International Journal of Sport, Exercise and Health Research

Review Article

IJSEHR 2018; 2(1): 97-99

www.sportscienceresearch.com
Received: 09-01-2018
Accepted: 05-03-2018

Time-motion analysis in surf: benefits

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Abstract

Time-motion analysis refers to the frame-by-frame examination of video footage of each athlete both during training or competition; this analysis registers the recording of time-and-distance data, movement patterns, frequency, mean duration and total time spent in a specific activity. These variables obtained in the time motion analysis can lead to information about the metabolisms involved in each activity and provide motion analysis for correction of possible execution errors to help the coaches to prescribe a specific training. This review shows the concept and benefits of time motion analysis in surf practice presenting the results obtained in the studies carried out using this approach of movement analysis.

Keywords: Time motion analysis, Surf, Physiological.

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INTRODUCTION

Sometime ago, sports analysis consisted in the direct observation of the athlete during his training or competition, since the electronic equipment were wide and difficult to transport and connection and were expensive. Nowadays, with the modernization of these equipment, with better availability and reduced costs, it becomes easier to use this equipment's to capture images of the athletes during their practice and to analyze them later.

Data manipulation and analysis have been modernized, facilitating video or image evaluation with speed, zoom and focus controls, although the principles have remained the same. One of the advantages of this technology is its high data processing capacity, along with the reliability, speed and accuracy of the data acquired, as well as being non-intrusive and not causing disruption during the sports practice [1].

Time-motion analysis refers to the frame-by-frame examination of video footage of each athlete both during training or competition which registers the recording of time-and-distance data, the activity movement patterns, frequency, mean duration and total time spent in a specific activity [2].

To prescribe a training program for surfers, the coach has to take into account factors such as duration of the activity and the metabolism that is requested to do this activity. It becomes necessary identify the physical demand periods in order to provide important data to help the coaches to understand the specific requirements of surfing competition; besides that, these factors can be used as a reference value for prescribing training programs that work with the same temporal metabolic demands that are required in surfing competition and can be useful in improving specific conditions and developing appropriate training protocols [2,3].

In order to improve athlete performance, the metabolic demands of the activity must be known to prescribe a specific training. Physical and physiological analysis provides scientists and coaches with accurate information to prescribe specific training routines and goals. Thus, time motion analysis should be an integral part of a training process in competitive surf since it assists in the prescription of training programs, with an objective of improve athlete performance, since the use of these kind of technologies provide detailed and meaningful insights into surf and athlete performances [2-4] by the analysis of distance, velocity, time sprinting and accelerations [5]. The frequency and duration of surfing activities and the ratio between work and rest periods were important variables to know the metabolisms involved in the activity. The calculation of sport-specific work-to-rest ratios can better prepare the athlete for the conditions of competition [3].

Knowing this variable obtained in time motion analysis, can help the coach to planning training sessions and developing suitable training programs to improve the specific physical condition of athlete. In addition, this information can also be used to evaluate athlete´s performance [1,3,6] once this technology allows to evaluate the performance of the athlete at that moment of execution and to rectify the potential errors soon after its performance. It isn´t uncommon nowadays for the coach to film the athlete's maneuver and ask him to get out of the water so they can analyze the performance of the maneuver by correcting errors to improve it, once the time motion analysis allow a detailed representation of the activity patterns performed during training or competitive heats.

Some a sports analysis has also included the use of global positioning system (GPS) technology that allows the athlete monitoring and improves the effectiveness of the analysis period [3,6]. The heart rate control also helps to determine the training intensity and the metabolism required [7] and estimated energy expenditure of surfing activity, in order to determine the intensity of this activity [8].

The surfing practice has become increasingly popular worldwide, both at competitive and recreational levels [9], with an increase in the number of athletes participating in competitions [3,10]. The International Surf Association revealed that there are 35 million of surfers in over 70 countries.

Surf consists of sliding on the wave wall, on a surfboard, towards the beach, being a physically demanding activity. The surf performance it´s depends to multiple surf conditions and environmental factors that includes the ocean currents, swell size, wave length, beach break or reef break, wave frequency, inconsistent surf, competing for waves, technical and physical level of the surfer, and the athletes motivation; these factors can influences the time and percentage durations that the surfers spent performing each activities and consequently the physical demands require for each surfing activity [11,12].

