Journal of Bodywork & Movement Therapies 40 (2024) 1140–1145

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

Influence of technical skill level and sport specialization on surfing injuries: A cross-sectional study

Aitor Santisteban, Iker Muñoz-Pérez *, Xabier Río, Iker Sáez

Department of Physical Activity and Sport Science, Faculty of Education and Sport, University of Deusto, 48007, Bilbao, Spain

ARTICLE INFO

Handling Editor: Dr Jerrilyn Cambron

Keywords:
Performance
Incidence
Risk factors
Motor skills

ABSTRACT

Objective: This study aimed to analyze the influence of sport specialization and the level of technical skills on injury risk in male surfers.
Design: Descriptive epidemiological study.
Setting: Web-based surveys.
Participants: 295 male surfers participated in the present study, of whom 25 (8.47%) were competitive surfers, and 270 (91.53%) were recreational surfers.
Main outcome measure: This study consisted of a single registry. A web-based survey was used to record information on the injuries sustained during the past year.
Results: No association was detected between the surfer's performance level and having suffered an injury during the practice ($p > 0.05$). Conversely, the results indicated that the higher the level of specialization, the greater the likelihood of suffering a sports-related injury ($\chi 2\ (3) = 12.9\ p = 0.005$; ES = 0.20). In addition, surfers who showed a medium-high self-concept of their skills (scores of 6, 7, and 8) tend not to get fewer injuries ($\chi 2\ (8) = 36.8\ p < 0.001$; ES = 0.35.
Conclusion: higher-level specialization surfers tend to suffer more injuries than lower-specialization surfers. Nevertheless, a good self-concept of technical skills may contribute to a lower likelihood of injury.

1. Introduction

Surfing is considered a booming sport that is increasingly practiced (Moran and Webber, 2013). It is the most practiced sport in natural aquatic environments (Szymski et al., 2021). It might be classified as an adventure and extreme sport due to the specific location where it occurs. These sports are usually characterized by a high risk of injury, which might be unexpectedly high (Caine, 2012). The injury rate during competitive surfing was set at 6.6 injuries per 1000h (Nathanson et al., 2007), and the significance of the lesions is usually moderate to severe (Lowdon et al., 1983). Thus, surfing is considered a relatively safe sport when compared to other adventure or extreme sports (Laver et al., 2017).

Although surfing is not one of the riskiest adventure sports, changing environments (e.g., reef, sand, rocks) may increase the risk of injury (Nathanson et al., 2007). In addition, during sports practice, aspects such as the performance, time of practice, and technical skills of each athlete can play a key role in increasing the risk of injury (Abadi et al., 2021; Arijs et al., 2017; Brymer and Schweitzer, 2013).

In addition to the above-mentioned aspects, it is necessary to consider that surfing is practiced in a changing environment that requires constant decision-making. Therefore, decision-making impacts both sports performance and the possibility of suffering an injury. Factors such as experience, knowledge of wave dynamics, and ability to read and respond to changing wave conditions (Farley et al., 2017) are key to achieving both increased performance and avoiding potential injury.

For this reason, in surfing, improving skills such as decision-making and perceptual-cognitive is mandatory to achieve high performance.

In turn, the aforementioned skills are largely influenced by the surfer's self-perception of their abilities. Perceived sports performance comprises individuals' perception of themselves in terms of actual or perceived fitness and skills. Several studies have established that higher scores on self-perception in questionnaires are related to more physical activity and healthy lifestyle habits (Babic et al., 2014; Mora-Gonzalez et al., 2019). These self-perceptions are created through self-experiences and contextual interpretations. However, there is little scientific evidence on the relationship between actual fitness, perceived fitness and

* Corresponding author. University of Deusto (Physiology Laboratory), Avenida de las Universidades, 24, 48007, Bilbao, Spain.
E-mail address: iker.munoz@deusto.es (I. Muñoz-Pérez).

https://doi.org/10.1016/j.jbmt.2024.07.008
Received 2 October 2023; Received in revised form 5 June 2024; Accepted 7 July 2024
Available online 11 July 2024

how both influence actual sports performance (Henning et al., 2022).

Regarding the cognitive development of surfers, it should be considered that the decision-making time may vary depending on the actions to be performed. Therefore, perceptual-cognitive development is essential to making the best decision, optimizing the technical execution, and preventing wipeouts (Hodges et al., 2021). The time spent in decision-making can vary from minutes or seconds to position oneself at the wave break, to seconds or milli-seconds in the execution of maneuvers (R. Buckley, 2019).

Thus, improving their perceptual ability seems to be one of the fundamental keys to improving performance, leading the surfer to perceive their practice environment in an unusual way. This perceptual anomaly is known as "slow time perception" (R. Buckley, 2019). This phenomenon is characterized by hormonal or neurophysiological adaptation that allows the brain to interpret information from the environment faster (Arstila, 2012). There seems to be sufficient evidence to indicate that surfers unconsciously learn "slow time perception" (R. Buckley, 2014). Proof of this is the body's adjustment in complex situations, like the more skilled ones adapting better when surfing the wave (R. Buckley, 2014).

