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Systematic Review

Safety Measures and Risk Analysis for Outdoor Recreation Technicians and Practitioners: A Systematic Review

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Abstract: There is no expectation to suppress all accidents in the outdoor recreation sector; nevertheless, it is expected that all possible safety measures are taken in order to minimize the risk of accidents. The objective of this study was to systematize the knowledge regarding recommended and used safety measures and risk assessments for technicians and outdoor recreation practitioners. We conducted a systematic review on PubMed, BVS, SciELO, Science Direct, ABI/INFORM, Spinger, Web of Knowledge, and Esmerald full text databases, up to February 2021. The eligible criteria followed the PICOS strategy; the included risk assessment studies on outdoor recreation (according to its definition) had methodological quality, were indexed, and peer reviewed. Ten studies, from ten countries, fulfilled these specifications, which focused on different approaches. Five studies focused on risk perception, four studies focused on safety practices, injuries, and risk assessment; three studies addressed safe behaviors; two studies addressed equipment- and risk matrix-related themes. We concluded that there was a concern for this topic, and the 28 mentioned measures could provide important information regarding health and prevention. These measures could be used to develop safety strategies and risk reduction, aimed at reducing accidents in outdoor recreation activities. In order to evaluate the pertinence and importance of the mentioned measures, namely risk perception, safe practices, sport injuries, risk analysis, safe behaviors, as well as equipment and risk assessment matrices, further investigation is needed using experimental or observational designs. These strategies and procedures can contribute to enhanced interventions by technicians with higher security and quality, and therefore, improved well-being and satisfaction of practitioners.

Keywords: outdoor recreation; safety measures; risk assessment; accidents; injuries

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1. Introduction

The development of significant management and prevention strategies requires comprehensive knowledge of all the factors that increase risk, including a profound understanding of the sources of risk (dangers) and their associated human motivations, attitudes, perceptions, and behaviors, as well as managing contexts and other relevant restrictions [1]. Practitioners and technicians, when confronted with risk, behave differently and have specific responses, depending on the context. This premise means that in order for strategies to effectively prevent and manage risk, they need to be adapted for the target audience. The design of effective safety strategies requires an interdisciplinary approach that integrates the available knowledge [2].

Outdoor recreation and tourism activities have experienced vast growth. This growth is the result of the public specifically seeking activities that involve a certain level of danger, satisfaction, and adventure [3–5].

Haegeli et al. [1] recommended identifying risk behaviors depending on the context, for an improved understanding of different segments of the population involved in these activities. This information would provide the basis for developing effective solutions to address outdoor recreation and tourism risks. Mata and Carvalhinho [6] was concerned about practitioners' and technicians' understanding of the associated risks of these activities. Therefore, the objective of our analysis was to investigate safety measures and risk assessment of outdoor recreation activities for practitioners and technicians.

1.1. Outdoor Recreation and Nature-Based Sports Investigation

Various studies have been conducted on safety measures, risk assessment, and management. In Table 1, we highlight some of the most studied themes.

Table 1. Studied themes about outdoor recreation tourism and nature-based sports.

Accidents and injuries	Bentley and Page (2008) [7]; Boyd, Haegeli, Abu-Laban, Shuster, and Butt (2009) [8]; Brighton, Sherker, Brander, Thompson, and Bradstreet (2013) [9]; Greene, Jamieson, and Logan (2014) [10]; Haegeli, Falk, Brugger, Etter, and Boyd (2011) [11]; Mei-Dan and Carmont (2013) [12]; Monasterio (2005) [13]; Nathanson et al. (2015) [14]; Windsor, Firth, Grocott, Rodway, and Montgomery (2009) [15]
Accident's analysis and prevention	Bentley and Page (2008) [7]; Brackenreg (1999) [16]; Davidson (2004, 2007) [17,18]; Jenkins and Jenkinson (1993) [19]; Johnson et al. (2016) [20]; Rasmussen (1997) [21]; Salmon et al. (2010, 2012, 2014, 2018, 2020) [22–25]; Zakaria et al. (2015) [26]
Risk perception and management	Hendrikx, Johnson, and Shelly (2016) [27]; Johnson, Haegeli, Hendrikx, and Savage (2016) [28]; Molm, Takahashi, and Peterson (2000) [29]; Van Riper et al. (2016) [30]
Decision making	Adams (2005) [31]; Carson et al. (2020) [32]; Furman et al. (2010) [33]; Gigerenzer and Gaissmaier (2011) [34]; Jamal et al. (2019) [35]; Jones and Yamamoto (2016) [36]; Stewart-Patterson (2016) [37]; Trotter et al. (2018) [38]; Walker and Latosuo (2016) [39]; Wheeler (2008) [40]; Pomfret and Bramwell (2016) [41]; Holyfild and Fine (1997) [42]
Ergonomic methods evaluation	Cassano-Piche et al. (2009) [43]; Jenkins et al. (2010) [44]; McLean et al. (2020) [45]; Salmon et al. (2018, 2020) [25,26]
Risk assessment	Cater (2006) [46]; Clinch and Filimonau (2017) [47]; Dallat et al. (2018) [48]; Wall (2020) [49]; Wang et al. (2019) [50]; Webster (2015) [51]; Callander and Page (2003) [52]; Hansen et al. (2019) [53]
Materials and equipment	Duerden (2009) [54]; Haegeli et al. (2014) [55]; Strapazzon et al. (2018) [56]; Vogwell and Minguez (2007) [57]

