



WATER SPORTS AND ABSTAIN TIME AFTER INJURY

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Abstract:

Injuries are painful experiences but also a reality for athletes. This is also the case with water sports such as water skiing and wakeboarding. The nature of both sports gives a multifactorial character to the cause and severity of injuries. The result of these is long abstinence from training, from the games, and the period of returning to competitive action increases. The purpose of this study was to determine the possible relationship between the independent variable of the sport (water-skiing, wakeboard) and the time of abstinence (from training, competing, and return time without physical discomfort). The sample consisted of 140 athletes in both water sports from Greece. The results of the study showed that there are no significant differences between the sports in the time of abstinence from training after injury. However, there are statistically significant differences in the times of abstinence from races and return to races without physical discomfort, with water-skiing athletes abstaining for a significantly longer period. It is recommended to the training and medical staff, to strictly control the athletes for the proper use of the appropriate equipment as a preventive measure, to make an immediate and meticulous diagnosis during the injury, and finally, to follow the protocol of the time required for recovery, to prevent a possible recurrence.

Keywords: sports injuries, water sports, water skiing, wakeboarding, abstinence time

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1. Introduction

Sports injuries are part of sports life and one of the main threats to an athlete's health. Fear of injury can lead to a negative attitude towards participation in a sports activity, which otherwise has a positive effect on health and well-being (Requa et al., 1993). The time of abstention from participating in a sports activity, of a training or competitive nature, is one of the six criteria for categorizing sports injuries based on the severity of the injury (Van Mechelen et al., 1992) and is an important psychological factor that can affect the return of the athlete (Tsongas, 1981).

According to the National Collegiate Athletic Association Injury Surveillance System (NCAA ISS), absenteeism is defined as the time between the onset of an injury and the athletes' return to a level that allows them to compete (Dick et al., 2007). In addition, any injury that requires the athlete to abstain from one or more training units, as well as any injury that requires medical advice and further diagnostic procedures, can be defined as an absenteeism injury (Powell & Barber-Foss, 1999; Powell & Dompier, 2004). The time of abstinence from athletic participation must be calculated accurately, using data from training and competition in which the athlete did not participate, counting the loss in days and weeks (Phillips, 2000).

Research results show that 73% of injuries lead to abstinence for less than 8 days while in basketball and freestyle wrestling athletes are absent for more than 7 days (Powell & Barber-Foss, 1999). Regarding gender, 22% of injuries suffered by males while 16% of injuries suffered by females resulted in abstinence from sports (Powell & Dompier, 2004). Dompier et al. (2007), report that in a sample of 779 athletes, 149 (19.1%) suffered at least one injury that resulted in their abstention from the sport.

2. Literature Review

2.1 Water Ski Injuries

The types of injuries in competitive water skiing are much different from ones that occur in water skiing for leisure (Roberts & Roberts, 1996). Weyman et al. (1996) report the difference observed between the injuries suffered by amateurs about professional water-skiing athletes and that this is due to the better physical condition, the better quality and better and correctly maintained equipment, and the higher level of the technique used by professional athletes. In addition, this is because athletes will perform in a relatively controlled environment, with controlled water conditions, an experienced driver as well as better equipment (Leggett et al., 1996).

Hummel & Gainor (1982) define water skiing injury as "... *any injury that occurs as a result of skiing activity*". The chance of injury is quite high for water skiing athletes in case of a fall. High accelerations combined with the boat's constant but high speed, which can reach up to 58 km / h, as well as the lack of protective equipment, can lead to various types of injuries (Hostetler et al., 2005). During the sport, the force exerted on the upper extremities exceeds 1.5 times the body weight, so it is easy to understand the load borne

by the respective muscle groups (forearm, arm, shoulder girdle), while in case pre-existing injury increases the likelihood of recurrence (Keverline et al., 2003).

