiva.

TERMO DE CONSENTIMENTO INFORMADO

Conforme a lei 67/98 de 26 de Outubro e a "Declaração de Helsínquia" da Associação Médica Mundial (Helsínquia 1964; Tóquio 1975; Hong Kong 1989; Somerset West 1996, Edimburgo 2000; Washington 2002, Tóquio 2004, Seul 2008 e Brasil 2013)

Por favor, leia com atenção todo o conteúdo desta declaração. Não hesite em solicitar mais informações ao investigador se não estiver completamente esclarecido.

Declaro que compreendi a explicação que me foi fornecida acerca da investigação no âmbito do projeto "Validação da tradução do LEAF-Q numa amostra de atletas portugueses".

Foi-me ainda dada a oportunidade de fazer as perguntas que julguei necessárias e, de todas, obtive resposta satisfatória.

- Tomei conhecimento de que, de acordo com as recomendações da Declaração de Helsínquia, a informação ou explicação que me foi prestada versou os objetivos, os métodos, os benefícios previstos, os riscos potenciais e o eventual desconforto.

- Compreendi que os dados serão armazenados apenas pelos investigadores, não associados ao participante.

- Consinto no tratamento dos meus dados pessoais recolhidos (email e respostas ao questionário) para as finalidades do estudo de investigação.

- Compreendi que tenho o direito de recusar a minha participação no estudo a qualquer momento, sem nenhum tipo de prejuízo. Percebi que a não participação no estudo não terá quaisquer consequências.

Assim, consinto que me sejam aplicadas as intervenções propostas pelo investigador.

O investigador responsável:

Teresa Cláudia Mendes Ferreira

Existem 45 perguntas neste questionário.

CONSENTIMENTO INFORMADO

TERMO DE CONSENTIMENTO INFORMADO

Conforme a lei 67/98 de 26 de Outubro e a "Declaração de Helsínquia" da Associação Médica Mundial (Helsínquia 1964; Tóquio 1975; Hong Kong 1989; Somerset West 1996, Edimburgo 2000; Washington 2002, Tóquio 2004, Seul 2008 e Brasil 2013)

Por favor, leia com atenção todo o conteúdo desta declaração. Não hesite em solicitar mais informações ao investigador se não estiver completamente esclarecido.

Declaro que compreendi a explicação que me foi fornecida acerca da investigação no âmbito do projeto "Validação da tradução do LEAF-Q numa amostra de atletas portugueses".

Foi-me ainda dada a oportunidade de fazer as perguntas que julguei necessárias e, de todas, obtive resposta satisfatória.

- Tomei conhecimento de que, de acordo com as recomendações da Declaração de Helsínquia, a informação ou explicação que me foi prestada versou os objetivos, os métodos, os benefícios previstos, os riscos potenciais e o eventual desconforto.

- Compreendi que os dados serão armazenados apenas pelos investigadores, não associados ao participante.

- Consinto no tratamento dos meus dados pessoais recolhidos (email e respostas ao questionário) para as finalidades do estudo de investigação.

- Compreendi que tenho o direito de recusar a minha participação no estudo a qualquer momento, sem nenhum tipo de prejuízo. Percebi que a não participação no estudo não terá quaisquer consequências.

Assim, consinto que me sejam aplicadas as intervenções propostas pelo investigador.

O investigador responsável:

Teresa Cláudia Mendes Ferreira

1 Desclaro que aceito participar no estudo *

Por favor, selecione **apenas uma** das seguintes opções:

◯ Sim
◯ Não

6 Profissão: *

Por favor, escreva aqui a sua resposta:

7 Escolaridade: *

Por favor, escreva aqui a sua resposta:

8 Idade: (anos) *

Neste campo só é possível introduzir números.
Por favor, escreva aqui a sua resposta:

9 Estatura: (cm) *

Neste campo só é possível introduzir números.
Por favor, escreva aqui a sua resposta:

10 Peso: (kg) *

Neste campo só é possível introduzir números.
Por favor, escreva aqui a sua resposta:

