ARTIGO REVISÃO

SWIMMING TRAINING LOAD CONTROL: AN INTEGRATED APPROACH

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CONTATO

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ABSTRACT

Swimming is a very popular sport all over the world. Sport provides major cardiorespiratory improvements and can help people lead healthier lives. However, like most sports, swimming when performed at high intensity in the long run can lead the athlete to suffer injuries throughout the competitive period which can be harmful. Therefore, it is essential that coaches provide tools to maintain the health of athletes, both in physiological and psychological aspects, always controlling the training load of the athlete in training to improve performance. It is known that there are several approaches in the literature to monitor, quantify and regulate the training load, but there are none that cover the monitoring, quantification and regulation of the training load. Thus, the aim of this study is to review the literature, proposing an integrated approach to control the training load in swimming and the training load in swimming.

Keywords: Load control; Athlete; Monitoring; Sport; Swimming

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1. Introduction

Swimming is an activity that provides great cardiorespiratory improvements and can help people to lead a healthier life (CONTI, 2015). When activities are carried out at high intensities in the long term and there are many competitions, they can cause disease, leading to a decline in performance (BOURDON, *et al.,* 2014). It is fundamental that the improvements of the individual are associated with the maintenance of health, not only in the physiological aspects, but also in the psychological aspects and in the control of effort, that being well done, optimize the performance (GABBETT, 2016).

Athletes who train and compete at a high level are often subject to several physiological, motivational, and mood changes. These changes can be caused by internal factors (cognitive, activation, sensory disturbances, psycho-physiological) and emotional states related to competition (JEAN-CHRISTOPHE, *et al.,* 2018).

In the field of sports questionnaires, psychometric measures are used in conjunction with indicators of performance, health status, physiological measures and other lifestyle factors, which are of great help in identifying athletes at risk for diseases (THORPE, *et al.,* 2017). To mitigate this negative result, training load control with an integrated approach, which incorporates three basic tools; monitoring, quantification and regulation to reduce this risk (CLAUDINO, *et al.*, 2018).

In the literature there are some approaches to monitoring and quantification and regulation the training load (MORGAN, *et al.*, 1987; MORGAN, *et al.,* 1988; GONZÁLEZ-BOTO, *et al.,* 2008; HELLARD, *et al.*, 2013; GARCÍA-RAMOS, *et al.*, 2015; COLLETE, *et al.,* 2018). However, in the best of our knowledge, there is no training load controlling approach to integrate the three cited tools. Thus, the purpose of this study is to do a literature review, to propose an integrated approach of control of training load in swimming.

2. Training Control

In effective management of training programs, planning is required, and needs to alternate load periods with recovery to avoid excessive fatigue, which can lead to overtraining (ARMSTRONG; VANHEEST, 2002; SMITH, 2003; KREHER; SCHARTZ, 2012). This planning process must manipulate the workload, through intensity, duration and frequency variables, with a combination of strength, speed and resistance performed with coordination and efficiency (AUSTIN; DEUSTER, 2015; SOLIGARD, *et al.*, 2016). Therefore, performance assessment should be part of planning, and should represent the highest level of performance, and adequate distance and intensity prescription needs to be made during training and competition periods (GABBETT, 2016; AUSTIN; DEUSTER, 2015; HALSON, 2014). This assessment or control of the training load should be an integrated approach that incorporates individual specific monitoring (AKENHEAD; NASSIS, 2016; BORRESEN; LAMBERT, 2009). Monitoring is defined as the verification of responses to training loads that were previously planned by the technician (AKENHEAD; NASSIS, 2016). Quantification is defined as the sum of the training load that was performed by the athlete (BORRESEN; LAMBERT, 2009). Regulation is defined as adjustments in training loads raised in relation to the athlete's responses (SIFF. 2003).

There is a need for adequate controls of both aerobic and anaerobic changes to identify possible improvements (AUSTIN; DEUSTER, 2015; MAGLISCHO, 2003; SAW; HALSON; MUJIKA, 2018). In addition, great training can be considered as a process for administering the total amount of exercise and recovery (BOURDON, *et al.,* 2017; HALSON, 2014).

