U.PORTO

Nutrition Strategies for Competitive Surfing: a review

Estratégias Nutricionais para Surf Competitivo: uma revisão

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REVISÃO TEMÁTICA
1.º CICLO EM CIÊNCIAS DA NUTRIÇÃO | UNIDADE CURRICULAR ESTÁGIO
FACULDADE DE CIÊNCIAS DA NUTRIÇÃO E ALIMENTAÇÃO DA UNIVERSIDADE DO PORTO

TC

Porto, 2021

Abstract

Surfing has been growing all over the world in the last decades and 2021 will be the first year as an Olympic sport, in Tokyo. Despite the interest, there are not many studies about surfing and the unique characteristics associated with it. Particularly when focusing on sports nutrition and Surfing, there is a lack of information regarding nutritional status and nutritional guidance for surfers.

The present study aims to explore evidence based nutritional recommendations and strategies for athletes, considering the physiology of surfing. Online databases, PubMed and Scopus, were used for the bibliographic research, from April to June 2021.

Surfing is an intermittent sport with high-intensity bursts that requires the use of multiple body parts, soliciting both aerobic and anaerobic energy systems and different skills. Elite athletes train in high volumes, up to 7 hours a day. Regarding the percentage of body fat mass, generally estimated values in surfers are higher than reported in other level matched endurance athletes. Some studies seem to indicate that high levels of adiposity can negatively influence surfing ability.

Appropriate nutritional guidance may have an impact on the athlete´s health and his/her improvement in surfing. The surfer's energy requirements, protein and carbohydrate intake should be thoughtfully considered, as well as supplements. Appropriate studies to assess surfer´s dietary patterns and preferences should be developed.

Key words: Surf; Physiology; Anthropometry; Sports Nutrition

Resumo

O surf tem crescido por todo o mundo ao longo das últimas décadas, em 2021 vamos poder vê-lo pela primeira vez como desporto olímpico, nas Olimpíadas de Tóquio 2020. Apesar do interesse, não existem muitos estudos sobre o surf e as suas características únicas. Especialmente no que concerne às ciências da nutrição há uma carência de informação relacionada com o estado e orientação nutricional para surfistas.

O presente estudo tem como objetivo explorar recomendações nutricionais para atletas baseadas em evidência, considerando a fisiologia associada a este desporto. Bases de dados como PubMed e Scopus foram utilizadas para a pesquisa bibliográfica de abril a junho de 2021.

O surf é um desporto intermitente com momentos de alta intensidade, que requer a utilização de várias partes do corpo, solicitando vias energéticas aeróbicas e anaeróbicas, bem como diferentes aptidões. Atletas de elite treinam até 7 horas por dia.

A percentagem de gordura corporal reportada para surfistas é superior à de atletas de modalidades equivalentes. É descrita em alguns estudos a possibilidade de altas taxas de gordura corporal influenciarem negativamente a capacidade para surfar. Uma orientação nutricional adequada pode ter um impacto benéfico na saúde do atleta e no seu progresso no desporto. As necessidades energéticas do/a surfista, a ingestão adequada de proteína e hidratos de carbono devem ser bem ponderadas, assim como a utilização de suplementos. Estudos metodologicamente apropriados para avaliar as preferências e padrões alimentares dos/as surfistas carecem de desenvolvimento.