1.2. Outdoor Recreation

There is no common designation for outdoor recreation; several designations are used depending on whether it is seen from a tourist, sport, or environmental perspective. Some of these designations are: Nature Sports, Outdoor Adventure Tourism, Outdoor or Extreme Sport; or Outdoor Recreation [58]. Outdoor recreation activities comprise physical activities that differ from traditional sports since they involve nature, environmental unpredictability, equipment and specialized materials, as well as a sense of thrill, adrenaline, risk, strong emotions, and overcoming fear. This kind of language is widely embedded in those who practice these adventure sports assuming some calculated risk [59]. These adventure sports

can lead practitioners to talk about their feelings of exploration of different environments such as land, water, and air [6].

Recently, the development and growth of national and international tourism has led to an increase in outdoor recreation activities, characterized by risk and environmental unpredictability. Outdoor recreation and nature-based tourism have exponentially increased in popularity [60–62]. In developed countries, outdoor recreation and nature-based activities have become the trademark of a healthy and modern lifestyle [2]. Risk is a challenge that provokes fear and, at the same time, an unmistakable pleasure, caused by the fusion of the different elements of sports, adventure, radicalness, and nature. It is considered that risk acts as a stimulus and a source of pleasurable feelings for the individuals involved or drawn to these adventure activities. In addition, there are more and more concerns regarding safety issues associated with participation in these adventure activities, due associated risks such as falls, slips, drowning, and other dangers related to the activities [6].

1.3. Outdoor Recreation Risks

The various outdoor recreation activities entail several other risks depending on the type of activity, various risk factors, and on the context of the uncertainty associated with the activity.

According to ISO 31000:2018 [63], risk is defined as the "effect of uncertainty on objectives", an effect is a positive or negative deviation from what is expected. Uncertainty, in risk assessment and management context, represents the lack of information that leads to inadequate comprehension or incomplete knowledge of a probability (frequency) and consequence (seriousness) of an event [51]. Tourist companies and their technicians should follow the ISO 31000:2018 [63] recommendations that include a risk management process supported by the ISO/IEC 31010 [64] which provides guidance about the selection and systematic technique requirements for the risk assessment process.

Historically, risk assessment approaches in outdoor recreation have been centered on certain directives such as: (i) minimum experience or qualification of leaders; (ii) minimum and/or maximum number of participants; (iii) maximum number of participants per leader; (iv) the requirement of participants' previous experiences; (v) equipment and certification processes [23,65].

Personal risks while practicing outdoor sports have a particular set of characteristics and risk sources that are obvious and commonly known. Self-knowledge of personal technical and psychological skills should be used to control the risk (up to a certain level). Risk consequences are also commonly known in the case of accidents that can be fatal; however, there can be great personal and social benefits associated with the risk [2].

1.4. Risk Analysis

In terms of risk and in relation to the risk and potential consequences, after identifying the risk, the next phase is to approach risk assessment. This analysis can be quantitative, qualitative, or a combination of both, depending on circumstances [66,67].

Since both quantitative and qualitative analyses have significant roles in risk comprehension, ISO 31000:2018 [63] does not indicate a preference for either type of analysis. A qualitative analysis is more often used for outdoor activities and nature-based sports, [68] particularly describing and classifying the odds of an accident occurring. In these activities, a quantitative analysis is rarely used. There are a number of reasons for this, such as lack of research due to the high costs associated, lack of reliable data, complexity of the theme, and the fact that most of the stakeholders' having personal interests (company or personal). Based on the results of the risk analysis, a risk assessment is carried out and, if necessary, measures can be taken to reduce the risk. The risk can be avoided, mitigated, transferred, or accepted, amongst others [69].

1.5. Outdoor Recreation Technicians

Technicians' evaluations and experiences form the bases for effective risk assessments for conducting clients in snow mountains, climbing routes, or descending rivers [2]. Demirhan and Grant et al. [70,71] also highlighted that experienced participants could evaluate real risks better than less experienced participants who might not recognize a risk or misinterpret it.