On the other hand, the athlete's sport performance needs to integrate many factors, some of the athlete's own (physiological, psychological and biomechanical), some learned (tactical), others beyond the athlete's and coach's control (genetics and age) as well as the environmental conditions of competition, material and technical limitations, coordination, ability and integration of body and mind (SMITH, 2003). Performance is influenced by many variables and cannot often be determined with a high degree of precision as in the laboratory, so the changes induced by training are not easily quantifiable (BOURDON, *et al.*, 2017; NOAKES, 2000; FOSTER; RODRIGUEZ-MARRYO; KONING, 2017).

The most difficult part of the training process is finding the optimum balance and how athletes are likely to train a lot, so overtraining is often found in elite athletes (KREHER; SCHWARTZ, 2012; KELLMANN, *et al.*, 2018).

Costill et al. (1991) already criticized the ideas of other researchers who stated that only the best performance was obtained, training in high intensity and long duration, and increases in strength and endurance are proportional to the volume and intensity of the work performed during the training, and this improvement of effectiveness is directly related to the volume of work performed.

In fact, fatigue induction involves the adaptation of the process to improve athletes' abilities by stimulating the body's functions and the balance between stress and recovery factors that define the quality of the training program (SMITH, 2003; HALSON, 2014). Hormonal assessment methods can also be used, which are accepted by athletes as they become more frequent (KREHER; SCHWARTZ, 2012). Another type of assessment that should also be done in swimming is the collection of anthropometric data, because with them, it is possible to verify a positive relation with athletic performance (GELADAS; NASSIS; PAYLICEVIC, 2005; MOURA, *et al.*, 2014; MORAIS, *et al.*, 2016).

According to Kellman et al. (KELLMANN, *et al*, 2018), to obtain good results in training, it is necessary to understand the basic notions of exercise physiology, since exercise involves the breakdown of cellular homeostasis. These changes caused by exercise stimulate initial physiological responses to restore homeostasis. The optimization of the physiological state of the athlete as a result of a good strategy and frequent assessments is probably accompanied by beneficial psychological disturbances (SAW; HALSON; MUJIKA, 2018; MUJIKA, *et al*, 2004).

Austin and Dioster (2015) suggest that training should be evaluated through retrospective, daily surveys, physiological monitoring, and direct observation of behavior in training. It is difficult to define which of the training adaptations are most important for performance improvement, or how training can be structured to maximize adaptations (NOAKES, 2000).

Smith et al. (2002) stated that the training and performance diagnosis should provide the basis for: 1) analyze the effects and trends produced through training; 2) advise the quality, structure and preparation for the competition; 3) predict future competitive performance; 4) get recommendations for the direction of future training.

The most important goal for a coach and an athlete is to improve physical and psychological skills, techniques as far as possible to achieve the highest levels of performance and develop a precise and controlled training program to ensure that the peak of performance is achieved at a particular point in the season (SAW; HALSON; MUJIKA, 2018). But different physiological systems may determine performance under different exercise conditions (NOAKES, 2000) and other external training loads, including the contribution of competition load, as well as out-of-water physical training work should be accounted for (LOTURCO, *et al.*, 2016).

McGuigan (2017) suggests that the training control methodology should include measures of: 1) loads of exercise in a given period (implicit type, frequency, duration, effort intensity); 2) training format (stimulus intensity), levels (levels sizes), ramp (slope ramp), or a binary pseudorandom number (designation number and size); 3) training extent and format, reduction levels (negative levels), ramp (slope reduction) and time reduction size.

Overloading can be caused by work of speed and force, essential factors for swimming success, and coaches' knowledge of proper prescription may lead one to assume that work may not produce the necessary adaptations for performance optimization (BERRYMAN, *et al.*, 2018).

That is why it is necessary to quantify the training. Quantification of training stimuli can be done by calculating the training impulse (TRIMP) (STAGNO; THATCHER; VAN SOMEREM, 2007; LAMBERT; BORRESEN, 2010). This method multiplies the duration of a training session by the average heart rate obtained during the session, determined by the intensity of the exercise.