During a surf session, its necessary to do repeated periods of paddling through the breaking until reach to the take-off zone (location to catch a wave), realize several times the duck-diving movement requiring breath holding under advancing broken waves, perform brief periods of paddling to catch a wave with power and velocity, or move around to find the best peak, and to catch a wave [13].

The paddling activity involve alternating and repeated upper limbs movements with the goals of reaching the outside or for searching the best wave peak; the sprint paddle for wave consist in a movement performed to catch the wave, recorded from the time the subject turned toward the shore and began to paddle forward with the wave forming until the start of take-off (extension of the trunk), even if not to catch a wave; in the stationary period the surfer can choose be in two positions, or to adopt the prone position or the sit position on his board, but cannot have any kind of locomotion activity; the wave riding is the time between the take-off and the moment where the athletes' feet lose contact with the board where the maneuvers are executed; and miscellaneous activities includes duck diving that consisting in pushing the surfboard to get under a wave that has broken or is just about to break, getting out and entering in the water, walking or running up the beach, and recovery the board after falling [8,12,14].

There is still little research that evaluated the time motion analysis in surfing, and few studies that utilized the heart rate and global positioning system (GPS) control, probably because the aquatic environment is hostile for electronic equipment, making it difficult to measure and acquire data. At the moment, there are only three studies that investigated the time-motion analysis of surfers during competition [9,12,14], only one study that investigated during surf training [15], and another one in recreation surfing practice [8].

Mendez-Villanueva *et al*. [9] evaluated forty-two male elite-level surfers, who participated in the World Qualifying Series (WQS) tour within the Association of Surfing Professionals (ASP), having been filmed 206 rides in a period of 7 days during The Salomon Masters International Surfing Tournament 2003. In each heat, with duration of 25 minutes, 4 surfers competed against each other, and the only surfers with the 2 best score passed on to the next round. Each surfer was individually videoed for the entire duration of his heat. The data revealed that 51.4% of the total time was spent in paddling, 42.5% in stationary period, 3.8% for wave riding and 2.2% for miscellaneous (other) activity. The mean duration lengths of the activities were 30.1 seconds, 37.7 seconds, 11.6 seconds, and 5 seconds for paddling, stationary, wave riding, and miscellaneous activities, respectively. Approximately 60% of paddling were performed at time intervals of between 1 and 20 seconds, and 50.9% of the stationary period were between 1 and 20 seconds.

Farley *et al*. [14] evaluated 12 surfers who was in the ranking top 30 in New Zealand and who competed in the sanctioned New Zealand Surf Association competition. During the heats of 2 sanctioned competitions, surfers had their heart rate monitored, as did the GPS units and were filmed for the entire duration of his heat. The duration of all heats was 20 minutes. 32 videos were analyzed and the data showed that the time spent during paddling was 54% of the total time, paddling for a wave 4%, stationary period represented 28%, and wave riding 8% of the total time. Surfers spent 61% of the total paddling bouts and 64% of total stationary bouts between 1 and 10 seconds. The mean time spent performing activity was 16.3, 4.2, 11.9, 14.9, and 3.1 seconds for paddling, paddling for wave, stationary, wave riding, and miscellaneous activities, respectively. The average speed obtained by GPS for all surfers was 3.7 $km \cdot h^{-1}$, and the highest speed recorded was 45 $km \cdot h^{-1}$. The average distance covered was 1,605 m. The mean heart rate achieved was 139 beats/minutes (64% of maximum heart rate), with a mean peak of 190 beats/minutes (87% of maximum heart rate).