In situations when less experienced participants, or without any experience at all, are interacting with nature for leisure or sports, there are always risks and dangers that require an experienced technician. This can balance the risks in order to guarantee a safe and quality experience for the participants.

In order that technicians feel protected and secure on the activities they provide, Stanbury, Pryer, and Roberts [72] suggested that adventure tourism operators should provide them with the best training, resources, and support. However, the literature, until now, suggests that the main focus of adventure tourism has been consumer well-being [3,73]. If this tendency persists, there may be serious consequences to operational sustainability, since technicians may not provide the expected experience due to stress caused by safety issues [47].

There is a need to understand how technicians perceive outdoor sport activities and in what ways are they prepared to discuss and create prevention and emergency plans, prior, during, and after the activity. These are the factors that may provide more or less safety for the practitioners [6].

Therefore, technicians need to self-evaluate thoroughly, in order to minimize risks and deal effectively with incidents. This information is useful for creating training programs and systems of support, and can reduce expenses and time needed to develop leaders' abilities, and therefore, can improve safety in outdoor recreation [74].

1.6. Outdoor Recreation Practitioners

According to Štanfel and Tutić [68], the number of outdoor recreation practitioners has increased, becoming a potential and important risk factor.

A risk assessment analysis for outdoor recreation and tourism practitioners aims to enhance knowledge about the risks involved and to transform that knowledge into effective programs to help practitioners and other intervenors to make substantiated and informed choices for their activities [1].

However, practitioners accustomed with the dangers and risks of their sports can become an accident enhancing factor. The risk is commonly understood as an element that can be controlled with determined procedures; therefore, more reflection about the meaning of adventure activities for the participants is needed [75].

Individuals should make subjective risk judgments in order to make the choice of behavior easier for each situation. This subjective risk judgment is based on risk perceptions from a cognitive and emotional response to the environment, [5] which include factors such as experience, personality, age, gender, and culture [76].

Regardless of the personal motivations to engage in nature activities and the magnitude of the risks involved, all participants seek to make the most of the activity and to return home safely.

2. Materials and Methods

2.1. Protocol

This review study did not use any registered protocol, and was designed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

2.2. Eligibility Criteria

This systematic review was conducted with the objective of analyzing safety measures and risk assessment for outdoor recreation practitioners. The PICOS strategy was used, in which "P" represented the outdoor recreation practitioners, without any age, race, or

gender limitation. There were no intervention ("I") or comparison groups ("C") analyzed. The outcome ("O") stands for the safety and risk assessment, and the study design ("S") indicates the descriptive and observational approaches (transverse or longitudinal).

Selection of the studies that were included in this systematic review was according to the following criteria: (a) nature-based sport studies (according to its definition); (b) academic relevance (methodological quality criteria); (c) completed articles published in indexed journals with peer review; (d) studies that established a relation between risk assessment/evaluation and nature sports; (e) publications in English and Portuguese.

The following studies were excluded: studies without at least two of the selected descriptors in their keywords; review articles; studies that only had an abstract; and duplicate studies.

2.3. Investigation Strategy and Information Sources

A search with no time period defined was performed, which ended on 23 January 2021. The electronic databases searched included: PubMed, BVS, SciELO, Science Direct, ABI/INFORM, Spinger, Web of Knowledge, and Esmerald full text. An advanced search was used based on the title and abstract with descriptors combinations.

The research strategy combined Boolean operators and expressions, as explained in Table 2.

Table 2. Expressions and research strategy.

Advanced Research	Expressions
Research expressions 1	Nature sports* OR Adventure recreation* OR Outdoor recreation* OR Outdoor sports* OR Nature based sports*
Research expressions 2	Segurança* E Desporto Natureza* (Safety* AND Nature sport*)
Research expressions 3	Risco* E Desporto de Natureza* (Risk* AND Nature sport*)
Research expressions 4	Safety* AND (Nature sports* OR Adventure recreation* OR Outdoor recreation* OR Outdoor sports* Nature based sports*)
Research expressions 5	Risk* AND (Nature sports* OR Adventure recreation* OR Outdoor recreation* OR Outdoor sports* Nature based sports*)
Research expressions 6	Safety* AND Risk* AND (Outdoor sports* OR Outdoor Recreation* OR Adventure Recreation* Nature based sports*)

* Search finds related terms.

2.4. Studies Selection and Data Extraction

Titles and abstracts of articles from the electronic databases were selected by two independent reviewers (C.M. and L.C.); all the complete studies with relevant potential were analyzed to ensure that they met the eligible criteria.

