

Criticality of preparation and equipment in hiking and trekking activities: a systematic review Criticidad de la preparación y el equipamiento en las actividades de senderismo y trekking: una revisión sistemática

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Abstract. Outdoor activities like hiking and trekking require appropriate preparation and equipment. However, many adventurers underestimate the importance of these factors, leading to increased risk and adverse events. This study aims to deliver a comprehensive review of existing literature on preparation and equipment requirements for hiking and trekking and to identify prevalent challenges during these activities. The review considered papers with English full-text, listed in MEDLINE/PubMed or Google Scholar, published between January 2000 and June 2023. The search method focuses on potential obstacles during the trip and equipment preparation and risks during hiking and trekking. Following the PRISMA 2021 guidelines, 14 papers were considered for detailed review. Two articles investigated hiking experts whereas the other studies included experts and beginners. The following preparative measures and equipment were identified as crucial: appropriate clothing, maps, compass, first aid kit, extra food and water, good physical fitness, and outdoor-related skills (e.g., orientation and medical proficiency). The reviewed studies had methodological flaws and were susceptible to bias. This review identifies common risks and best practices with respect to preparation and equipment for hiking and trekking. It contributes to outdoor adventure safety, potentially reducing risks and the likelihood of adverse events and enriching outdoor experiences.

Keywords: Hiking, Trekking, Equipment Requirements, Preparedness, Outdoor Activities, Risk Management, Safety Practices, Adventure Tourism, Literature Review.

Resumen: Las actividades al aire libre como el senderismo y el trekking requieren preparación y equipo adecuados. Sin embargo, muchos aventureros subestiman la importancia de estos factores, lo que aumenta el riesgo y los eventos adversos. Este estudio tiene como objetivo ofrecer una revisión exhaustiva de la literatura existente sobre preparación y requisitos de equipo para caminatas y trekking e identificar los desafíos predominantes durante estas actividades. La revisión consideró artículos con texto completo en inglés, listados en MEDLINE/PubMed o Google Scholar, publicados entre enero de 2000 y junio de 2023. El método de búsqueda se centra en obstáculos potenciales durante el viaje y preparación del equipo y riesgos durante la caminata y el trekking. Siguiendo las pautas de PRISMA 2021, se consideraron 14 artículos para su revisión detallada. Dos artículos investigaron a expertos en senderismo, mientras que los otros estudios incluyeron a expertos y principiantes. Se identificaron como cruciales las siguientes medidas y equipos preparativos: ropa adecuada, mapas, brújula, botiquín de primeros auxilios, comida y agua adicionales, buena condición física y habilidades relacionadas con el aire libre (por ejemplo, orientación y competencia médica). Los estudios revisados tenían fallas metodológicas y eran susceptibles de sesgo. Esta revisión identifica riesgos comunes y mejores prácticas con respecto a la preparación y el equipo para caminatas y trekking. Contribuye a la seguridad en las aventuras al aire libre, reduciendo potencialmente los riesgos y la probabilidad de eventos adversos y enriqueciendo las experiencias al aire libre.

Palabras clave: Senderismo, Trekking, Requisitos de Equipo, Preparación, Actividades al Aire Libre, Gestión de Riesgos, Prácticas de Seguridad, Turismo de Aventura, Revisión de Literatura.

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Introduction

Tourism activities (cultural, sporting, and business-related events) have become a rapidly expanding leisure travel market segment over the past several decades (Batyrbekov et al., 2024; Getz & Page, 2016), which, the service, adventure and perils, marked hiking trails, and accessibility might be crucial for the visitors (Wall-Reinius & Bäck, 2011). Meanwhile, exercise is essential for maintaining body metabolism and raising physiological and mental health (Mikkelsen et al., 2017; Sari et al., 2024; Tan et al., 2016).

Recently, sports recreation, including outdoor activities like hiking and trekking in the mountains, has become popular to reduce stress levels (D'souza & Puttaraju, 2020; Wolf et al., 2014). The popularity of mountain sports activity is strongly increasing worldwide, with millions prac-

ting one or more recreational sports on the mountain during the summer and winter sessions (Burtscher & Ponchia, 2010; Gatterer et al., 2019). Evidence suggests that exposure to a natural environment (without physical activity) positively affects stress reduction, restoration, and physical recovery (Hartig et al., 1991). Additionally, physical activity (without exposure to nature) showed similar effects on stress reduction (Ahsan & Abualait, 2024; Hamer et al., 2006; Robles et al., 2023; Festiawan et al., 2021; Sumartiningih et al., 2022; Susanto et al., 2023). Therefore, exercising in natural environments may synergistically affect stress-related physiological health (Festiawan et al., 2024; Ketut Yoda et al., 2024).