These authors proposed the method to study the effects of training on the verification of athletes' responses to the stimulus. The created mathematical model estimates the fatigue and adaptability profiles of the training impulses (TRIMP), and is carefully noted to understand the variation in athlete performance during periods of heavy training divided by rest periods.

The concept of TRIMP is determined as the product of duration and intensity of training in which the average heart rate is multiplied by a non-linear metabolic adjustment based on the classification described above prior to blood lactate and the duration of the training session (MCGUIGAN, 2017). The limitation of the method is only in training of aerobic intensities, obtaining the heart rate responses to the maximum, that the loads can be determined (SMITH, 2003).

With this model, the performance level of an athlete at any point in the training process can be estimated by the difference between fatigue and adaptability, and the result of each phase and its adaptation (MCGUIGAN, 2017). The training stimuli are quantified not only by training volume, but also by intensity. This model has been used as a method of quantifying training stimuli as physiological responses to the process of organism formation. TRIMP produces two responses: performance improvement and fatigue, while you can use the specific models and parameters to estimate and optimize future training schemes (GÁRCIA-RAMOS, *et al*, 2015).

In a more traditional theory, Lavoie et al. (1985), suggest another model of training control, specific for swimming. In it, a division is made up of six levels of effort. Level 1 is the slow exercise without accumulation of lactate, level 2 is the aerobic exercise close to 4 mmol/L of lactate and the series are greater than 1500m and rests smaller than 15s. Level 3 is the aerobic exercise done near maximal aerobic speed, where the series are made between 500 and 1500m and rests smaller than 30s. Level 4 is the anaerobic exercise, above maximal aerobic velocity, where the series are made between 200 and 400m with intervals greater than 30s. Level 5 is the anaerobic exercise near competition speed levels, with all series lasting less than 3 minutes and long intervals. Level 6 is the aerobic anaerobic velocity, where the exercises do not exceed 25m and the breaks are greater than 90s. This model contemplates aerobic and anaerobic efforts.

According to Maglischo (2003) the training volume at aerobic level 1 should be different for volumes of the aerobic level 2 and aerobic level 3, indicating that the total distance covered in aerobic exercises 1 should be higher than that of the other two aerobic levels.

The volumes of anaerobic, lactic and non-lactic exercises should be different, as well as for the volumes of aerobic exercises 2 and 3, since these types of exercises should be well below the aerobic series volumes, a situation that, according to Olbrecht (2015) and Maglischo (2003) is mandatory. It is necessary that athletes be prepared through the training process to meet the physiological goals that are to increase bodily functions and optimize performance as described by Borresen and Lambert (2009).

The prescription of exercises in the training program should be different, even for the training of legs, which for swimmers is of relative importance, since they use their legs with great intensity in the shorter races (GLEESON, *et al.*, 2000).

It is possible to verify the changes in response to exercise, when there are increases in intensity and decrease of volume (BORRESEN; LAMBERT, 2009; MAGLISCHO, 2003; OLBRECHT, 2015). In swimming, the use of training control models is very frequent, as can be seen in many studies (SAW; HALSON; MUJIKA, 2018; GLEESON, *et al.,* 2000; MARTIN; THOMPSON, 2000; TRAPPE; COSTILL; THOMAS, 2001; MUJIKA; PADILHA; PYNE, 2002; DELGADO-GONZALO, *et al.,* 2016; CROWCROFT, *et al.,* 2017; MITCHELL, *et al.,* 2018).