The first published research on the sport of water skiing was conducted in 1962 by Romano et al. (1962), to investigate the risks that may arise from participation in water skiing. The researchers cite the lack of literature as well as the need for systematic collection of data that they proposed based on their observation and specific causal injuries mechanisms. In their research, they report that the majority of the injuries concerned different types of fractures, among them the femoral fracture and the tibial fractures. Other injuries include abrasions, bruises, and dislocations from falling into the water. Following their research, they report that quite often the water ski athletes suffer muscle ruptures and sprains in the ankle.

Grace (1974) mentions in particular in competitive water skiing the main causes of injuries are abrasions from the rope during the participation in the trick ski event as well as the non-release of the rope from the athlete's foot, the impact of the athlete with the jump ramp in the jump event and the fall due to excessive speed during the slalom event.

Roberts and Roberts (1996), after analyzing data from the American Water Ski Federation, reported injuries to the lower extremities as the most common injuries. Especially the ligament ruptures in the area of the knee joint and the ankle sprains, the chronic back pain in high-level athletes, the injuries in the shoulder joint for the upper part, as well as the pathology of the spine especially in athletes that participate in the jumping event.

Water-ski is associated with injuries to the hamstring muscles and it has been reported that hamstring injuries to elite water skiers are typically severe and involve partial or total rupture of the proximal hamstring muscles (Petersen and Holmich, 2005). Sallay et al. (1996) studied 12 cases of biceps femoris injury that occurred during the traction of the athlete from the boat. Six of the athletes were beginners and suffered the injury while trying to emerge from the water wearing one or two skis and six were experienced athletes who suffered the injury while falling on the water. The diagnosis of injuries showed partial or total rupture of muscle fibers.

Sallay et al. (1996) agreed that injuries were caused in different ways, but the mechanism of injury was the same in all 12 cases. The incorrect posture of the body resulted in the abrupt extension of the knees with simultaneous excessive bending of the hips. They also mention the specificity of biceps injuries in water skiing and that usually these injuries are much more serious due to the nature of the sport than the injuries that athletes are subject to in other sports.

Hostetler et al. (2005), based on data from the National Electronic Injury Recording System (NEISS) in America, agreed that the most common injuries in water-skiing athletes regardless of gender are strains and sprains with a rate of 36.3% while craniocerebral injuries occur more rarely at a rate of 2.4%. According to a survey of athletes participating in championships in Great Britain, sprains and strains were the most common form of injury (64.6%), while the part of the body that suffered the most injuries was the trunk and the lumbar spine (38.8%) (Loughlin, 2013). In the same study, abrasions and bruises were the most common injury in females (41.2%).

Spine pathology has been reported to be affected depending on the loads the athlete receives in each sport (Boden & Jarvis, 2009), especially in the sport of water skiing where the participation of the athlete is considered necessary from an early age. In a study by Horne et al. (1987), in a sample of 117 athletes in the jump event, 45% of these athletes had some kind of spinal abnormality. It was found that people who had started jumping at the age of fewer than 15 years were found to suffer from Scheuermann-type kyphosis (26%), which is a developmental deformity of the vertebrae, while in athletes who continued their athletic career in jumping was found a positive correlation between years of involvement and the occurrence of spondylolysis and spondylolisthesis in 34%. There is also a high frequency of fractures in the jump event due to the high-speed impacts, either after a collision with the jumping ramp or after falling into the water (Satar et al., 2019).

Based on the international literature review, reference is made to the trick ski event where results show that it has the lowest frequency of injuries. This may be due to the slower towing speed of the boat. However, during the race, athletes performing in the trick event by placing the handle on their feet are at risk of injury. According to a report by the British Water Skiing Federation on injuries in championships between 2000-2008, the figures event had the lowest incidence of injuries (6%) compared to slalom (54%) and jumping (39%) (Loughlin, 2013).