Palavras-chave: Surf; Fisiologia; Antropometria; Nutrição Desportiva

Abbreviations List

BFM%- Percentage of Body Fat Mass

CHO- Carbohydrate

EI- Energy Intake

g/Kg/d- g/Kg body weight/day

HR- Heart Rate

ISA- International Surfing Association

LEA- Low energy availability

WSL- World Surf League

SD- Standard Deviation

TDEE- Total Daily Energetic Expenditure

TT- Total Time

WCT- World Championship Tour

Summary

Introduction

Surfing roots appear to remain in premodern Hawaii and Polynesia.[1] Recently, some archaeological records indicating that ancient pre-Incan cultures have used wave riding crafts as early as 200 CE, were discovered.[2] Some say it was considered the sport of Hawaiian kings, only them could appreciate surfing the waves[3], while others believe it was practiced by people from all social strata, both men and women. It was in the 20th century that surfing had a big development in Hawaii and spread to California and Australia. The people behind its diffusion were the writer Jack London and the Hawaiian surfers George Freeth and, mainly, Duke Kahanamoku.[1] Kahanamoku, considered the father of modern surfing, was a gold medal winner in the 100m free-style on the Olympic games of Stockholm in 1912. While accepting his medal he suggested surfing as a future Olympic Sport.[2, 4]

Surfing has been growing all over the world in the last decades. Surfing entities include World Surf League (WSL) and International Surfing Association (ISA). In 2016, the International Olympic Committee voted to include surfing as one of the five new sports for Tokyo 2020. In 2021 we will be able to see the first appearance of this sport on the Olympics.[2]

With the popularity of surfing increasing, researchers in sport-science are looking for new methods to improve performance and decrease the risk of injuries in surf athletes.[5] Despite the interest, the majority of the studies focus on physiological component of surfing and have limitations such as the number of participants enrolled in the study and studies conducted out-of-water, which are far from recreating the same conditions surf athletes have on the ocean.[6]

Particularly when searching for published articles focusing on sports nutrition and surfing, there is a lack of information regarding nutritional status and nutritional guidance for surfers.

Aim

The aim of this review is to explore evidence based nutritional recommendations and strategies for athletes, considering the physiology of surfing and its singularities. Regarding that, athletes, coaches, and nutritionists working on the field can make better choices.

Methodology

For searching bibliography information, online databases were used, such as PubMed and Scopus, from April 2021 to June 2021. Firstly, the physiology of surfing was explored and then bibliography about nutrition and surfing, as well as sports nutrition. The following keywords and their combinations were used “surf”, “surfing”, “surf athletes”, “physiology”, “nutrition”, “sports nutrition”, “anthropometry”, “energy availability”, “protein”, “carbohydrates”, “diet”, “weight loss” and “supplements”. To assess the relevance of the studies, at first titles and abstracts were considered and, if related to the theme, complete articles were read through. References in selected articles were also taken into account. For managing references EndNote 20 was used.

1) **Surfing Analyses**

Surfing is an intermittent sport that requires the use of multiple body parts and different skills. It´s characterised by using various endurance paddling bouts and explosive paddling bursts to catch the wave, involving several recovery periods.[4, 7-9] There are not too many complicated rules in professional surfing, but for a comprehensive review of the sport they must be addressed. Surfing contests are based on elimination heats (20 to 40 minutes in general), in which 2,3 or 4 surfers catch the waves and are given scores by a panel of judges.[4] The panel scores each wave on a scale of 1 to 10 based on, commitment and degree of difficulty, innovative and progressive manoeuvres, combination of major manoeuvres, variety of manoeuvres and speed, power and flow.[10] For that, athletes must have well developed physical fitness, technical and tactical ability, as well other factors including cognitive and mental skills and balance. [4, 9, 11] Surf is extremely dependent on environmental conditions, variables like different wave size and frequency, swell, wind, type of breaker, currents, which require constant adaptation and can have an influence on the athletes performance.[4, 6, 12] With the purpose to improve and practice their surf, elite athletes train intensively, up to 7 hours a day, and even before the competitive heats so that they get accustomed to the conditions.[12, 13]