Bergeron et al. (2015) state that training is influenced by many circumstances, including aspects of physical ability, environment, psychological and behavioral factors that combined with clinical care, collectively form the basis for the following intervention strategies: 1) Training: to handle intensity and volume carefully; vary competitiveness, monotony and training pressure; direct planning for load increases; and provide adequate rest and recovery; 2) Environment: to limit initial exposure when training or competing in adverse conditions (heat, humidity, altitude, air pollution) and acclimate accordingly; 3) Psychological: to teach self-control and psychological technical skills to the athletes and to monitor the physiological and psychological responses of the athletes in front of the high level of competition and training; 4) Behavioral: to adopt a balanced diet with adequate intake of micro and macro nutrients, limit the spread of contagious diseases and common infections, reduce exposure to airborne pathogens and physical contact with infected persons; and 5) Clinical considerations: medical check-up, anatomic-pathological examinations, immunization and prophylaxis, and control of disease-prone routines in athletes

Among the aspects of swimming training control are workload and recovery, performance, blood lactate response, heart rate response, control of subjective perception of effort, other biochemical responses, and control of psychological variables.

The workload and recovery

The training load is a combination of the following elements: intensity, duration and frequency. The ideal adaptation of the work will occur if the magnitude of the load is applied for a high performance and an appropriate sequence (KELLMANN, *et al.,* 2018). Coaches generally organize in short and long periods with alternating load and recovery.

Intensity is a qualitative component and is a function of the activity performed in each unit of time. The frequency refers to the number of training sessions within a given period, such as a day or a week. Duration is a quantitative component regarding the time or amount of exercise in the session. And volume implies the total amount of training done per week, month or year and is the combination of duration and frequency (AUSTIN; DEUSTER, 2015).

Recovery is part of the training process needed to reduce fatigue and cause overload adaptations, being the process of restoring physiological and psychological resources (KELLMANN; BECKMAN, 2017) and depends on the reduction, or change, or pause of stress (KELLMANN, 2002). It may also be related to the type, intensity and duration of the training phases as suggested by Kellmann et al. (2018), as well as the way in which the athlete can psychologically manage the training, due to the psychological and emotional stress undergone (GOMES, *et al.,* 2013).

According to Coutts et al. (2007), load adjustments, including duration, intensity, frequency and recovery, are specific and reversible, implying that the work should be as specific as possible and should be repeated on a regular basis. The ideal time for the next training session is when overcompensation (recovery) is at a good level because it highlights this as the most important phase of the training process.

In relation to the load and the recovery, Halson (2014) affirms that due importance should be given to volume and intensity, recovery, and stress in the face of possible neuropsychic tensions, as well as the quality of execution of the tasks, sports regime and performance in competitions.

Training control for performance

In swimming, it is common to use performance percentages to monitor training intensity according to the percentages of the best time, be it competition, training or session (MAGLISCHO, 2003; TOUBEKIS; TOKNAKIDIS, 2013).

Several authors cite the velocity analysis that allows a great contribution to define realistic goals, based on the personal incomes previous to the competition (GELADAS; NASSIS; PAYLICEVIC, 2005; LOTURCO, *et al.*, 2016; MUJIKA; PADILHA; PYNA, 2002; ARNETT, 2001; RENOUX, 2001; TRUIIJENS, *et al.*, 2003; CLEMENTE-SUÁREZ, *et al.*, 2017).

Speed control was also used in studies by Trappe et al. (2001), Garet et al. (2004), Tsalis et al. (2004) and Hue et al. (2007) as a performance control in swimmers and presented as a good measure of aerobic capacity.

Through this, the analysis of swimmers' previous times allows, in the final phase of training, a contribution in improving performance in important competitions, along with other factors such as motivation, hair removal and feeding (MUJIKA; PADILHA; PYNE, 2002).

But these assessments should be done at the same time to avoid circadian variation factors that may interfere with data collection. These physiological changes may occur in swimmers, as shown in the Arnett (2001) study, where the researcher found differences in morning and afternoon swimming performance, hence the need for blood collection and filling in the questionnaires at the same time for all athletes. According with Arnett (2001), Martin and Thompson (2000) state that diurnal variation is evident at rest, but found no effect on physiological responses when standardized swimming warm-up was performed, nor were heart rate variations observed when the swimmers trained in the morning or afternoon.

The search for new parameters to predict physical performance is of great importance for the evolution of training control in cyclic sports, such as swimming. Predicting this performance through speed or time control is fundamental to training control. Thus, the search for simpler control parameters and that can be done in the athlete's environment, sports researchers began to use the critical power, whose term was introduced by Monod and Scherrer (1965), and this name was changed by Wakayoshi et al. al. (1992), to represent the velocity and not the power, thus defined Critical Velocity (Vcrit), which is the maximum velocity that can be maintained over a long period without fatigue.