The reference lists of selected articles were examined with the aim to find other relevant investigations.

The following data were extracted from the selected articles: first author name, publication year, country of origin, investigation objectives, study population (number of participants), main results, conclusions summary, and safety measures and recommendations.

2.5. Risk of Bias

The risk of bias was independently evaluated in duplicate by two authors (C.M. and L.C.); unconformities were resolved by consensus, or by consulting a third author (C.P.).

The Robvis tool (visualization tool for risk of bias assessments in a systematic review) was used [77] to evaluate the quality of the ten selected studies. This tool has been previously used to evaluate the risk of bias [78,79]. The quality of the studies was analyzed and the results presented according to specific criteria.

3. Results

The initial database search led to a total of 2094 studies, 1352 of these studies were duplicates. After reading the abstracts, 1297 studies were excluded due to not being related to the theme, and 55 studies were excluded due to not including technicians or practitioners. After reading the titles and abstracts, 1297 studies were excluded for not being related to the topic, 55 studies were selected for full reading, among which 45 studies were excluded for not meeting the established criteria.

Ten studies remained that fit the inclusion criteria for the systematic review and were included in the quantitative analysis, as shown in Figure 1.

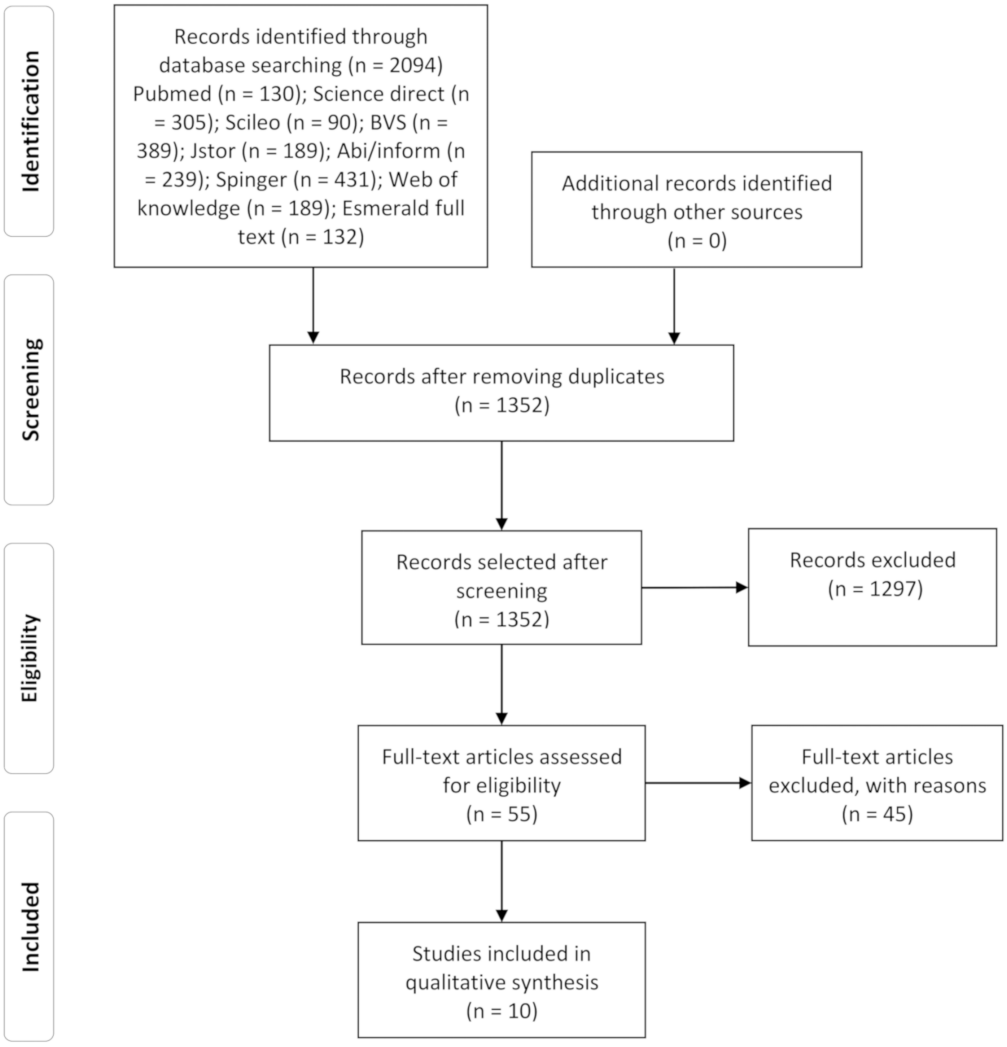

Figure 1. Study selection flowchart, in an electronic database.