11 O peso máximo que já teve com a sua altura atual: (kg) *

Neste campo só é possível introduzir números.
Por favor, escreva aqui a sua resposta:

(excluindo gravidez)

12 O peso mínimo que já teve com a sua altura atual: (kg) *

Neste campo só é possível introduzir números.
Por favor, escreva aqui a sua resposta:

13 Fuma? *

Por favor, selecione **apenas uma** das seguintes opções:

- ◯ Sim
- ◯ Não

14 Usa algum tipo de medicação (excluíndo contracetivos orais, pílula)? *

Por favor, selecione **apenas uma** das seguintes opções:

- ◯ Sim
- ◯ Não

15 Se sim, que tipo de medicação? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '14 [MEDICACAO]' (Usa algum tipo de medicação (excluíndo contracetivos orais, pílula)?)

Por favor, escreva aqui a sua resposta:

16

O seu tempo de treino habitual (média) - número total de horas por semana e que tipo de exercício, como corrida, natação, ciclismo, treino de força, treino de técnica, etc.:

*

Por favor, escreva aqui a sua resposta:

17

Comentários ou informação adicional sobre o exercício:

Por favor, escreva aqui a sua resposta:

1. Lesões - Assinale a resposta que melhor descreve a sua situação

18

A: Faltou a treinos ou falhou a participação em competições devido a lesões, durante o último ano?

*

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Não, nunca
- [ ] Sim, uma ou duas vezes
- [ ] Sim, três ou quatro vezes
- [ ] Sim, cinco ou mais vezes

19

A1: Se sim, quantos dias faltou ao treino ou falhou a participação em competições devido a lesões, no último ano?

*

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim, três ou quatro vezes' *ou* 'Sim, uma ou duas vezes' *ou* 'Sim, cinco ou mais vezes' na pergunta '18 [AFALTA]' (A: Faltou a treinos ou falhou a participação em competições devido a lesões, durante o último ano?)

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] 1 a 7 dias
- [ ] 8 a 14 dias
- [ ] 15 a 21 dias
- [ ] 22 dias ou mais

20 A2: Se sim, que tipo de lesões teve no último ano? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim, cinco ou mais vezes' *ou* 'Sim, três ou quatro vezes' *ou* 'Sim, uma ou duas vezes' na pergunta '18 [AFALTA]' (A: Faltou a treinos ou falhou a participação em competições devido a lesões, durante o último ano?)

Por favor, escreva aqui a sua resposta:

21

Comentários ou informação adicional sobre lesões:

Por favor, escreva aqui a sua resposta:

2. Função Gastrointestinal

22 A: Sente-se inchada ou acumulação de gases no abdómen, mesmo quando não está menstruada? *

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Sim, várias vezes por dia
- [ ] Sim, várias vezes por semana
- [ ] Sim, uma ou duas vezes por semana ou mais raramente
- [ ] Quase nunca ou nunca

23 B: Tem cólicas ou dores de estômago não relacionadas com a menstruação? *

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Sim, várias vezes por dia
- [ ] Sim, várias vezes por semana
- [ ] Sim, uma ou duas vezes por semana ou mais raramente
- [ ] Quase nunca ou nunca

24 C: Em média, com que frequência evacua? *

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Várias vezes por dia
- [ ] Uma vez por dia
- [ ] De dois em dois dias
- [ ] Duas vezes por semana
- [ ] Uma vez por semana ou mais raramente

25 D: Como descreveria as suas fezes habituais? *

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Normais (moles)
- [ ] Líquidas (diarreicas)
- [ ] Duras e secas

26

Comentários sobre função gastrointestinal:

Por favor, escreva aqui a sua resposta:

3.1 Contracetivos

27

A: Usa contracetivos orais (pílula)?

*

Por favor, selecione **apenas uma** das seguintes opções:

- ◯ Sim
- ◯ Não

28 A1: Se sim, porque usa contracetivos orais? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '27 [ACONTRACETIVOS]' (A: Usa contracetivos orais (pílula)?)