In recent years, Vcrit has received special attention from researchers in sports science because of its high correlation with anaerobic swimming thresholds (GUEDES, 2012). Vcrit is a simple method to determine the VLAN because it does not involve sophisticated, expensive equipment, in addition to the calculation for the identification to be extremely simple (VILAS-BOAS, et al. 2012). A large number of researchers have correlated Vcrit with methods to determine VLAN, such as fixed concentration of 4 mmol.L-1 lactate [65] and individual blood lactate (IAT) behavior (ZOCCA; CASTRO, 2010; ZOCCA, et al. 2016; RIZZATO, et al. 2018; KRANENBURG; SMITH, 1996). According to Kranenburg and Smith (1996), Vcrit is a parameter of aerobic fitness that has been shown to be a sensitive instrument for the assessment and control of endurance training (RIZZATO, et al. 2018; TOUBEKIS; TSAMI; TOKMAKIDIS, 2006; GUEDES, et al. 2011). Specifically, in swimming, the Vcrit can be obtained by a linear regression equation between fixed distances and their respective times, with Vcrit being the angular coefficient of the line obtained (WAKAYOSHI, et al. 1992). An even easier form Kranenburg and Smith (1996) suggest that the equation using two times and two distances is also able to identify Vcrit safely:

Vcrit (m / s) = (2nd distance - 1st distance) / (2nd time - 1st time).

Machado et al. (2009), showed that the variation of distances between 50 and 800 meters can generate a great variation in the estimation of Vcrit, overestimating or underestimating swim speed, the authors further conclude that the ideal is to use the tests specific to each swimmer's distance.

Control of Heart Rate Training

According to Achten and Jeukendrup (2003), the main applications of heart rate monitoring are: monitoring exercise intensity, detecting and preventing overtraining and estimating maximum aerobic capacity and spent energy.

Heart rate is used in different ways to measure training intensity and assess changes in physical condition and has the advantage of being easy to read and collecting data easily (AUSTIN; DEUSTER, 2015).

The training protocols included in heart rate monitoring were used to estimate physical performance loads (GARCIA-RAMOS, et al. 2015; ACHTEN; JEUKENDRUP, 2003; D'ANDRADE, et al. 2003; THOMPSON, et al. 2004), but the relationship between heart rate and other parameters used to predict and monitor individual training status may be influenced by many other factors (ACHTEN; JEUKENDRUP, 2003).

In swimming, to control the effort and use of new workloads, the recovery frequency is used, which is the time necessary for the athletes' heart rate to return to rest levels after exercise. This was considered an excellent parameter to measure the adaptations to the training, having a fast return as a sign of good conditioning and a long time, a sign of error in the adaptation effort or disease. This is why heart rate recovery provides an excellent parameter for monitoring the effects of training on athletes' physical conditioning (MAGLISHO, 2003).

Control of training for subjective perception of effort

Perhaps the most direct way to monitor training intensity is the perceived degree of effort and has the advantage of being convenient and easy to apply for the prescription of training intensity, so a minimum of training is required to use this method in an effective manner (MAGLISHO, 2003). The perception of physical exercise is related to the subjective determination of effort, strength and fatigue that is experienced during exercise (BOURDON, et al. 2017; AUSTIN; DEUSTER, 2015; HALSON, 2014; FOSTER; RODRIGUEZ-MARROJO; KONING, 2017).

According to Austin and Deuster (2015) it is a valid and reliable control for exercise prescription and can be used as a tool for a full estimate of exercise intensity, but according to Haddad et al. (2017), the subjective perception of effort is influenced by other factors, such as gender, personality and state of training.

In addition, the subjective effort scale is a valuable and reliable indicator for monitoring an individual's tolerance for exercise and has a high degree of correlation with heart rate and work rhythms of the exercise (HALSON, 2014; HADDAD, et al. 2017; MEDICINE, 2003).