Like "slow time perception", there are several sports learning processes, such as neuromuscular learning. For all of them, experience and sport modality-specific practice are essential (Dowse et al., 2021). Lack of experience seems to hinder the perception of the environment, causing confusion and consequently increasing the risk of injury (R. Buckley, 2012). For this reason, in this kind of sport, fear and scarcity of confidence can affect the optimization of decision-making, so the surfer's previous training is essential (Rogers and Paskevich, 2021). Hence, it is recommended to perform specific training sessions that correspond to this modality in order to avoid injuries (R. Buckley, 2012; Minghelli et al., 2018).

Greater specificity in training can lead to early sports specialization, which is an increasingly frequent practice among young athletes (Puzzitiello et al., 2021). Currently, there is no agreement on the concept of sports specialization, but two main orientations can be found. On the one hand, it can be understood as the practice of a single sport for eight or more months a year, excluding the practice of other sports (Myer et al., 2015). On the other hand, it might be defined as year-long intensive training that excludes other sports (Jayanthi et al., 2013). This second meaning qualifies the previous one in two aspects: choosing a main sport to focus on and the intensity of practice. This tendency to specialize may be ineffective for long-term sporting success (Rugg et al., 2018).

Specialization may contribute to an increased risk of physical injury and/or burnout (Bell et al., 2018) as the performance of a single sport may introduce highly repetitive movement patterns, thus limiting basic neuromuscular skills that hinder the long-term development of the athlete (D. R. Patel et al., 2017; Schroeder et al., 2015). In the USA alone, the number of injuries due to sports specialization amounts to 4.5 million in the adolescent population (Post et al., 2017).

Likewise, the prevalence of injuries during surfing has been extensively studied, observing higher risks of injury in more technically demanding maneuvers (Furness et al., 2015; McArthur et al., 2020). Therefore, specific work to improve motor skills could make a difference in decreasing the number of injuries (Lubans et al., 2010). Even so, in order to avoid injuries, it is worth mentioning that exercise focused on the integral development of motor skills should be performed (Lubans et al., 2010; Myer et al., 2015). However, to the best of our knowledge, there is a lack of studies focusing on the influence of Surfer skills and performance on the risk of injury.

Therefore, the main objective of this study is to analyze whether injury risk in male surfers is influenced by sport specialization and the self-concept of technical skills. Our initial hypothesis is that as the surfer's level of specialization and self-concept of technical skills increases, the risk of injury increases.

2. Materials and methods

2.1. Study design

To address the established objectives, a cross-sectional study was conducted. The privacy of the data provided by the participants was respected, and they were informed about the aim of the study, recording techniques, and data analysis through informed consent, addressed to both adults and underage individuals. The study was approved by the University of Deusto Ethics Committee (reference: ETK-10/20–21) and was conducted in accordance with the Declaration of Helsinki and meets the European General Data Protection Regulation.

2.2. Participants

The participants (n = 295) were selected by non-probabilistic convenience sampling from a, all of the participants were from the Biscay region, aged 33 ± 10.7 years, of whom 25 (8.47%) were competitive surfers and 270 (91.53%) were recreational surfers. Regarding sporting experience, they had been surfing for 14.4 ± 10.6 years, doing 3.22 ± 2.55 sessions per week, reaching 6.04 ± 4.62 h of practice per week.

The contact with the sample was through local clubs (Bizkaia), through the Biscayan Surfing Federation and through their social networks. The inclusion and exclusion criterias have presented at Table 1.

2.3. Instruments

An ad-hoc questionnaire was designed by a panel of experts in qualitative methods (questionnaires) and sports scientists specialized in injury prevention. The questionnaire consisted of four sections: the first inquired about the participant's socio-demographic information (age, weekly training frequency, etc.). In the second section, the participants answered the questionnaire proposed by Jayanthi et al. (2013) to determine their level of sports specialization. The third part consisted of administering various questions on "self-concept in surfing skills" based on the study by Hutt et al. (2001). In the last section, several questions were asked to determine whether the participants had suffered any injury derived from sports practice, and if so, to classify injuries into five categories (skin injury, bone injury, joint or ligament injury, muscle or tendon injury, and marine injury) (Furness et al., 2015).

2.4. Procedure

After the questionnaire was designed and approved by the University of Deusto ethics committee, a pilot study was conducted using it in November 2020 (n = 20) to assess the clarity and appropriateness of the content. The pilot study demonstrated that it was not necessary to make changes to the designed questionnaire. Subsequently, the principal investigator administered the questionnaire using paper copies before the surfer started his sporting activity.

Questionnaires were administered in April and May 2021. If the participants were underage, the questionnaires were presented to their parents or legal guardians to ensure that the questions were understood and that the answers were valid.