The ten studies selected for quantitative evaluation, recommended some safety measures and risk assessments with applications to outdoor recreation activities.

Tables 3–5 summarize the main characteristics of the selected studies. All papers were written in English. The studies were from 10 different countries and focused on several approaches of nature-based sport's safety. The risk perception theme had the higher focus being approached in five studies, followed by safety practices, injuries, and risk analysis in four studies. Safety behaviors were approached in three studies and equipment- and risk-related matrices in two studies.

Table 3. Description of the selected studies.

Author	Year	Country	Objective	Sample
Groves and Varley [80]	2020	Scotland	Winter mountaineering in Scotland, safety practices and equipment and their relations with attitudes, behaviours, and climbers' decisions.	Climbers, N = 18
Haegeli et al. [1]	2012	Canada	To identify skiers with greater risk exposure in a dynamic context, and to examine their behavior patterns, perceptions, attitudes, and motivations.	Skiers, N = 1355
Backe et al. [81]	2009	Sweden	To examine rates and factors associated with climb injuries, and to identify formal climbers, first aid training, and safety practices.	Climbers, N = 5606
Clinch & Filimonau [47]	2017	United Kingdom	To exploit how nature-based sports technicians perceive and manage risk.	Nature-based sports technicians N = 12
Martha et al. [82]	2009	France	To examine how practitioners perceive safe climbing and the risks of becoming seriously injured during the climb, and their relations with the risk exposure.	Climbers and alpinists, N = 235
Demirhan [70]	2005	Turkey	To evaluate risk perceptions, by gender and experience, in 19 different modalities of nature-based activities.	Nature-based sports practitioners and non-practitioners
Salmon et al. [21]	2010	Australia	To analysis in the lead outdoor activity domain, the application and evaluation of a risk management framework.	Case study of an accident with canoeists
Wang et al. [50]	2019	China	A risk evaluation in tide-watching adventure tourism, considering practitioners' perceptions of severity and vulnerability, self-efficacy, and response effectiveness.	Adventure sports tourist practitioners, N = 302
Zweifel et al. [83]	2016	Italy/Switzerland	To explore avalanche accident risks with respect to group size, and to discuss the reasons for different risk levels.	Climbers and skiers in winter backcountry recreation
Salmon et al. [23]	2014	Australia	A system-based accident analysis in the lead outdoor activity domain, application and evaluation of a risk management framework, and identification of the factors involved in incidents.	Accidents with nature sports practitioners, N = 1014

Table 4. Description of the main results and summary of the conclusions of selected studies.

Author	Results	Conclusions
Groves and Varley 2020 [80]	The ability and capacity to use knowledge to surpass the need for rescue equipment (transceiver), being considered inadequate in the Scottish context and identified with potential negative impacts at the physical and cognitive levels. Less experienced practitioners accept the best equipment.	Accumulated experiences from the practitioners lead to safety suggestions that contribute to an unconscious protective framework that induces a possible bias in decision making towards risk.
Haegeli et al., 2012 [1]	Examine risk-taking preferences of practitioners with respect to exposure and preparedness, based on a risk management framework, in order to assign an overall risk level to participants.	Comprehensive and process-oriented perspective of multifaceted risk-taking behavior. This information may provide more meaningful insights for the development of targeted prevention initiatives that aim to address existing shortcomings in the risk management process.
Backe et al., 2009 [81]	Overall, 4.2 injuries per 1000 h of climbing were reported, injuries due to excessive practice constituted 93% of all injuries. The most common injuries were tissue inflammations on fingers and fists. There was a higher risk for new injuries amongst male climbers and a lower risk amongst older climbers.	Male climbers of boulders, with high BMI, had a higher risk of injury. Climbing hours and load levels should be gradually increased, and climbers should be regularly monitored for signs and symptoms of excessive practice.