1.1) Activities, distances, and speed during surf sessions

In 1991, Meir et al. characterised the surfing activities as paddling, stationary, wave riding and miscellaneous, in one of the first studies to provide some information about surfing energy requirements, on a group of recreational surfers.[14] Analysing the total time (TT) doing these activities, the greatest amount was spent in paddling (44% of TT), 35% of TT was remaining stationary, the least amount of time was used in wave riding (5% TT). Later, Farley et al. conducted a descriptive study using video analyses and GPS during a competitive surfing event.[8] Regarding the data provided, there was a distinction between "paddling" and "paddling for wave" to acknowledge if there were differences in these particular moments. The greatest amount of time was spent in paddling ($54 \pm 6.3\%$), remaining stationary represented $28 \pm 6.9\%$ of TT, paddling for wave and wave riding only represented $4 \pm 1.5\%$ and $8 \pm 2\%$, respectively. Considering the studies evaluating durations and percentages of time spent in each surfing activity[8, 13-16], the differences may be due to different locations, environmental variables, and definition of activities. Competitive surfing seems to be more demanding than recreational, so the variation on data may be due to professional tactic and wave selection.[6]

The distance travelled in surfing sessions give important insights about workloads, given that paddling is such a fundamental activity in this sport. Contemplating the published data, distances travelled in competitions differ from training and recreational surf, and may be influenced by the type of surf break and other conditions.[6] Distances in competitive sessions evaluated by Farley et al.[8, 17] ranged from 1433m at beach-break, to 997m and 1806m at point-break, per 20 minutes. During training the distances varied from 1538m to 1600m per 30 minutes[16], and 3925m per hour during recreational surfing[15]. A developed sprint paddling ability will improve the athlete ability to feel less fatigue and tackle bigger workloads.[11] Furthermore, if surfers want to improve point scoring opportunities during a competition they need to paddle faster and stronger to catch the waves.[6] Within statistics available, during paddling average speed ranged from 3Km/h[16] to 4Km/h[8], reaching up to speeds higher than 40 Km/h[8] when riding the wave.

The first study examining heart rate (HR)[14] suggested that surfing could induce a high degree of cardiovascular strain. More studies have been published since then in recreational[15], simulated[4] or competitive[8] heats and training environments[16], but data is still limited. Results from these studies demonstrate that the mean HR is approximately 137 beats/minute, and the HR_{peak} is approximately 177 beats/minute. HR measures indicate that surf consists in moderate intensity activity periods, with 66% of TT from 56 to 74% of HR_{max} that predominantly request the aerobic system, intercalated with bouts of high intensity (>90% HR_{peak}) soliciting both aerobic and anaerobic energy systems.[6]

Furness et al.[18] conducted a study with the purpose of understanding if there were differences between the aerobic and anaerobic profile of recreational and competitive surfers. The findings revealed that competitive athletes had significant higher values for both oxygen consumption and anaerobic power. It´s relevant to note that the test was performed out-of-water, using a swim bench ergometer with a surfboard on top of the bench, which does not replicate the water nor the ocean conditions. It is hypothesised, given that paddling requires a series of short sprints, that competitive surfing could cause an increase in maximal oxygen consumption.[18]

A recent study from 2021[19], revealed some interesting insights about the impact of a single surfing paddling cycle on energy cost and fatigue. The sixteen competitive male surfers performed paddling at different intensities in a swimming pool. The results suggest that even in a single surfing paddling cycle, there seems to be fatigue. Regarding relative velocities, lower energy cost was associated with higher velocities in surfers at maximal paddling velocity and endurance paddling. The relation between body mass and velocity was accessed, and was not significant, but a direct strong relation between body mass and energy cost was observed.

Findings like the ones described above can help coaches and athletes implement training protocols adequate to surfing. To cope with ocean characteristics surfers must respond to periods of high and moderate intensity, with upper and lower body parts, in paddling and wave riding, respectively. Considering that, resistance training that focuses on developing a high degree of body strength and power should be implemented.[11, 13] In a study evaluating the impact of 5 weeks of short-term maximal strength training in paddling performance, in recreational and competitive adult surfers, subjects of the train group improved their paddling ability. Authors say that maximal strength training alongside nutritional intervention may be an effective way of reducing body fat to reach optimal levels.[20] Due to limited evidence-based out-of-water training programs, this topic is being more explored each day, also nutritional interventions and body composition keep being mentioned by different authors. Another study aiming to determine the effectiveness of an 8-week core strength training program, in 19 American junior surfing athletes, revealed that subjects enrolled in the protocol improved their rotational power, core strength, time to peak acceleration, maximal countermovement jump, estimated peak power and rotational flexibility.[21]