Fig. 1 represents the flow chart that was followed to proceed with the study.

2.5. Statistical analysis

The registered variables were expressed through frequency tables in order to analyze the data. A $\chi 2$ Pearson test, with the contingency coefficient, was performed to determine if there was any significant association between the surfer's performance level, his self-concept of surfing skills, level of specialization, and having suffered an injury. If the previous analysis showed a significant association, Cramérs's V was set to establish the effect size ($\leq$0.2 "small", 0.2 > 0.6$\leq$ "medium", and

Table 1
Inclusion and exclusion criteria.

Inclusion criteria
Participants had to be of legal age
The surfers had a minimum of one year's surfing experience.
A minimum of 5 h of surfing per week
People residing in the study area (bay of Biscay).
Surfers that correspond to that of shortboard surfers
Exclusion criteria
Surfers with chronic pathologies (EPOC, cardiopaties, …)
Those who are not willing to provide accurate and complete information about their injury.
Surfers specializing in big waves
Surfers with amputations
Surfers who have taken beginner surf lessons in the last 12 months
Not answering all the required items

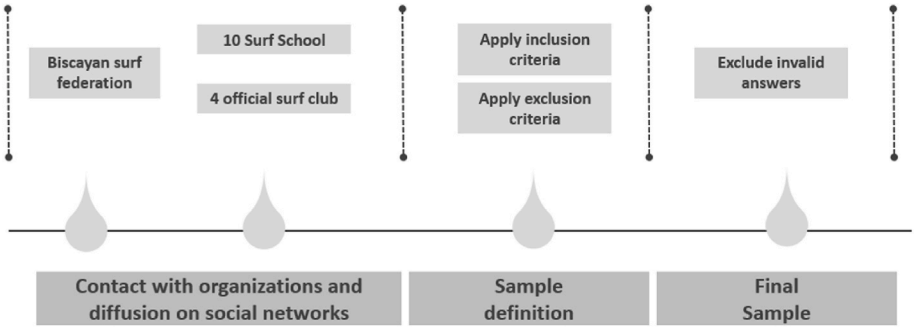

Fig. 1. The flow chart of the study.

>0.6 "large"). Subsequent correspondence analysis was performed to set the proximity relationship between variables. Odds ratio (OR) was established to quantify the strength of the association between being a competitive surfer, regardless of performance, and having been injured while surfing.

The statistical analysis was carried out using the 2.3 version of Jamovi (Sidney, Australia), with a level of significance $p < 0.05$.

3. Results

After applying the inclusion and exclusion criteria, 295 participants participated in this study. Table 2 shows the sample characteristics according to the surfers' level of practice. It should be noted that 91.53% of the surfers were recreational, while the remaining 8.47% competed regularly for local, national, and/or international events.

As expected, the higher the performance level, the higher the training volume and frequency of sessions per week.

The sample distribution according to the level of experience, self-concept of surfing skills, and number of surfers who had suffered an injury due to surfing is shown in Table 3. It was highlighted that 70.7 % claimed to have suffered an injury while surfing and most participants had a good self-concept of their surfing skills (≥6 scores). Almost half of the surfers were classified as high (45.1 %), according to their level of specialization.

Table 3
Sample's characterization.

Item		Frequency (%)
Level of specialization	Very low level	22 (7.5 %)
	Low level	35 (11.9 %)
	Middle level	105 (35.6 %)
	High level	133 (45.1 %)
Self-concept of surfing skills (Hutt's rating, 2001)	1	5 (1.7 %)
	2	19 (6.4 %)
	3	27 (9.1 %)
	4	43 (14.5 %)
	5	69 (23.3 %)
	6	91 (30.7 %)
	7	27 (9.1 %)
	8	13 (4.4 %)
	9	0 (0.0 %)
	10	1 (0.3 %)
Injured in sports practice	Yes	208 (70.6 %)
	No	87 (29.4%)

Data are presented as absolute and relative frequencies.

No association was detected between surfer performance level and having suffered an injury during practice ($p > 0.05$). However, when participants were divided according to whether they participated in competitions, a significant association was observed between this and

Table 2
Training background based on surfer's performance level.

		Training frequency (session/week)		Training volume (hours/week)		Training experience (years)			
						Percentile			
	Frequency (%)	$\bar{x}$	SD	$\bar{x}$	SD	Me	25th	50th	75th
High performance (WQS)	11 (3.73 %)	9.27	3.50	12.82	5.69	13	6.5	9.00	12.00
Competition (provincial or regional championships)	14 (4.75 %)	6.64	2.37	13.07	5.05	14	5.25	7.00	8.00
Federated recreational	266 (90.17 %)	2.77	2.00	5.39	4.02	10	1.75	3.50	5.75
Recreational	4 (1.36 %)	4.00	3.16	5.50	3.87	5	1.00	2.00	3.00

injury during practice ($\chi 2$ (1) = 3.98, $p < 0.05$; ES = 0.122) (Table 4).