Table 4. *Cont.*

Author	Results	Conclusions
Clinch and Filimonau 2017 [47]	Nature-based adventure technicians identified the following strategies as very important: regular and qualified training, in order to maintain their abilities and knowledge; the ratio between participants and instructors; people management training; environmental and equipment evaluation.	These areas of intervention should be approached by sector specialists and reinforced by dedicated policies. This should be used to enhance future risk management strategies, to improve the safety and well-being of participants and instructors.
Martha et al., 2009 [82]	Risk perception was related to the real risk of climbing modalities; there was no evidence of defensive denial amongst practitioners about their likelihood of getting seriously injured.	Climbers' risk perceptions accurately reflected their exposure to risk, they acknowledged their own absolute risk and that the sport involved high risks of getting seriously injured.
Demirhan 2005 [70]	Gender and group in several sports such as mountain bike, rowing, surf, sailing, Nordic skiing, touring skiing, snowboarding, skydiving, and cliff jumping were compared, and it was shown that medium risk perception amongst male participants was lower than amongst female participants. Medium risk perception amongst experienced climbers was higher than amongst less experienced climbers.	Men have less risk perception than women. Amongst climbers and rock climbers, there were no significant differences. In sports such as cliff jumping, skydiving, and orientation the differences were significant. Specialists were shown to have a lower medium risk as compared with other groups.
Salmon et al., 2010 [21]	It was shown that the AcciMap methodology is valid and suitable to analyze and understand accidents and incidents, as well as in critical areas of safety in outdoor activities.	An analysis with the AcciMap methodology is a risk management, prevention, and mitigation approach for future accidents and incidents. This approach may increase safety by promoting the intervenient comprehension.
Wang et al., 2019 [50]	A relative low risk evaluation was shown throughout the sample. Second cluster obtained a level of perception relatively low, and did not adopt self-protection behaviors, even though they showed intense worry towards the subject. For the other two clusters, worry mediated the relation between risk perception and safely behaviors.	The outcomes helped in the management, comprehension, and information provided to adventure tourists, who normally are not orientated to safety and do not understand the risks. It is the job of local governments and tourism operators to develop communication strategies to highlight the risk and promote self-protective behaviors.
Zweifel et al., 2016 [83]	The bigger the group, the higher the avalanche risk was. The most common groups were groups with 2 participants, which represented a lower risk as compared with that of bigger groups. In the Italian data, there was no significant difference found in the risk level for lone participants as compared with that of the reference group (group of two); in the Swiss group the risk level found was lower.	The conclusion was that the bigger the group the higher the avalanche risk was. This conclusion is aligned with the safety recommendations for avalanches, and in disagreement with the lower risk of lone practitioners, which is not recommended.
Salmon et al., 2014 [23]	The medium number of factors that contribute to incidents was 4.1 (SD = 2.33), suggesting that nature activity incidents are caused by several factors, instead of being caused by a single action or decision.	The Rasmussen risk management framework is an adequate analysis for implementing an approach for preventing accidents in outdoor activities: (1) equipment and surroundings; (2) physical processes and instructor/participant; (3) technical and operational management; (4) local area government; (5) regulatory bodies and associations; (6) policy and budgeting.

Twenty-eight measures were found throughout the studies regarding safety recommendations for nature-based sports, three recommendations were duplicated (Table 5).

Table 5. Safety measures and risk assessment recommendations of the selected studies.

Author	Safety Measures and Recommendations
Groves and Varley 2020 [80]	Policies and training programs for nature-based sports. Decision making in complex, dynamic, and high-risk areas. In-depth research of the nature-based sports risks. Sector code of conduct.
Haegeli et al., 2012 [1]	Prevention based on the approach of the practitioners' experiences. Attribution of a general risk level for each participant based on a risk matrix.
Backe et al., 2009 [81]	Good warm up. Practical and theoretical training of safety procedures, including first aid and rescue climbing techniques. Record of accident occurrences.
Clinch and Filimonau 2017 [47]	License and insurance oversight. Regular re-evaluations of instructors' abilities for risk management, first aid, and social abilities development.
Martha et al., 2009 [82]	Better understanding of the relation between risk perception and risk exposure. Understand the technical competence to safely climb.
Demirhan 2005 [70]	Further investigation about risk in all nature-based sports in different countries.
Salmon et al., 2010 [21]	Local, governmental and regulatory authorities' management. Develop standard systems for accident and incident report. Universal database of nature-based activity accidents and incidents. Development of taxonomies of system failure and human error.
Wang et al., 2019 [50]	Practitioner education in effective preventive measures. Risk communication through different platforms such as social media, brochures, or interactive interpretation systems.
Zweifel et al., 2016 [83]	Video monitoring as a risk analysis technique in outdoor recreation. Investigation of risk factors such as: age, gender, behaviors or level of expertise. Promote discussion amongst technicians in order to stablish risk reduction strategies.
Salmon et al., 2014 [23]	Identify bad decisions or instructors' inabilities. Improve participant consent and information forms. Inform participants about the associated risks. Empower instructors to be able to abort activities or prevent participants from participating. Develop risk management strategies suited for insecure terrain or adverse climate during the activities.

Risk of Bias

The studies analyzed in this review were considered to have a low risk of bias, mostly because the criteria classification, which was restricted to low, unclear, high and without information. Most of the studies presented a high risk in the first criteria (random sequence generation) with the exception of Martha et al. [82] that was unclear, and Backe [81] and Demirhan [70] with low risk due to random sample selection.