ⓘ Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- ☐ Contraceção
- ☐ Redução do fluxo menstrual
- ☐ Para regular o ciclo menstrual em relação aos treinos/competições, etc.
- ☐ Senão a menstruação pára
- ☐ Outro:

29

A2: Se não, já usou contracetivos orais anteriormente?

*

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Não' na pergunta '27 [ACONTRACETIVOS]' (A: Usa contracetivos orais (pílula)?)

Por favor, selecione **apenas uma** das seguintes opções:

◯ Sim
◯ Não

30

A2:1 Se sim, quando e durante quanto tempo?

*

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '29 [A2PORQUENAO]' (A2: Se não, já usou contracetivos orais anteriormente?)

Por favor, escreva aqui a sua resposta:

31 B: Usa algum tipo de contraceptivo hormonal? (ex.: implante ou dispositivo intrauterino) *

Por favor, selecione **apenas uma** das seguintes opções:

◯ Sim
◯ Não

32 B1: Se sim, de que tipo? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '31 [BUSO]' (B: Usa algum tipo de contraceptivo hormonal? (ex.: implante ou dispositivo intrauterino))

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Adesivo hormonal
- [ ] Anel vaginal
- [ ] Dispositivo intrauterino hormonal – DIU hormonal
- [ ] Implante hormonal
- [ ] Outro:

3.2 Função menstrual

33 A: Com que idade teve a sua primeira menstruação? *

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] 11 anos ou menos
- [ ] 12 a 14 anos
- [ ] 15 anos ou mais
- [ ] Não me lembro
- [ ] Nunca menstruei (Se escolheu esta opção, não tem que responder a mais questões))

34 B: A sua primeira menstruação veio de forma natural (por si mesma)?

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Sim
- [ ] Não
- [ ] Não me lembro

35 B1: Se não, que tipo de tratamento foi usado para iniciar o seu ciclo menstrual? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Não' na pergunta '34 [BMENARCA]' (B: A sua primeira menstruação veio de forma natural (por si mesma)?)

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Terapia hormonal
- [ ] Aumento de peso
- [ ] Redução do volume de exercício
- [ ] Outro: _____

36 C: Tem uma função menstrual normal? *

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Sim
- [ ] Não
- [ ] Não sei

37 C1: Se respondeu "sim", quando teve a sua última menstruação? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '36 [CFUNCAONORMAL]' (C: Tem uma função menstrual normal?)

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Há 4 semanas ou menos
- [ ] Há 1 ou 2 meses
- [ ] Há 3 ou 4 meses
- [ ] Há 5 ou mais meses

38 C2: Se sim, os seus períodos são regulares? (A cada 28 a 34 dias) *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '36 [CFUNCAONORMAL]' (C: Tem uma função menstrual normal?)

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Sim, a maioria das vezes
- [ ] Não, maioritariamente não

39 C3: Se sim, quantos dias habitualmente dura a sua hemorragia menstrual? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '36 [CFUNCAONORMAL]' (C: Tem uma função menstrual normal?)

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] 1 ou 2 dias
- [ ] 3 ou 4 dias
- [ ] 5 ou 6 dias
- [ ] 7 ou 8 dias
- [ ] 9 dias ou mais

40 C4: Se sim, já alguma vez teve problemas com hemorragia menstrual severa? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '36 [CFUNCAONORMAL]' (C: Tem uma função menstrual normal?)

Por favor, selecione **apenas uma** das seguintes opções:

- ◯ Sim
- ◯ Não

41 C5: Se sim, quantas menstruações teve no último ano? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '36 [CFUNCAONORMAL]' (C: Tem uma função menstrual normal?)

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] 12 ou mais
- [ ] 9 a 11
- [ ] 6 a 8
- [ ] 3 a 5
- [ ] 0 a 2

42 C6: Se respondeu "não" ou "não sei", quando teve a sua última menstruação? *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Não' *ou* 'Não sei' na pergunta '36 [CFUNCAONORMAL]' (C: Tem uma função menstrual normal?)