Regarding the relationship between participation in a surf competition, independently of the surfer performance, and the likelihood of suffering from an injury during practice, the OR showed that they increased the exposure to an injury by 3.29 times (IC 95% 0.96–11.31).

Analysis of the results regarding the level of specialization and having suffered an injury during sports practice revealed a significant association with dependence ($\chi 2$ (3) = 12.9, p = 0.005; ES = 0.204). The following correspondence analysis showed that a higher level of specialization is associated with the possibility of injury as a consequence of sports practice (Fig. 2).

Regarding the relationship between self-concept of surfing skills and suffering an injury, the $\chi 2$ Pearson test showed a significant association between these variables ($\chi 2$ (8) = 36.8, $p < 0.001$; ES = 0.353). Subsequent descriptive correspondence analysis showed a stronger association between surfers with a medium-high self-concept of their skills (scores of 6, 7, and 8) and a lower trend of suffering an injury (Fig. 3).

4. Discussion

Our previous hypothesis has been corroborated partially. On one hand, the results showed a significant positive association between higher sport specialization and the risk of injury during surfing practice (Fig. 2). On the other hand, our results demonstrated a relationship between the self-concept of the surfer's skills and the risk of suffering an injury during sports practice. In this sense, the higher the self-concept of surfers' skills, the lower the likelihood of suffering sports injuries (Fig. 3).

In the present study, the year before data collection, 70.7% (N = 208) of our surfers had suffered some kind of injury related to their surf practices. These data are far from the results of previous studies (Furness et al., 2015; Minghelli et al., 2018; Mitchell et al., 2013) on the same type of athletes. Minghelli et al. (2018) showed a lower percentage of injuries than our study (29.6% vs. 70.7%). Similarly, Australian surfers showed that the injury rate was lower than that in our results 37,98% (Furness et al., 2015). One of the possible causes for the differences in injury percentage between our study and those conducted with Portuguese (Minghelli et al., 2018) and Australian (Fuernes et al., 2015) populations may be the lower number and type of shoreline breakers. However, it was not possible to make a comparison because these data have not been reported in previous studies.

Regarding the tendency to suffer an injury during surf practice, the surfer's performance group might be a key factor in understanding the higher risk of displaying damage. The tendency of high-performance surfers to develop injury rather than lower-performance surfers was verified by our results (88% vs. 68,9%, competitive and recreational, respectively). This tendency is in accordance with the results of a previous study conducted by Furness et al. (2015), which showed a higher tendency to suffer from an injury if surfers took part in competition than recreational and non-competitor surfers (43.1% vs. 35.07% respectively). However, Furness et al. (2015) did not achieve the same overall high percentage of injuries as in our study.

The number of exposures could partially explain this large difference in the percentage of injuries among competitive surfers. In other words, the frequency with which these surfers participated in competitions.

Table 4
Association between participating or not in a surfing competition and the risk of suffering an injury.

	¿Developed an injury during the practice?		
Type of surfers	No	Yes	Total
Participate in sporting events	3 (12.0%)	22 (88.0%)	25 (100%)
Do not participate in sporting events	84 (31.1%)	186 (68.9 %)	270 (100%)
Total	87 (29.4%)	208 (70.6%)	295 (100%)

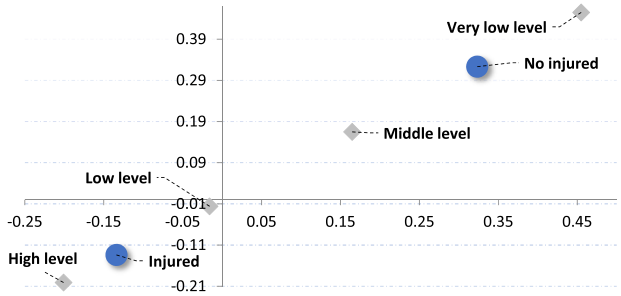

Fig. 2. Correspondence analyses regarding the surfer's level of specialization and suffering an injury.

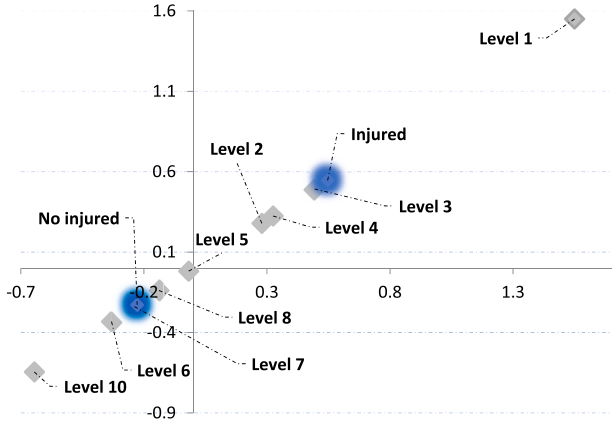

Fig. 3. Correspondence analyses regarding the surfer's self-concept and suffering an injury.