In a questionnaire delivered to 150 orthopedists who undertook sports injuries to investigate knee injuries in water skiing, it was reported that among 106 individual injuries, the most common occurrence was in the lateral ligaments (Wilson & Jackson, 1992). Jung H. et al. (2021), in a survey of 96 athletes they mentioned a total of 336 water skiing-related injuries. The research stated that the highest rate of injuries occurred in the lower-extremity area and more specific in the ankle and feet (26.5%), followed by the injuries at the knee area (16.7%). The age group of the participants was 21.4 +- 2.23 years. The same research stated that the highest rate of injuries the athletes suffered during the jumping event (41.8%), followed by the slalom (39.3%), and last was the trick ski (18.9%). Identifying the injury mechanism in water skiing is of great importance for the diagnosis, as well as for the prevention of injuries. Apart from the human factor, many others, such as the condition of the equipment, the boat, and the weather conditions, contribute to these injuries.

2.2 Wakeboard Injuries

The wide board used by wakeboard athletes, in combination with the foot-mounting system on the board that does not have a specific release mechanism, creates rotational acceleration and deceleration forces during the athlete's fall (Carson, 2004). In wakeboard, the athletes try to show their ability by performing twists, turns, as well as a simultaneous combination of both, something that is of an increased risk since in every effort they try to exceed their limits. It has been observed that the severity of the injury increases according to the athlete's level of ability (Schofer et al., 2014).

Injuries majority occur in the lower extremities with an incidence of 34%, followed by the head area with a percentage of 26% (Carson, 2004). The most common injury

occurs in the knee joint and specifically in the anterior cruciate ligament (Carson, 2004; Narita et al., 2004; Schofer et al., 2014; Starr & Sanders, 2012). The age group that is most vulnerable to this injury is those over 25 (Starr & Sanders, 2012). Isolated cases of rupture of the posterior cruciate ligament during the landing phase after the execution of an aerial maneuver have also been reported (Takahashi et al., 2004) as well as total rupture of the adductor during the athlete's start through the water (Hesch, 2018). Overuse injuries to bones as well as the onset of osteochondritis can occur if there is no proper and targeted recovery from a previous injury (Karantanas, 2010). Injuries to the upper extremities such as tendon ruptures in the shoulder girdle and muscle fractures in the biceps have also been observed (Baker et al., 2010).

In contrast to the above results is the research of Hostetler et al. (2005), who argued that the most common injury among wakeboard athletes is abrasions (31.1%) and specifically in the facial area (59.6%). In 7-year research by Baker et al. (2010), it is reported that in 18,967 recorded wakeboard injuries, 47.9% involved the head and neck area, and 26.5% of the injuries were in the lower extremity area with the highest incidence of sprains and strains. Severe bodily injuries, such as upper limb amputations and cardiovascular hematomas during exercise, have been reported less frequently (Su et al., 2007; Woodacre & Marshall, 2015).

The lack of protective equipment during the sport and in particular the non-use of a helmet can result in the rupture of the eardrum after falling into the water as well as craniocerebral hematomas, which can be fatal for the athlete if there is no immediate treatment (Chia, 2000; Schofer et al., 2010). Frequent contact with water can also be associated with a risk of infection and depending on the geographical location and in combination with the relevant ultraviolet radiation, they act as risk factors for both skin cancer and melanoma (Knobloch, 2017).

2.3 Injuries and Abstain Time from Water Sports

Unfortunately, literature concerning abstaining time from water skiing and wakeboarding due to injuries is quite limited. The only available reference concerns the time of the return of athletes to the sport after an injury is the research of Sallay et al. (1996), for biceps femoris injuries in water-skiing athletes, stating that the time to return to competitive activity after a biceps femur rupture which is a fairly common injury ranges from 3 months to 1.5 years (Chakravarthy et al., 2005).

Depending on the severity of the injury, there are different times for the athlete's return. The athlete should return at a time that minimizes the risk of recurrence (Hsu et al., 2016). Because the season in most sports, such as water skiing, is relatively short, the goal of the rehabilitation team should be to return as soon as possible with the highest safety. In addition to good physical condition, the athlete must have fully regained his confidence to return to the sport.