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Há 2 ou 3 meses
- [ ] Há 4 ou 5 meses
- [ ] Há 6 ou mais
- [ ] Estou grávida e, por isso, não tenho menstruação

43 D: Alguma vez a sua menstruação parou por 3 meses consecutivos ou mais (além de períodos de gravidez)? *

Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- [ ] Não, nunca aconteceu
- [ ] Sim, já aconteceu
- [ ] Sim, é essa a minha situação atual

44 E: Sente que a sua menstruação se altera quando aumenta a intensidade, frequência ou duração do exercício? *

Por favor, selecione **apenas uma** das seguintes opções:

- ◯ Sim
- ◯ Não

45 E1: Se sim, como? (Assinale uma ou mais opções) *

Responda a esta pergunta apenas se as seguintes condições são verdadeiras:
A resposta for 'Sim' na pergunta '44 [EALTERACAO]' (E: Sente que a sua menstruação se altera quando aumenta a intensidade, frequência ou duração do exercício?)

❗ Selecione todas as que se apliquem
Por favor, selecione **todas** as que se aplicam:

- ☐ A menstruação é menos abundante
- ☐ O período de menstruação é mais curto
- ☐ A minha menstruação pára
- ☐ A menstruação é mais abundante
- ☐ O período de menstruação é mais longo

Agradecemos a sua disponibilidade para preencher o LEAF-Q. As suas respostas serão tratadas confidencialmente.

Submeter o seu inquérito
Obrigado por ter concluído este inquérito.

Annex

Annex Index

Annex A – Translated version of the LEAF-Q, after the translation and back-translation process

O questionário de baixa disponibilidade energética no sexo feminino (LEAF –Q) foca-se nos sintomas fisiológicos de ingestão energética deficitária.

As próximas páginas contêm questões sobre lesões e função gastrointestinal e reprodutiva.

Agradecemos sua disponibilidade para preencher o LEAF-Q. As suas respostas serão tratadas confidencialmente.

Profissão:

Escolaridade:

Idade: (anos)

Estatura: (cm)

Peso: (kg)

O peso máximo que já teve com a sua altura atual: (kg) (excluindo gravidez)

O peso mínimo que já teve com a sua altura atual: (kg)

Fuma? Sim/Não

Usa algum tipo de medicação (excluindo contracetivos orais)? Sim/Não

Se sim, que tipo de medicação?

O seu volume habitual de treino (média) - número de horas por semana e que tipo de exercício, como corrida, natação, ciclismo, treino de força, treino de técnica, etc.:

Comentários ou informação adicional sobre o exercício:

1. Lesões - Assinale a resposta que melhor descreve a sua situação

A: Faltou a treinos ou falhou a participação em competições devido a lesões, durante o último ano?

Não, nunca

Sim, uma ou duas vezes

Sim, três ou quatro vezes

Sim, cinco ou mais vezes

A1: Se sim, quantos dias faltou ao treino ou falhou a participação em competições devido a lesões, no último ano?

1 a 7 dias

8 a 14 dias

15 a 21 dias

22 dias ou mais

A2: Se sim, que tipo de lesões teve no último ano?

Comentários ou informação adicional sobre lesões:

2. Função gastrointestinal

A: Sente-se inchada ou acumulação de gases no abdómen, mesmo quando não está menstruada?

Sim, várias vezes por dia

Sim, várias vezes por semana

Sim, uma ou duas vezes por semana ou mais raramente

Quase nunca ou nunca

B: Tem cólicas ou dores de estômago não relacionadas com a menstruação?

Sim, várias vezes por dia

Sim, várias vezes por semana

Sim, uma ou duas vezes por semana ou mais raramente

Quase nunca ou nunca

C: Em média, com que frequência evacua?

Várias vezes por dia

Uma vez por dia

De dois em dois dias

Duas vezes por semana

Uma vez por semana ou mais raramente

D: Como descreveria as suas fezes habituais?

Normais (moles)

Líquidas (diarreicas)

Duras e secas

Comentários sobre função gastrointestinal:

3. Função menstrual e uso de contracetivos

3.1 Contracetivos

A: Usa contracetivos orais?

Sim/Não

A1: Se sim, porque usa contracetivos orais?

Contraceção

Redução do fluxo menstrual

Para regular o ciclo menstrual em relação aos treinos/competições, etc.