1.2) Physical Characteristics of Surf Athletes

In comparison with the average age-matched sporting population, competitive surfers seem to be lighter and shorter. It seems that a shorter stature may be an advantage in surf performance, as a lower centre of gravity can give a better dynamic balance.[4] In 2005 anthropometric analyses of surfers did not appear to have a role in performance, but that hypothesis is changing with some studies demonstrating implications in performance. The top 44 ranked male surfers of the World Championship Tour (WCT) in 2003 had an average height of 174.7 ± 6.1 cm, and the female top 14 in 2003 WCT had an average height of 162.0 ± 4.9 cm. Comparing to more recent studies, Sheppard et al.[12] reported a mean height of 177.0 ± 6.5 cm in ten competitive male surfers, which is in line with other studies, 177.4 ± 7.4 cm[20], 173.0 ± 7.0 cm[22], 173.1 ± 5.4 cm[23].

In what refers to body mass, Borgonovo-Santos et al.[22] reported an average of 68.3 ± 10.8 Kg in 23 male surfers, other studies revealed values of 72.2 ± 2.4 Kg[12], 76.7 ± 9.9 Kg[20] and 73.7 ± 7.0[23]. Regarding the percentage of body fat mass (BFM%), generally estimated values in surfers are higher than reported in other level matched endurance athletes.[4] Using skinfolds to estimate the BFM%, Ribeiro et al.[23] reported a BFM% of 12.2 ± 3.6% in 48 professional surfers. Borgonovo-Santos[22] et al. reported 14 ± 5% of BFM% (assessed through multifrequency bioimpedance analysis). In this study, the results found a significant relationship between skeletal muscle mass percentage and total duration of the pop-up ("defined as a quick transition from the prone to standing position on a surfboard"), but no other relations were found between anthropometric variables and performance. Previous research, that also used skinfolds to estimate BFM%, described values ranging from 10.5%, for world-class male surfers, to 22% for elite female surfers [4, 18, 24]. Furness et al.[18] conducted a study involving 62 male surfers, in which 34 of them were accessed by Dualenergy x-ray absorptiometry (DXA), with the variable of interest being percent body fat, results revealed that competitive surfers had an average BFM% of 17.11 ± 2.93%. Also, a correlation analysis showed a significant association between arm span, lean muscle mass, and key performance variables such as, peak oxygen uptake and peak and relative power output. It raised the question to whether increases in arm span of competitive group are a result of a physical predisposition for success in surfing. DXA was also used in a study performed in Portugal(25) aiming to assess surfers (18 surf athletes, 11 male, 7 female) with Functional Movement Screen, the mean BFM% reported was 19,49 ± 3.48% for men, and 31.58 ± 5.17% for women. Especially for women, values are higher than the ones described before which may be due to different assessment methods (skinfolds Vs DXA), must also take into consideration the number of subjects and their age (14.86 ± 2.04 years). The authors refer a negative large association between Trunk stability push-up (that seems to be a reliable indicator of performance in surf) and BFM%, which may be an indicator that high levels of adiposity can negatively influence surfing ability.(25, 26) The assessment of body composition is a common practice in sports settings, and all the methods used have faults and strengths. When it comes to evaluating and tracking body fatness, skinfold technique when presented as a sum of folds (millimetres) seems to provide the best solution, if accessed by an accredited anthropometrist by the International Society for the Advancement of Kinanthropometry, due to low costs associated, speed and frequency in which can be implemented and accessed.(27)

Many factors can possibly influence the performance of competitive surfing athletes, from environmental conditions to mental and emotional state, adaptations to travel, injuries and physical condition. Looking at the ranks of elite surfers it seems that having high muscle development while also maintaining relatively low levels of adiposity can influence surfing ability. [26]

2) Nutrition Strategies

Considering all the specific characteristics of surfing, the dynamic context in which it is performed, the different body parts and energetic pathways utilized, and demanding time spent training in and out-of-water to improve the performance of competitive surfers, appropriate nutritional guidance may have an impact on the athlete health and it´s improvement in this challenging sport. Despite sports nutrition being widely explored in several sports, when it comes to surfing there are only few published studies.