For swimming, Maglischo (2003) argues that an advantage of training prescription with the use of the perceived effort scale in comparison with other methods is that the periodic variations of athletes in the physiological capacities are considered. And an additional advantage of its use is an improvement in the cognitive aspect of athletes, which allows optimizing performance (HADDAD, et al. 2017).

Andrade Nogueira et al. (2016) observed that the distance at each training session with swimmers is significantly associated with the perceived effort scale, suggesting that PSE is very useful in controlling large volumes and low intensities.

Biochemical control in training

It is common for some studies to control training with biochemical variables (OLIVEIRA, et al. 2012; RAMA, et al. 2013), being the most commonly used variable the blood lactate [81-84]. Some authors suggest other biochemical markers, using in their studies cortisol, creatine kinase, catecholamines, serotonin and amino acids.

Casuso et al. (2018) studied cortisol, CK (creatine kinase), and some cytokines in physiological and biochemical changes with swimming and running. They found evidence that there is similar inflammation in running and swimming, with less metabolic stress in swimming.

In the study by Moreira et al (2018) they reported the detection of metabolites in urine after training, and considered as a rapid and effective method for the detection of metabolites, such as creatine, ketones, urea and phosphate, and with a strong relation with performance in swimming. Atlaoui et al. (2007) found that monitoring training levels and catecholamines in urine with reduced intensity was positively related to athletic performance in swimmers. In the study by Saw et al. (2018) urine monitoring was done in various periods of preparation for the Olympic Games, and during this period an inadequate response was not found which would necessitate a change in training, including poor hydration, which is common in periods of altitude training (SAWKA; CHEUVORONT; KENEFICK, 2015).

Deminice et al. (2010) used biomarkers of oxidative stress in high-intensity interval training with swimmers and suggest modulation of ascorbic acid as an important rule of swimming performance.

The values of blood lactate accumulation in swimmers are useful as indicators of individual characteristics (THOMPSON, et al. 2004; HOLFELDER; BROWN; BUDECK, 2013) and has been a common practice to verify the performance and swimming training control (TOUBEKIS; TSAMI; TOKMAKIDIS, 2006; CZUBA, et al. 2017), since it provides a useful indication of energy derived from anaerobic glycolysis during exercise, and, in competition, the values obtained may be important in the contribution of anaerobic mechanisms to energy required (CAMPOS, et al. 2017).

The monitoring of blood lactate concentrations, followed by proposed training intensities, can also be used as a quick and useful practice to monitor the effects of training (RIBEIRO, et al. 2017).

Similarly, Maglischo (2003) states that the lactate test is accurate and appropriate for the training monitoring variables and may be associated with alternative methods, such as repetitions of standardized exercises, heart rate control and use of the subjective scale of effort.

The ease and speed with which the relationship between lactate and perceived effort can be determined is useful for monitoring excessive training and recovery (KELLMANN, et al. 2018; GUIMARD, et al. 2018). This control of responses can be considered a part of effective management during intense training periods (BOURDON, et al. 2017; CZUBA, et al, 2017).

One of the principles of lactate assessment is the identification of aerobic and anaerobic thresholds, whereby through the determination of swimming speeds, they can be obtained (MAGLISHO, 2003; ESPADA, et al. 2015). The results of lactate assessments can be used to monitor training in various ways, to assess changes in metabolism, to prescribe optimal speeds for resistance and velocity training, or to determine performance power (MAGLISHO, 2003).

According to Espada et al. (2015) for proper training control, the lactate test should be performed to define individual limits by establishing these programs for athletes. In addition, the maximum aerobic speed, the limit and the efficiency of the propulsion should be considered.

Control of psychological variables in training

There is evidence that athletes can be distinguished by psychological techniques and emotional skills, and these differences can be observed in the performance of athletes (SMITH; NORRIS; HOGG, 2002).

The consistency of knowledge for high performance is not achieved without a solid athletic build of psychological aspects. These aspects include motivation, aggression, that is, to design goals, ability to tolerate pain and sustain effort, abilities to face victories or defeats, ability to control anxiety and stress, ability of the coach, competence to manage distractions, and the ability to relax (SAMULSKI, 2009).