Senão a menstruação pára

Outro

A2: Se não, já usou contracetivos orais anteriormente?

Sim/Não

A2:1 Se sim, quando e durante quanto tempo?

B: Usa algum outro tipo de contracetivo hormonal? (ex.: implante ou dispositivo intrauterino)

Sim/Não

B1: Se sim, de que tipo?

Adesivo hormonal

Anel vaginal

Dispositivo intrauterino hormonal – DIU hormonal

Implante hormonal

Outro

3.2 Função menstrual

A: Com que idade teve a sua primeira menstruação?

11 anos ou menos

12 a 14 anos

15 anos ou mais

Não me lembro

Nunca menstruei (Se escolheu esta opção, não tem que responder a mais questões)

B: A sua primeira menstruação veio de forma natural (por si mesma)?

Sim

Não

Não me lembro

B1: Se não, que tipo de tratamento foi usado para iniciar o seu ciclo menstrual?

Terapia hormonal

Aumento de peso

Redução do volume de exercício

Outro

C: Tem uma função menstrual normal?

Sim

Não (ir para a questão C6)

Não sei (ir para a questão C6)

C1: Se respondeu "sim", quando teve a sua última menstruação?

Há 4 semanas ou menos

Há 1 ou 2 meses

Há 3 ou 4 meses

Há 5 meses ou mais

C2: Se sim, os seus períodos são regulares? (A cada 28 a 34 dias)

Sim, a maioria das vezes

Não, maioritariamente não

C3: Se sim, quantos dias dura a sua hemorragia menstrual?

1 ou 2 dias

3 ou 4 dias

5 ou 6 dias

7 ou 8 dias

9 dias ou mais

C4: Se sim, já alguma vez teve problemas com hemorragia menstrual severa?

Sim/Não

C5: Se sim, quantas menstruações teve no último ano?

12 ou mais

9 a 11

6 a 8

3 a 5

0 a 2

C6: Se respondeu "não" ou "não sei", quando teve a sua última menstruação?

Há 2 ou 3 meses

Há 4 ou 5 meses

Há 6 meses ou mais

Estou grávida e, por isso, não tenho menstruação

D: Alguma vez a sua menstruação parou por 3 meses consecutivos ou mais (além de períodos de gravidez)?

Não, nunca

Sim, já aconteceu

Sim, é essa a minha situação atual

E: Sente que a sua menstruação se altera quando aumenta a intensidade, frequência ou duração do exercício?

Sim/Não

E1: Se sim, como? (Assinale uma ou mais opções)

A menstruação é menos abundante

O período de menstruação é mais curto

A minha menstruação pára

A menstruação é mais abundante

O período de menstruação é mais longo

Annex B – Original version of the LEAF-Q

The low energy availability in females questionnaire (LEAF –Q), focuses on physiological symptoms of insufficient energy intake. The following pages contain questions regarding injuries, gastrointestinal and reproductive function. We appreciate you taking the time to fill out the LEAF-Q and the reply will be treated as confidential.

Name: _____

Address: _____

_____

E-mail: _____

Cell: _____

Profession: _____

Education: _____

Age: _____(years)

Height: _____(cm) Weight: _____(kg)

Your highest weight with your present height: _____(kg)
(excluding pregnancy)

Your lowest weight with your present height: _____(kg)

Do you smoke? Yes ☐ No ☐

Do you use any medication (excluding oral contraceptives)? Yes ☐ No ☐

If yes, what kind of medication?_____

Your normal amount of training (average) – number of hours per week and what kind of exercise, such as running, swimming, bicycling, strength training, technique training etc.:

_____

_____

_____

Comments or further information regarding exercise:_____

_____

_____

1. Injuries **Mark the response that most accurately describes your situation**

A: Have you had absences from your training, or participation in competitions during the last year due to injuries?

☐ No, not at all ☐ Yes, once or twice ☐ Yes, three or four times ☐ Yes, five times or more

A1: If yes, for how many days absence from training or participation in competition due to injuries have you had in the last year?