The other criteria were classified as low risk, with the exception of the Wang et al. [50] study that was unclear in three criteria, as shown in Figure 2.

For the overall evaluation, we calculated the medium of the seven criteria, resulting in a classification of unclear in Wang [50] and low risk in the remaining studies.

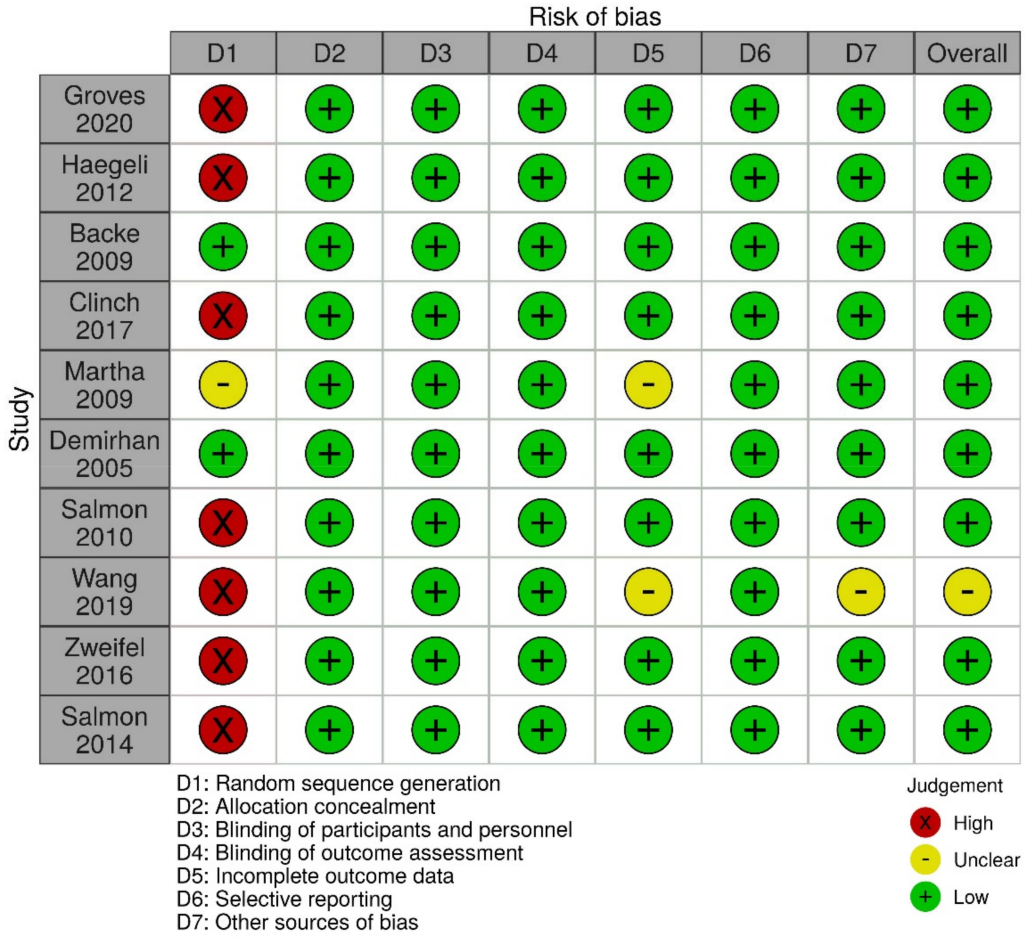

Figure 2. Risk of bias assessed by Robvis (visualization tool).

4. Discussion

The objective of this systematic review was to analyze safety measures and risk assessment frameworks recommended by research on nature-based sports practitioners and technicians. The results showed that studies on these subjects have mostly been descriptive, instead of observational and experimental study designs, which limited the number of studies for qualitative analysis. There is a certain level of concern and interest about this field of study; the 28 safety measures and risk assessment frameworks recommended for future implementation supply extremely important information about nature-based health and prevention.

There is no consensus about a designation name for nature-based sports; a number of names have been assumed such as adventure tourism, outdoor or radical sports, outdoor sports, outdoor recreation, or adventure recreation [6,58]. Among the studies analyzed in this review, there is general consensus that these activities benefit from a high popularity, with increased interest from participants and people, since they are characterized by contact with nature, and surroundings that provide strong emotions, adrenaline, and constantly overcoming fear [6,84–87].