2.1) Energy requirements

Understanding the athlete's energy balance, their specific requirements, as well as doing an accurate estimation of Total Daily Energetic Expenditure (TDEE) is essential to provide guidance.[28, 29] Many equations were developed to access the resting energy expenditure, some of them are more appropriate to use in athletes[28, 30] such as Cunningham equation[31], De Lorenzo equation[32], and Harris-Benedict equation[33] (mainly in women). To estimate the physical energy expenditure physical activity levels or metabolic equivalents of tasks can be used. Low energy availability (LEA) in athletes compromises numerous physiological processes.[34] The health concerns about long term LEA are real, as it can affect gastrointestinal and cardiovascular systems, as well as menstrual cycles and libido; also performance through reduced recovery and impairment of muscle mass can be negatively affected.[29, 34]

In the first study aiming to record dietary habits of elite female surfers in 1996, Felder et al.[24] reported that energy intake (EI) failed to reach the estimated requirements of surfing. Limitations were explained as the surfers could have underreported their EI, so authors believe the female athletes were in energy balance since their weight was stable. In other studies the EI described was also bellow values expected for the subjects.[23, 35] In both studies values were auto reported by the athletes, through a 24h food recall[23] and a 3 day dietary record[35], which is something to have into consideration thus the limitations associated with these methods.

2.2) Protein

Protein requirements for general population are defined around 0.8 g/protein/Kg body weight/day (g/Kg/d), for healthy individuals.[36, 37] However, athletes are a particular population, were optimal protein intake is bigger than general population.[38, 39] Journal of the International Society of Sports Nutrition stated that “For building muscle mass and for maintaining muscle mass through a positive muscle protein balance, an overall daily protein intake in the range of 1.4–2.0 g/Kg/d is sufficient for most exercising individuals”, referring that higher protein intakes (2.3-3.1 g/Kg/d) could have beneficial effects on body composition, maximizing the retention of lean body mass, especially during an energy deficit.[38] Morton et al. concluded that beyond a total daily protein intake of ~1.6 g/Kg/d, during resistance exercise training, did not provide further benefit on gains in muscle mass or strength.[40] Current data shows that protein intakes ranging from 1,2-2,0 g/Kg/d seem to be appropriate to support metabolic adaptation, protein turnover and repair. Higher intakes can be necessary with calorie restriction (1.8-2.7 g/Kg/d) and injuries (1.6-2.5 g/Kg/d).[41, 42]

Comparing the protein intake reported by Ribeiro et al.[23] (1.8 ± 0.6 g/Kg/d), it seems that the majority of surfers accessed, had an appropriate protein intake. Lower intakes were reported in a sample of 13 male surfers (1.4 ± 0.4 g/Kg/d).[35]

2.3) Carbohydrates

The depletion of muscle glycogen stores is related to reduction in the intensity of sustained exercise, high work rate, and fatigue, which is why daily carbohydrate (CHO) intakes should match the fuel needs for training and glycogen restoration.[43, 44] Guidelines for CHO intakes should focus on understanding the needs of the athlete based on their body mass, exercise load and its intensity.[41, 45] Guidelines suggest the intake of 5-7 g/Kg/d for moderate exercise load, 6-10 g/Kg/d for heavy exercise load, and 8-12 g/Kg/d for extreme exercise load.[45] When comparing these guidelines to a group of professional surfers[23], the reported results show a mean CHO intake of 5.3 ± 1.9 g/Kg/d, which may be not adequate for some. In another study[35] the described mean was even lower 4.4 ± 1.1 g/Kg/d.