Previous studies have highlighted that just by participating in competitions, surfers increase the risk of injury by pursuing maximum performance (Martins et al., 2022; Minasian and Hope, 2022). Moreover, as has been established in other sports, athletes who regularly participate in competition tend to suffer more injuries than recreational and non-competitive athletes because of the higher training load and performance demand (Junge et al., 2004). Nonetheless, it is difficult to compare the results of different studies with ours because of the lack of data on competition frequency and time of exposure.

Another explanation for this large difference between the injury prevalence of the participants in our study and previous studies could be based on surroundings and environmental conditions (McArthur et al., 2020; Nathanson et al., 2007). The type of seabed (i.e., rocky, sand, reef, etc.) increases the likelihood and seriousness of injury because of possible contact (McArthur et al., 2020; B. J. Patel et al., 2020). Simultaneously, environmental conditions such as wave size, direction, shape, and/or force lead to a higher incidence of injury when the surfer faces a larger wave (Nathanson et al., 2007).

This lack of information makes it difficult to compare the results of our study with those of previous studies (Furness et al., 2015; Minghelli et al., 2018; Mitchell et al., 2013) because it makes it difficult to compare injury incidences without key variables such as seabed and environment (Patel et al., 2020) and sea conditions.

Beyond environmental factors, several authors have noted that the level of specialization is a key factor that might influence the prevalence of injury during sports practice (P. S. Buckley et al., 2017; McLellan et al., 2022; Post et al., 2017). In this respect, our results are in accordance with those of previous studies. Our data suggested a significant relationship between specialization level and suffering an injury during practice; as the specialization level increases, the number of surfers

injured increases. However, specialization in one sport might lead to years of intensive training, excluding other sports (Jayanthi et al., 2013). For this reason, it is difficult to establish whether the real causes of the increasing likelihood of injury during practice are premature specialization or an increase in training volume and load because both are typically combined or linked together.

Regarding early sports specialization, Lloyd et al. (2016) suggested that this might limit the development of fundamental motor skills, such as balance, coordination, and agility (Lloyd et al., 2016). This produces a lack of diversity in movement, which increases the susceptibility to musculoskeletal injuries (Myer et al., 2015).

However, this evidence should not be interpreted as excluding sport-specific training. Several studies support the convenience of discipline-specific technical development to avoid sport-specific injuries, as long as fundamental skills have been trained beforehand (Bruton et al., 2013; Goodway and Robinson, 2015; Lloyd et al., 2015).

One of the main results of the present study was to corroborate the relationship between the self-concept of the surfer's skills, measured by the Hutt et al. scale (2001), and the likelihood of injury. The results show that surfers with a higher self-concept of their skills are less prone to injury (Fig. 3). This can be partly explained by the fact that these surfers take fewer risks in their maneuvers as they are aware of their technical limitations (surfer's self-concept). Similarly, their good self-concept of surf skills makes it plausible that their decision-making is less risky, making them less prone to injury (Williams and Andersen, 1998). In addition, surfers with a medium-high self-concept are more skilled in all types of maneuvers, which could be related to fall avoidance during surfing.

One of the most relevant aspects of this study is to highlight the importance of sports specialization and the surfer's self-concept, which can influence the risk of injury. Thus, these concepts should be considered to maximize injury-prevention strategies.

Limitations and future lines of research.

The present study has several limitations, one of which was the retrospective data collection. This type of achieving data is based on the participant's injury memories, which could result in a lack of accuracy in the results and interpretation. However, this error was minimized as much as possible by collecting only injuries recorded during the past year.

Another limitation of our study was the possibility that the number of injured surfers answering this survey was higher than those without any injury, as previous studies have pointed out (McArthur et al., 2020).

Another limitation was that the number of training hours was not recorded. These data are important, since several studies showed a large correlation between the number of training hours and the risk of injury in different sports (Drew and Finch, 2016; Eckard et al., 2018). On the other hand, one of the main limitations is the study's design (cross-sectional and not longitudinal), which made it impossible to determine under what conditions (surroundings and environment) the surfers' injuries occurred, which might be a key factor in the injury mechanism.

Future studies should consider whether surfers' injuries have been diagnosed by GP. This would be a key point in increasing the accuracy of real injury data in subsequent surveys.

Finally, it would also be helpful to determine the effectiveness of injury prevention strategies in terms of equipment, such as wetsuits and helmets. Further analysis by type, location, and severity of injury according to the level of each surfer will allow for the development of specific prevention strategies for each level of competition. Therefore, future studies should consider controlling for previous variables to decrease the risk of injury during sports practice.

5. Conclusion

To the best of our knowledge, this study is the first to show a relationship between sport specialization and the self-concept of technical skills and the risk of injury in surf.

This study found that competitive surfers tend to suffer injuries 3.9 (OR) times more often than recreational surfers. However, comparing these results with previous studies is difficult because environmental and surface conditions may play a key role in the likelihood of injury. To the best of our knowledge, this valuable data has not been reported in previous studies.