3. Material and Methods

The sample consisted of 140 water ski and wakeboard athletes, of whom 104 (74.3%) were men and 36 (25.7%) were women (Table 1).

Table 1: Absolute and Relative Frequencies Concerning the Gender

Gender	Absolute Frequency	Relative Frequency (%)
Male	104	74.3
Female	36	25.7
Total	140	100.0

Of the total participants, 92 (65.7%) were water skiing athletes while 48 (34.3%) were Wakeboarding athletes (Table 2).

Table 2: Distribution of Participants According to the Sport

Sport	Absolute Frequency	Relative Frequency
Water Ski	92	65.7
Wakeboard	48	34.3
Total	140	100.0

Of the 140 participants in the survey, 31 (22.1%) stated that they had not suffered any injuries, while most (109, 77.9%) stated that they had suffered at least one injury in their involvement in these sports (Table 3).

Table 3: Distribution of Participants in Terms of Injury Occurrence

Injury	Absolute Frequency	Relative Frequency
No	31	22.1
Yes	109	77.9
Total	140	100.0

A special questionnaire was prepared to conduct the present research and in particular to record the injuries of water ski and wakeboard athletes in Greece. This research tool was designed after a thorough literature review in similar studies and research to record injuries in various sports. For its compilation, a variety of research papers from the international literature have been considered (Junge & Dvorak, 2004; Moreno-Alcaraz et al., 2020; Park et al., 2019; Piri et al., 2020; Willick et al., 2021), while consulting and corresponding researches took place in Greece (Sfiris, 2011; Tyflidis, 2010).

Regarding the data collection process, the researcher converted the questionnaire into electronic form. He wrote a cover letter, informing the prospective participants about the research, its purpose, the anonymity of the answers, and the use of the answers only for research purposes, as well as the optional nature of their participation.

He then contacted the Greek Watersports Federation, requesting its assistance in the electronic distribution of the questionnaires directly from its database. The ultimate goal of this action was, not to let the researcher come in contact in any way with the

personal data of the athletes, that is, not to become aware of or possess the electronic addresses of the athletes. In this way, he ensured the confidentiality of the personal data of the participants, as well as the anonymity of the answers. The answers were collected through the system in an excel spreadsheet automatically and encoded as numerical data.

4. Results and Discussion

Regarding the days of abstinence from training as a result of injury, the results showed 108 cases that were absent from training and 32 cases that were not absent either due to non-injury or due to minor injury. The average number of days off training is $M = 70.63$ ($SD = 85.37$), the median $Mdn = 30$, the range $R\alpha = 365$ with minimum $Min = 0$ and maximum $Max = 365$ (Table 4).

Table 4: Means and Standard Deviations of Abstinence Time from Training

N	Absence Cases	108
	No Absence	32
Mean		70.63
Median		30.00
Standard Deviation		85.373
Range		365
Min		0
Max		365

The Mann-Whitney U Test non-parametric statistical criterion was used to investigate the possible individual differences between the levels of the independent variable of the Sport with the dependent of the Time of abstinence from training. The results of the comparison between the categories Water skiing ($N = 63$) and Wakeboard ($N = 38$), showed that there are no statistically significant differences between these categories ($U = 1067$, $z = -1.954$, $p = .051$). The results show that both water ski and wakeboard athletes have the same abstinence time from training due to an injury (Table 5).

Table 5: Non-Parametric Test between the Independent Variable of the Sport and the Dependent Variable of the Abstinence Time from Training

	Abstinence Time from Training: [Days]
Mann-Whitney <i>U</i>	1067.000
Wilcoxon <i>W</i>	1928.000
<i>Z</i>	-1.954
Asymp. Sig. (2-tailed)	.051

^a. Grouping Variable: Sport

Regarding the days of absence from the competitive activity as a result of the injury, results showed that 101 cases that were absent from competing activity and 39 cases that were not either due to non-injury or due to a minor injury. The average number of days away from the games is $M = 79.5$ ($SD = 116.16$), the median $Mdn = 30$, the range $R\alpha = 365$ with minimum $Min = 0$ and maximum $Max = 365$ (Table 6).