CHO intake pre exercise of 1-4 g/Kg/d should be done 1-4 hours before exercise. Choice of high fat, protein and fiber rich foods should be reduced to avoid gastrointestinal issues.[44, 45] Heats during surfing competitions have a short duration (<60 minutes), so CHO intake is not needed. Some competitions occur during 2 or 3 days[4], which should be considered when planning meals.

Excessive intake of alcohol post exercise may inhibit glycogen storage during period of elevated blood alcohol concentration, athletes should be aware of alcohol intake and its consequences particularly after exercise.[43] Alcohol mean intake during the 1st day of a national championship was 17,8g with a maximum of 73,4g.[35]

Athletes that train multiple times a day, where glycogen depletion and substantial muscle damage occur should look at the peri-exercise period as well as other times through the day as opportunities to consume macronutrients such as CHO and protein to support recovery, adaptation and, at the end, performance. Nutrient timing can possibly have a positive impact on the athlete.[46] Although macronutrients are important, food is much more than the macronutrient itself, and should be perceived as so.

2.4) Weight Loss

There is a vast multitude of diets described from low fat diets to ketogenic diets, with multiple purposes and health statements.[47] There are different types of diets, the ones that manipulate macronutrient content, others that restrict some food groups or particular foods, and others that are based on time manipulation[48], and are used by necessity, personal preferences, to gain or lose weight, and so on. Before adopting a different type of diet athletes should look at the possible risks as well as benefits, and the evidence behind its claims.

Surfing athletes that want to lose weight should maintain adequate protein intakes, so that lean mass can be preserved during this period. This macronutrient has also some interesting characteristics such as satiety and thermogenic effect. Stuart M. Phillips advises that "athletes would be to focus on reducing intakes of lipids to allow CHO intakes to achieve performance".(49) Considering that, athletes should also be discouraged from having a fat intake lower than 20% of energy intake chronically, as this can reduce the intake of a variety of nutrients such as fat-soluble vitamins and essential fatty acids.(41) Regarding to Ketogenic Low-CHO high fat diets, athletes that are considering adhering to this diet should contemplate their personal experiences and balance the risk of impaired performance of higher intensity exercise with the potential benefits of replacing an unavoidable depletion of carbohydrate stores with greater reliance on muscle fat use.(50)

2.5) Supplements

In what concerns to dietary supplements used by surfers the information is scarce. WSL has an anti-doping policy that was instituted in 2012. This policy covers the use of both performance-enhancing and illicit substances and applies to surfers and their support staff.(10)

In a group of surfers from a national surf championship in Brazil (23) the most consumed supplements were maltodextrin, whey protein and branched chain amino acids.

Regarding the actual evidence about dietary supplements, only some can be beneficial for athletes. According to the International Olympic Committee(51) the supplements with good or strong evidence to improve performance in specific scenarios are caffeine, creatine, nitrate, beta-alanine, and sodium bicarbonate.

Supplements should be trialled thoroughly by the athlete in training scenarios that mimics the competition, to evaluate secondary effects. There are some supplements as well that may help with recovery, muscle soreness and injuries, such as tart cherry, omega-3 and creatine monohydrate, with good level of evidence and vitamin D, beetroot juice and pomegranate juice with lots of evidence, but unclear beneficial effects.[52]

Conclusion

Surfing is an intermittent sport with high-intensity bursts, and a lot of special characteristics. To be able to surf the waves surfers must adapt to environmental conditions every time they enter the ocean. There are still many study gaps in this sport, and studies with numerous limitations from number of participants enrolled to the difficulty in recreating the environment in which surfing is practised. Most studies published are conducted in male athletes leaving a breach of information about female surfers. Regarding nutritional sciences the studies available are not enough to describe surfing athletes in their dietary patterns and preferences. Now that surfing is an Olympic sport, sport scientists and nutritionists should take the opportunity to explore this field and its specifications. Nutrition professionals should give guidance to surfers based on sport nutrition evidence, still respecting athlete's preferences, and energy requirements, working with the athlete and coaches to define and reach goals.

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