Our results suggest a direct relationship between surfers' level of specialization and the risk of injury. Thus, early sports specialization could cause a lack of fundamental motor skills, which is linked with a higher risk of injury.

In addition, surfers who have mastery of more advanced maneuvers (6–8 on Hutt's scale) are less likely to be injured. This can be attributed to the fact that they are proficient surfers, being able to perform all types of maneuvers safely, avoiding stressful situations that the uncertainty of sea conditions may cause, and/or avoiding falls caused during the execution of the maneuvers.

Although sustaining an injury is a multifactorial event, the self-concept of the surfer's skills, especially recreational ones, can be a protective mechanism to avoid sports-related injuries.

Funding

"This research received no external funding".

Institutional review board statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of University of Deusto (protocol code ETK-10/20–21, 29-10-2020).

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Data availability statement

Data supporting reported results can be found by mailing authors.

CRediT authorship contribution statement

Aitor Santisteban: Writing – review & editing, Writing – original draft, Visualization, Supervision, Methodology, Investigation, Formal analysis. **Iker Muñoz-Pérez:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation. **Xabier Río:** Writing – review & editing, Writing – original draft, Supervision, Methodology. **Iker Sáez:** Writing – original draft, Supervision, Investigation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: The authors declare that they do not have any financial interest/personal relationships wich may be considered as potential competing interests.

Acknowledgments

To all athletes participating in the study.

References

Abadi, M.R., Widyahening, I.S., Sudarsono, N.C., Tobing, A.J., 2021. Incidence rate of musculoskeletal injuries among Professional Tennis Players during 2019 international tournaments in Indonesia. J. Sports Sci. Med. 20 (2), 268–274. https://doi.org/10.52082/jssm.2021.268.