Table 6: Means and Standard Deviations of the Time Abstained from Competitive Activity

N	Absence Cases	101
	No Absence	39
Mean		79.50
Median		30.00
Standard Deviation		116.155
Range		365
Min		0
Max		365

The Mann-Whitney U Test non-parametric statistical criterion was used to investigate the possible individual differences between the levels of the independent variable of the Sport concerning the dependence of the Time of abstinence from the competition. The results of the comparison between the categories Water skiing (N = 67) and Wakeboard (N = 41), showed that there are statistically significant differences between these categories (U = 713, z = -3.505, p = .000). Interpreting the results, the water ski athletes have a significantly longer time of absence from competitive activity in comparison to the wakeboard athletes, who return faster to competition after an injury.

Table 8: Non-Parametric Test between the Independent Variable of the Sport and the Dependent Variable of the Abstention Time from the Competitive Activity

	Abstention Time from Competitive Activity [Days]
Mann-Whitney U	713.000
Wilcoxon W	1454.000
Z	-3.505
Asymp. Sig. (2-tailed)	.000

^a. Grouping Variable: Sport

Regarding the time of return to the competition without physical discomfort, results presented 98 cases that took some time to return to the action without any discomfort and 42 cases that did not abstain either due to non-injury or due to a minor injury. The average days of abstinence for a full return to the games is M = 87.86 (SD = 109.29), the median Mdn = 50, the range Rα = 365 with minimum Min = 0 and maximum Max = 365 (Table 6).

Table 6: Means and Standard Deviations of the Return Time to Competition without Physical Discomfort

N	Absence Cases	98
	No Absence	42
Mean		87.86
Median		50.00
Standard Deviation		109.294
Range		365
Min		0
Max		365

The Mann-Whitney U Test non-parametric statistical criterion was used to investigate the possible individual differences between the levels of the independent variable of the Sport concerning the dependence of the Time of return to the competition without physical discomfort. The results of the comparison between the categories Water skiing (N = 63) and Wakeboard (N = 35, showed that there are statistically significant differences between these categories (U = 740.50, z = -2.703, p = .007). The effect is moderately negative $r = -.27$. Interpreting the results, the water ski athletes have a significantly longer time of return to competitive activity without physical discomfort in comparison to the wakeboard athletes, who return faster in competition without physical discomfort after an injury (Table 7).

Table 7: Non-Parametric Test between the Independent Variable of the Sport and the Dependent Variable of the Return Time to Competition Without Physical Discomfort

	Return Time to Competition Without any Physical Discomfort [Days]
Mann-Whitney <i>U</i>	740.500
Wilcoxon <i>W</i>	1370.500
<i>Z</i>	-2.703
Asymp. Sig. (2-tailed)	.007

^a. Grouping Variable: Sport

5. Conclusion

The purpose of this study was to investigate the relationship between the two water sports, water-skiing, and wakeboarding in terms of abstaining time from training, from competitive activities, and abstaining time to return to competitive activity without physical discomfort. The results showed that water-skiing athletes had significantly longer abstain time from competition activities and longer abstain time from competition activities without physical discomfort than injured wakeboard athletes, with no significant difference in abstain time from training after injury. These differences may be due to the complexity of the movements required during water skiing, the higher speeds developed by the boat, the greater forces applied to the athletes' bodies in water skiing, and the severity of the injuries. For the above reasons, the return to competitive action should take place only if there is a full recovery. Training and medical teams should immediately assess and diagnose the severity of the injury condition and give the necessary time for recovery, without taking any risk of early return that could cause severe recurrence of injury. Finally, it is important for coaches to stick to prevention through the use of precautionary measures and the use of appropriate safety equipment, making it clear to their athletes that it is mandatory and not optional, as the health of the athletes is a priority.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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