Minghelli *et al*. [12] analyzed a sample constituted by 42 Portuguese children and adolescent's surfers that participated in the championship of the "School Sport" of the Algarve region in 2017. The duration of the heats was 15 minutes. Each surfer was individually videoed for the entire duration of the heat using a video camera. The results showed that surfers were paddling 58%, stationary 42%, sprint paddle for wave 3.8%, and wave riding 3.1% of the total time. The average of surfing activities was 13.3, 3.4, 7.4, 6.7, and 7.8 seconds for paddling, to sprint paddle for wave, for stationary period, for wave riding, and for miscellaneous activities, respectively. Paddling time intervals more done by surfers was up to 5 seconds (39%), and the period between 6 to 10 seconds corresponded to a 26% of the total time of paddling. The intervals more done for sprint paddle for wave was up to 5 seconds (92.6%), for wave riding also was up to 5 seconds (45.5%), followed by the intervals between 6 to 10 seconds (40%), up to 5 seconds for stationary period (58%), and up to 30 seconds for miscellaneous activity (95.30%).

Secomb *et al.* [15] did the time motion analysis during a 2 hour of surf training session in 15 male competitive surfers (in regional-level competition) with GPS heart rate monitor. Each surfer was individually filmed during the entire surfing session. The mean times that surfers spent performing paddling, sprint paddling to catch waves, stationary, wave riding, and recovery of the surfboard were 42.6%, 4.1%, 52.8%, 2.5%, and 2.1%, respectively. The mean time spent performing activity was 19.2, 6.3, 34.2, and 7.5 seconds for paddling, paddling for wave, stationary, and wave riding, respectively. The average distance covered was 6,293.2 m, the average speed was 52.4 m/min, the heart rate average was 128 beats/min, and the average peak of heart rate was 171 ± 12 beats/minutes.

Meir *et al*. [8] evaluated 1 hour of recreational surfing in 6 male recreational surfers (who had previously competed at state level), with heart rate control and video analysis. The data showed that the mean total time spent in paddling, stationary and wave riding represented 44%, 35% and 5% of the total time surfing, respectively. The heart rate average was 135 beats/minute.

This discrepancies between the results of these studies may be due the difference of age, of skill level between the individuals that constituted the sample, the surfer motivation to do this activity, and the external conditions once the total time of surfing activity is dependent of unpredictable nature of the surfing environment. The data obtained in these studies above only can provide the information about the specific surfer population that was analyzed, in that specific local beach where the data was collected and with the specific external conditions of the day of the assessments.

The results of the studies that analyzed surfers who participated in competition and in training or in free-surf condition shouldn´t be compared, since different contexts are being analyzed. During a competition, the surfer has to select the best waves to obtain the highest score and don´t get caught several waves because if the athlete spends his time catching many waves without quality, he would lose time of competition to paddling for return to the peak, and besides that he loses priority in the next wave. It´s because during competition the surfers were judged for the best 2 scored waves, not by the greatest amount of surf waves. Moreover, during competition, the athlete has to take some tactical decisions considering the heat opponent's scores or wave selection, and these options might have also have had an impact on the total time that surfers spent in these activities. This doesn´t occur during training or in free-surf activity, in which the surfer can catch as many waves as he wants, without being selecting or waiting for the best wave set to surf. [14].

Regarding the difference of age and skills, the competitive level of athletes of the Minghelli *et al*. study [12] and the others studies is different and may also influence the results obtained, since in the first study the sample consisted of young regional athletes, and the others studies involved adults athletes, competitive surfers, but with different background, involving world or national elite athletes, or regional surfers competitors that technical skills could influence the percentage and durations of time that the surfers spent performing each activity.

Surf activity involves high-intensity periods of paddling with the goal of getting into the wave and perform the stand up, alternating with periods of low-intensity paddling, and with short recovery periods [14,16]. The results of these studies, those analyzed the time-motion of surf, showed that surfing can be considered an intermittent activity characterized by extensive variety of activities, and concluded that these surfing activities are controlled by nature environmental factors, and by the motivation and technical skills of surfers too.

These results identified that surf consist in a long-arm paddling activity provide for the coaches an important information about the specific demands of surfing competition that will be used for develop conditioning training programs according with the surf specific demands.

The data obtained in the time motion analysis indicates that the activities performed throughout the surf session requires high muscular endurance, moderate-high cardio-respiratory endurance and recovery, and anaerobic power of the upper torso [2,11]. Thus, the couches should include a specific training that involves all these metabolisms to improve the surfer performance.

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