The control of psychological variables is very important for the development of high-performance sports, as detected by Vacher et al.

(2017) in a study with swimmers where it was observed that for optimization of stress control the use of strategies in training is very useful.

The control of psychological variables includes motivation, mood, stress, quality of life, among other psychological factors.

The level of motivation is a basic element for the development of potentialities, since at level of motivation the influence and education are added, and this is the true cause of sports practice (DORMEHL, et al, 2017). Tucker e Collins (2012) state that great athletes have in common the ability to motivate themselves, probably due to previously experienced successes.

Therefore, sports performance provides the greatest source of information based on perceptions of self-efficacy and satisfying experiences. These experiences affect the perceptions. If they are repeated and seen as success, this will increase the expectation of effectiveness, but if they are perceived as failure, this will decrease the expectation (BRANDT; BEVILACQUA; ANDRADE, 2017).

For the assessment of the state of humor, the most used questionnaire in the sports sciences is POMS (BOURDON, et al. 2017). Terry et al. (2003) presented evidence of simultaneous and confirmatory validity and presented normative data for adults. The same authors argued that POMS was valid for use in sports and exercise.

Another aspect to evaluate is mental fatigue, where in the study by Grillon et al. (2015), the results indicated that mental fatigue, after performing cognitive tasks, makes it difficult to regulate emotion without affecting emotional reactivity, suggesting that this should be incorporated into emotional regulation models. Similarly, Marcora et al. (2009) found that mental fatigue limits exercise in humans through a greater perception of effort, rather than cardiorespiratory mechanisms and muscle energy.

3. Considerations

Considering the current state of knowledge, derived from all the information consulted regarding the importance of controlling swimming training for health maintenance in high performance athletes, we consider the following reflections as considerations.

We must emphasize the importance of using psychological tests to monitor and control the training processes. But these tests must be validated and reliable for the population to which they should be applied, and it is important that all of them have been scientifically proven and have been validated in the application language.

It is necessary to emphasize another consideration, that the high-performance training and competition are precursors of the increase of diseases. Hence the need to check whether long-term intense training, such as swimming and monitoring responses from overtraining markers that cause increase of diseases, results in processes that may divert swimmers from training.

Now, we can say, after the review work carried out, that we should observe the current state of knowledge in relation to high-performance training in swimming in the field for health maintenance.

In fact, this state of knowledge in this respect is not clear and we believe that it is necessary to develop new research, in this case, oriented to the systematization of swimming training planning, that is, to its proper design, correct planning and adequate programming, over time, depending on the capabilities, limitations, interests and motivations of each individual.

Measures that must be taken so that it does not provide low performance and that must be repeated in new studies: 1) avoid sudden increase of loads and many competitions; 2) individual training prescription, 3) training planning, 4) recovery planning and rest days during the training cycle. Likewise, it is also suggested that athletes use strategies to improve performance and reduce disease susceptibility by: quality of recovery; adequate rest, hydration and diet; with psychological profile surveys and daily analysis of the subject's demands, variables that are cited in our research.

The talented swimmer must develop the technique and the physical conditioning to have a reliable performance in the competitions and, for the competition period, the final phase of the process, with optimal performance, it is necessary a healthy body and the integration not only of the physiological aspects but also psychological, technical and tactical aspects And it should be considered the type of test that swimmers should perform because there is a very large difference between the types of tests, distances traveled and swimming styles, which require individual observations and analyzes.

In addition, an integrated approach to load control was not found in the literature, where monitoring, quantification and regulation were performed in a multidisciplinary way within the Sports Sciences. This is necessary because we must not forget the nutritional aspects of the athletes, because the high performance is obtained by a series of factors, including nutritional.

Finally, another of the previous considerations that we also obtained from the review of the literature consulted was that the analysis and assessment of swimming training should consider other indicators, such as workload. In addition, the few studies on swimming control training do not point to the proper control of the load, leaving us an important empty space.

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