Arijs, C., Chroni, S., Brymer, E., Carless, D., 2017. 'Leave your ego at the door': a narrative investigation into effective wingsuit flying. Front. Psychol. 8, 1985. https://doi.org/10.3389/fpsyg.2017.01985.
Arstila, V., 2012. Time slows down during accidents. Front. Psychol. 3, 196. https://doi.org/10.3389/fpsyg.2012.00196.
Babic, M.J., Morgan, P.J., Plotnikoff, R.C., Lonsdale, C., White, R.L., Lubans, D.R., 2014. Physical activity and physical self-concept in youth: systematic review and meta-analysis. Sports Med. 44 (11), 1589–1601. https://doi.org/10.1007/s40279-014-0229-z.
Bell, D.R., Post, E.G., Trigsted, S.M., Schaefer, D.A., McGuine, T.A., Watson, A.M., Brooks, M.A., 2018. Sport specialization characteristics between rural and suburban high school athletes. Orthopaedic J Sports Med 6 (1).
Bruton, M., O'Dwyer, N.J., Adams, R.D., O'Dwyer, N.J., Adams, R.D., 2013. Neuromuscular characteristics of recreational and competitive male and female surfers. Int. J. Perform. Anal. Sport 13 (2), 388–402. https://doi.org/10.1080/24748668.2013.11868656.
Brymer, E., Schweitzer, R., 2013. Extreme sports are good for your health: a phenomenological understanding of fear and anxiety in extreme sport. J. Health Psychol. 18 (4), 477–487. https://doi.org/10.1177/1359105312446770.
Buckley, P.S., Bishop, M., Kane, P., Ciccotti, M.C., Selverian, S., Exume, D., Emper, W., Freedman, K.B., Hammoud, S., Cohen, S.B., Ciccotti, M.G., 2017. Early single-sport specialization: a survey of 3090 high school, collegiate, and professional athletes. Orthopaedic J Sports Med 5 (7), 232596711770394. https://doi.org/10.1177/2325967117703944.
Buckley, R., 2012. Rush as a key motivation in skilled adventure tourism: resolving the risk recreation paradox. Tourism Manag. 33 (4), 961–970. https://doi.org/10.1016/j.tourman.2011.10.002.
Buckley, R., 2014. Slow time perception can be learned. Front. Psychol. 5, 209. https://doi.org/10.3389/fpsyg.2014.00209.
Buckley, R., 2019. Cognitive timescales in highly skilled physical actions learned through practice: a 20-year participant observation analysis of recreational surfing. J Outdoor Recreation Tour 27, 100231. https://doi.org/10.1016/j.jort.2019.100231.
Caine, D.J., 2012. The epidemiology of injury in adventure and extreme sports. Med. Sport Sci. 58, 1–16. https://doi.org/10.1159/000338558.
Dowse, R.A., Secomb, J.L., Bruton, M., Parsonage, J., Ferrier, B., Waddington, G., Nimphius, S., 2021. Ankle proprioception in male and female surfers and the implications of motor experience and lower-body strength. J. Strength Condit Res. https://doi.org/10.1519/JSC.0000000000004126.
Drew, M.K., Finch, C.F., 2016. The relationship between training load and injury, illness and soreness: a systematic and literature review. Sports Med. 46 (6), 861–883. https://doi.org/10.1007/s40279-015-0459-8.
Eckard, T.G., Padua, D.A., Hearn, D.W., Pexa, B.S., Frank, B.S., 2018. The relationship between training load and injury in athletes: a systematic review. Sports Med. 48 (8), 1929–1961. https://doi.org/10.1007/s40279-018-0951-z.
Farley, O.R.L., Abbiss, C.R., Sheppard, J.M., 2017. Performance analysis of surfing: a review. J. Strength Condit Res. 31 (1) https://doi.org/10.1519/JSC.0000000000001442.
Furness, J., Hing, W., Walsh, J., Abbott, A., Sheppard, J.M., Climstein, M., 2015. Acute injuries in recreational and competitive surfers: incidence, severity, location, type, and mechanism. Am. J. Sports Med. 43 (5), 1246–1254. https://doi.org/10.1177/0363546514567062.
Goodway, J.D., Robinson, L.E., 2015. Developmental trajectories in early sport specialization: a case for early sampling from a physical growth and motor development perspective. Kinesiol. Rev. 4 (3), 267–278. https://doi.org/10.1123/kr.2015-0028.
Henning, L., Dreiskämper, D., Tietjens, M., 2022. The interplay of actual and perceived physical fitness in children: effects on motivation and physical activity. Psychol. Sport Exerc. 58, 102055 https://doi.org/10.1016/j.psychsport.2021.102055.
Hodges, N.J., Wyder-Hodge, P.A., Hetherington, S., Baker, J., Besler, Z., Spering, M., 2021. Topical review: perceptual-cognitive skills, methods, and skill-based comparisons in interceptive sports. Optom. Vis. Sci. : Offi Pub American Aca Opto 98 (7), 681–695.
Hutt, J.A., Black, K.P., Mead, S.T., 2001. Classification of surf breaks in relation to surfing skill. J. Coast Res. 29, 66–81. http://www.jstor.org/stable/25736206.
Jayanthi, N., Pinkham, C., Dugas, L., Patrick, B., LaBella, C., 2013. Sports specialization in young athletes: evidence-based recommendations. Sport Health: A Multidisciplinary Approach 5 (3), 251–257. https://doi.org/10.1177/1941738112464626.
Junge, A., Dvorak, J., Graf-Baumann, T., Peterson, L., 2004. Football injuries during FIFA tournaments and the olympic games, 1998-2001. Am. J. Sports Med. 32 (1_Suppl. l), 80–89. https://doi.org/10.1177/0363546503261245.
Laver, L., Pengas, I.P., Mei-Dan, O., 2017. Injuries in extreme sports. J. Orthop. Surg. Res. 12, 59. https://doi.org/10.1186/s13018-017-0560-9.
Lloyd, R.S., Cronin, J.B., Faigenbaum, A.D., Haff, G.G., Howard, R., Kraemer, W., Micheli, L.J., Myer, G.D., Oliver, J.L., 2016. National strength and conditioning association position statement on long-term athletic development. J. Strength Condit Res. 30 (6), 1491–1509. https://doi.org/10.1519/JSC.0000000000001387.