☐ 1-7 days ☐ 8-14 days ☐ 15-21 days ☐ 22 days or more

A2: If yes, what kind of injuries have you had in the last year? _____

_____

Comments or further information regarding injuries:_____

_____

_____

2. Gastro intestinal function

A: Do you feel gaseous or bloated in the abdomen, also when you do not have your period?

☐ Yes, several times a day ☐ Yes, several times a week

☐ Yes, once or twice a week or more seldom ☐ Rarely or never

B: Do you get cramps or stomach ache which cannot be related to your menstruation?

☐ Yes, several times a day ☐ Yes, several times a week

☐ Yes, once or twice a week or more seldom ☐ Rarely or never

C: How often do you have bowel movements on average?

☐ Several times a day ☐ Once a day ☐ Every second day

☐ Twice a week ☐ Once a week or more rarely

D: How would you describe your normal stool?

☐ Normal (soft) ☐ Diarrhoea-like (watery) ☐ Hard and dry

Comments regarding gastrointestinal function: _____

3. Menstrual function and use of contraceptives

3.1 Contraceptives **Mark the response that most accurately describes your situation**

A: Do you use oral contraceptives?

☐ Yes ☐ No

A1: If yes, why do you use oral contraceptives?

☐ Contraception ☐ Reduction of menstruation pains ☐ Reduction of bleeding

☐ To regulate the menstrual cycle in relation to performances etc..

☐ Otherwise menstruation stops

☐ Other_____

_____

A2: If no, have you used oral contraceptives earlier?

☐ Yes ☐ No

A2:1 If yes, when and for how long?_____

_____

_____

B: Do you use any other kind of hormonal contraceptives? (e.g. hormonal implant or coil)

☐ Yes ☐ No

B1: If yes, what kind?

☐ Hormonal patches ☐ Hormonal ring ☐ Hormonal coil ☐ Hormonal implant ☐ Other

_____

3.2 Menstrual function

Mark the response that most accurately describes your situation

A: How old were when you had your first period?

☐ 11 years or younger ☐ 12-14 years ☐ 15 years or older ☐ I don't remember

☐ I have never menstruated (If you have answered "I have never menstruated" there are no further questions to answer)

B: Did your first menstruation come naturally (by itself)?

☐ Yes ☐ No ☐ I don't remember

B1: If no, what kind of treatment was used to start your menstrual cycle?

☐ Hormonal treatment ☐ Weight gain

☐ Reduced amount of exercise ☐ Other

C: Do you have normal menstruation?

☐ Yes ☐ No **(go to question C6)** ☐ I don't know **(go to question C6)**

C1: If yes, when was your last period?

☐ 0-4 weeks ago ☐ 1-2 months ago ☐ 3-4 months ago ☐ 5 months ago or more

C2: If yes, are your periods regular? (Every 28th to 34th day)

☐ Yes, most of the time ☐ No, mostly not

C3: If yes, for how many days do you normally bleed?

☐ 1-2 days ☐ 3-4 days ☐ 5-6 days ☐ 7-8 days ☐ 9 days or more

C4: If yes, have you ever had problems with heavy menstrual bleeding?

☐ Yes ☐ No

C5: If yes, how many periods have you had during the last year?

☐ 12 or more ☐ 9-11 ☐ 6-8 ☐ 3-5 ☐ 0-2

3.2 Menstrual function **Mark the response that most accurately describes your situation**

C6: If no or "I don't remember", when did you have your last period?

☐ 2-3 months ago ☐ 4-5 months ago ☐ 6 months ago or more

☐ I'm pregnant and therefore do not menstruate

D: Have your periods ever stopped for 3 consecutive months or longer (besides pregnancy)?

☐ No, never ☐ Yes, it has happened before ☐ Yes, that's the situation now

---

E: Do you experience that your menstruation changes when you increase your exercise intensity, frequency or duration?

☐ Yes ☐ No

E1: If yes, how? (Check one or more options)

☐ I bleed less ☐ I bleed fewer days ☐ My menstruations stops

☐ I bleed more ☐ I bleed more days

Validation of the LEAF-Q translation in a sample of Portuguese athletes

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