Considering the results of the selected studies, the expertise of technicians and participants often translates into a false sense of security and even to a depreciation of some safety equipment [80]. This can be explained by the processes mechanization and routine by technicians and participants, however, according to Martha et al. [82] the awareness of the possibility of having an accident or incident with severe consequences is always present, as these constitute risk activities. Risk perception is directly reflected in the risk exposure. Demirhan [70] argued that risk perception was lower for male and expert participants

as compared with other groups. Female participants have a higher risk perception in nature-based sports. This can be related to some known female qualities such as pondering, carefulness, and observation behaviors.

This review has shown that low risk perception and low ability to assess risk can lead to inadequate safety behaviors and few self-protection measures [50]. Therefore, we should focus on the interventions that are often not focused on in an analysis of real risk comprehension, and result in inadequate safety measure responses.

According to the studies' results, accidents and incidents occur due to several risk factors. Salmon et al. [21] and Salmon et al. [23] claimed that the Rasmussen risk management framework was adequate to implement an analysis approach for preventing accidents in outdoor activities: (1) equipment and surroundings; (2) physical processes and instructor/participant; (3) technical and operational management; (4) local area government; (5) regulatory bodies and associations; (6) policy and budgeting. This risk assessment framework constitutes another tool to prevent and mitigate future accidents and incidents, increasing participants safety. In addition, it is important to balance the ratio of technicians and practitioners, depending on the risk associated with an activity. Important factors to be aware are people management training for instructors, and evaluations of surroundings and equipment as stated by Clinch and Filimonau [47]; Zweifel et al. [83] and Davidson [18]. Another identified tool was a risk matrix that can be used to establish risk levels for each participant [1]. In addition, a matrix can also be used to analyze activities in order to classify each associated risk.

It is our perception, and also according to Cater [46] and Haegeli et al. [1], in order to access the needs of the outdoor recreation sector, this type of intervention should be done by specialists and supported by policies. Backe et al. [81] presented a higher number of injuries in more intense and formal activities that occurred due to hours of practice and loads, as well as practitioners with high BMI. According to the author in these cases, there should be a thorough training plan prepared, with gradually increased hours of training and loads, and that the practitioners should be regularly monitored for signs and symptoms of excessive practice.

Lastly, we collected 28 safety measure recommendations for nature-based sports (Table 5), among which we highlight those recommendations that differ from the ones mentioned so far through this systematic review: (i) conduct code for the sector; (ii) experience supported prevention; (iii) practical and theoretical training of safety procedures, including first aid and rescue techniques; (iv) universal database of nature-based activity accidents and incidents; (v) license and insurance oversight; (vi) regular re-evaluations of instructors' abilities for risk management, first aid, and social abilities development; (vii) practitioner education in effective preventive measures; (viii) risk communication through different platforms such as social media, brochures, or interactive interpretation systems; (ix) video monitoring as a risk analysis technique in outdoor recreation; (x) investigation of risk factors such as age, gender, behaviors, or level of expertise; (xi) promote discussion amongst technicians in order to establish risk reduction strategies. (xii) improve participant consent and information forms; (xiii) empower instructors to be able to abort activities or prevent participants from participating; (xiv) develop risk management strategies suited for insecure terrain or adverse climate during the activities.

The measures mentioned in the studies all provide extremely important knowledge with respect to health and prevention. These measures can be used to develop safety strategies and risk reduction that are aimed at reducing accidents in outdoor recreation. However, there is no expectation that all of the accidents can be fully eliminated; regardless, all efforts should be made to reduce the risk of accidents.

For instance, activities that require a certain level of expertise by participants should be evaluated by technicians in order for technicians to manage activities according to various factors such as sports history, technical expertise, use of personal protective equipment, and correct suitability of materials such as clothing. These indications agree with those stated by Nathanson et al. [14], who also recommended knowledge of the surroundings and warning

and communication systems in the event of an emergency. Risk is an integral part of nature-based sports and constitutes a reason for practitioners' fascination and the increased popularity of these activities, and we believe that this risk can be considerably reduced [88].

The present study presents some limitations such as the exclusion of revision and descriptive studies and only the inclusion of indexed studies selected in scientific databases. In addition, the number of included studies was low, which limits the extraction of conclusions. Another limitation may be connected with the absence of PROSPERO registration.

5. Conclusions

On the basis of the obtained results, we conclude that there is interest and concern in this topic. The 28 measures mentioned in the studies provide important knowledge with significant implications related to health and prevention. These measures can be used to develop safety strategies and risk reduction aimed at reducing accidents in outdoor recreation.

In order to evaluate the pertinence and importance of the mentioned measures, namely risk perception, safe practices, sport injuries, risk analysis, safe behaviors, equipment, and risk matrix assessment, further investigation is needed using experimental or observational studies.

These strategies and procedures contribution to enhance technicians' interventions with higher security and quality, and therefore, impact practitioners' well-being and satisfaction.

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