Lloyd, R.S., Oliver, J.L., Faigenbaum, A.D., Howard, R., De Ste Croix, M.B.A., Williams, C.A., Best, T.M., Alvar, B.A., Micheli, L.J., Thomas, D.P., Hatfield, D.L., Cronin, J.B., Myer, G.D., 2015. Long-term athletic development- Part 1. J. Strength Condit Res. 29 (5), 1439–1450. https://doi.org/10.1519/JSC.0000000000000756.
Lowdon, B.J., Pateman, N.A., Pitman, A.J., 1983. Surfboard-riding injuries. Med. J. Aust. 2 (12), 613–616.
Lubans, D.R., Morgan, P.J., Cliff, D.P., Barnett, L.M., Okely, A.D., 2010. Fundamental movement skills in children and adolescents: review of associated health benefits. Sports Med. 40 (12), 1019–1035. https://doi.org/10.2165/11536850-000000000-00000.
Martins, F., França, C., Marques, A., Iglésias, B., Sarmento, H., Henriques, R., Ihle, A., Lopes, H., Ornelas, R.T., Gouveia, E.R., 2022. Sports injuries of a Portuguese professional football team during three consecutive seasons. Int. J. Environ. Res. Publ. Health 19 (19), 12582. https://doi.org/10.3390/ijerph191912582.
McArthur, K., Jorgensen, D., Climstein, M., Furness, J., 2020. Epidemiology of acute injuries in surfing: type, location, mechanism, severity, and incidence: a systematic review. Sports 8 (2), 25. https://doi.org/10.3390/sports8020025.
McLellan, M., Allahabadi, S., Pandya, N.K., 2022. Youth sports specialization and its effect on professional, elite, and olympic athlete performance, career longevity, and injury rates: a systematic review. Orthopaedic J Sports Med 10 (11), 232596712211295. https://doi.org/10.1177/23259671221129594.
Minasian, B., Hope, N., 2022. Surfing on the world stage: a narrative review of acute and overuse injuries and preventative measures for the competitive and recreational surfer. Br. J. Sports Med. 56 (1), 51–60. https://doi.org/10.1136/bjsports-2021-104307.
Minghelli, B., Nunes, C., Oliveira, R., 2018. Injuries in recreational and competitive surfers: a nationwide study in Portugal. J. Sports Med. Phys. Fit. 58 (12), 1831–1838. https://doi.org/10.23736/S0022-4707.17.07773-8.
Mitchell, R., Brighton, B., Sherker, S., 2013. The epidemiology of competition and training-based surf sport-related injury in Australia, 2003–2011. J. Sci. Med. Sport 16 (1), 18–21. https://doi.org/10.1016/j.jsams.2012.05.009.
Mora-Gonzalez, J., Esteban-Cornejo, I., Cadenas-Sanchez, C., Migueles, J.H., Molina-Garcia, P., Rodriguez-Ayllon, M., Henriksson, P., Pontifex, M.B., Catena, A., Ortega, F.B., 2019. Physical fitness, physical activity, and the executive function in children with overweight and obesity. J. Pediatr. 208, 50–56.e1. https://doi.org/10.1016/j.jpeds.2018.12.028.
Moran, K., Webber, J., 2013. Surfing injuries requiring first aid in New Zealand, 2007-2012. Int. J. Aquat. Res. Educ. 7 (3), 192–203. https://doi.org/10.25035/ijare.07.03.03.
Myer, G.D., Jayanthi, N., Difiori, J.P., Faigenbaum, A.D., Kiefer, A.W., Logerstedt, D., Micheli, L.J., 2015. Sport specialization, Part I: does early sports specialization increase negative outcomes and reduce the opportunity for success in young athletes? Sport Health 7 (5), 437–442. https://doi.org/10.1177/1941738115598747.
Nathanson, A., Bird, S., Dao, L., Tam-Sing, K., 2007. Competitive Surfing Injuries: a Prospective Study of Surfing-Related Injuries Among Contest Surfers, 35, pp. 113–117. https://doi.org/10.1177/0363546506293702, 1.
Patel, B.J., Heath, M.R., Geannette, C.S., Fabricant, P.D., Greditzer, H.G., 2020. When the wave breaks you: magnetic resonance imaging findings after surfing injuries. Sport Health: A Multidisciplinary Approach 12 (1), 88–93. https://doi.org/10.1177/1941738119880863.
Patel, D.R., Yamasaki, A., Brown, K., 2017. Epidemiology of sports-related musculoskeletal injuries in young athletes in United States. Transl. Pediatr. 6 (2), 160–166.
Post, E.G., Thein-Nissenbaum, J.M., Stiffler, M.R., Brooks, M.A., Bell, D.R., Sanfilippo, J. L., Trigsted, S.M., Heiderscheit, B.C., McGuine, T.A., 2017. High school sport specialization patterns of current division I athletes. Sport Health 9 (2), 148–153.
Puzzitiello, R.N., Rizzo, C.F., Garvey, K.D., Garvey, K.D., Matzkin, E.G., Salzler, M.J., 2021. Early sports specialisation and the incidence of lower extremity injuries in youth athletes: current concepts. J ISAKOS : Joint Dis Ortho Sports Med 6 (6), 339–343.
Rogers, M., Paskevich, D., 2021. Experience and management of fear in men's world cup alpine ski racing. Front. Psychol. 12, 682059 https://doi.org/10.3389/fpsyg.2021.682059.
Rugg, C., Kadoor, A., Feeley, B.T., Pandya, N.K., 2018. The effects of playing multiple high school sports on national basketball association players' propensity for injury and athletic performance. Am. J. Sports Med. 46 (2), 402–408. https://doi.org/10.1177/0363546517738736.
Schroeder, A.N., Comstock, R.D., Collins, C.L., Everhart, J., Flanigan, D., Best, T.M., 2015. Epidemiology of overuse injuries among high-school athletes in the United States. J. Pediatr. 166 (3).
Szymski, D., Achenbach, L., Siebentritt, M., Simoni, K., Kuner, N., Pfeifer, C., Krutsch, W., Alt, V., Meffert, R., Fehske, K., 2021. Injury epidemiology of 626 athletes in surfing, wind surfing and kite surfing. Open Access J. Sports Med. 12, 99–107. https://doi.org/10.2147/oajsm.s316642.
Williams, J.M., Andersen, M.B., 1998. Psychosocial antecedents of sport injury: review and critique of the stress and injury model'. J. Appl. Sport Psychol. 10 (1), 5–25. https://doi.org/10.1080/10413209808406375.