Hiking is any long-distance uphill or downhill strolling in the wilderness. The Compendium of Physical Activity classifies hiking as moderate to vigorous, with an estimated 6 METs (Ainsworth et al., 2000). Due to the limited skills

and equipment required and the low cost, hiking is considered accessible. Hiking is one of the few activities that allow patients to meet physical activity recommendations and attain the potential health benefits of spending time in natural settings (Mitten et al., 2018).

However, hiking activities involve health risks, most commonly headache, vomiting, insomnia, fatigue, and disorientation (Basnyat & Murdoch, 2003; Rochel Vera et al., 2024). A systematic review article discovered that mountain hiking at high altitudes is associated with acute mountain sickness (Meier et al., 2017). These studies may demonstrate that recreational sports pose numerous hazards. Since many of the abovementioned risks can be mitigated, awareness, medication, and proper preparation are recommended (Gaillard et al., 2004).

Previous research revealed that injuries and hypothermia were linked to improper equipment (e.g., footwear and clothing) and a lack of track knowledge (Johannis et al., 2020). Beyond that, hiking guidebooks, physical fitness (Schneider et al., 2002), and first aid skills are integrative in preparative strategies for reducing health risks (Drew et al., 2011). In addition to know-how about medical treatment in the case of emergencies, competencies regarding weather in the mountains were advised (Leon et al., 2004). Besides that, inadequate clothes and footwear (e.g., hiking boots) have been a primary cause of hypothermia, falls, and frostbite, leading to accidents, injuries, and deaths (Procter et al., 2018). Therefore, the research above has demonstrated that proper preparation, equipment, and hiking knowledge and skills are essential before embarking on an expedition to lower the risk of adverse events.

It's interesting to note that various gadgets for mountaineering and/or hiking have gained popularity recently because they offer an enormous amount of information. The majority of people use digital tools for planning (86%) and navigating (73%), according to a survey including 410 recreationalists. Which the trail running, mountain biking, and hiking participants planned their trips primarily using digital resources (Schwietering et al., 2024). Additionally, in recent years, smartphones featuring maps, route planners, statistics, messaging apps, and plants and animals have emerged as a fantastic tool for aiding hikers (Shaker et al., 2021). However, we must use the smartphones carefully because some tools provide false information that could raise the danger of something going wrong, like being lost in the mountains (Michalakakis et al., 2020). Nevertheless, tour guides might be essential for directing hikers and lowering risks while on the trail (Curtin, 2010).

Managing health and safety incidents in the wilderness may be more challenging, and better-prepared hikers may be more capable of managing potential incidents. Carefully preparing the "10 essentials" (i.e., fire, first-aid supplies, hydration, illumination, insulation, navigation, nutrition, shelter, sun protection, and tools) has been proposed to prevent adverse events in the mountains (Mason et al., 2013). Carline et al. (2017) pointed out that the "10 essentials" may help to respond effectively to adverse events if

they occur and prevent them from turning into emergencies (Carline et al., 2017). However, Daniel et al. (2021) argued that water, food, extra clothing, and medical kit may be more essential to bring during hiking than the "10 essentials".

As shown, the relevance of various equipment for hiking was debated. Unfortunately, the current literature does not provide a clear conclusion, and many hikers underestimate the importance of preparation and appropriate hiking equipment, leading to emergencies and death every year. Clarity and increased awareness of the most typical risks and recommended equipment to mitigate these may contribute to reducing the number of adverse occurrences. In addition, the purpose of this study was to provide a concise overview of 1) the essential equipment recommended for hiking and 2) typical risks that can be alleviated by equipment.

Methods

Following the PRISMA guidelines (Page et al., 2021), this study systematically reviewed the literature to provide a comprehensive overview of the essential equipment for hiking and trekking to mitigate regularly encountered challenges.

Literature search

We devised a search strategy by analysis of critical studies to capture hiking and trekking equipment for the trip. One author searched for relevant articles. Then, two researchers were independently involved in the selection process (see Figure 1). In the case of disagreement between the two reviewers, a third researcher made the final decision whether to include or exclude a study.

The scope of the review was limited to studies with full-texts available in English, published between January 2000 and June 2023. The search was conducted on two electronic database platforms (i.e., MEDLINE/PubMed and Google Scholar). The following MeSH terms were used for the search: "randomized controlled trial" OR "random allocation" OR "cross-over studies" OR "quasi-experimental" OR "cohort studies" OR "prospective studies" OR "case reports" AND "walking" OR "mountaineering" OR "sport climbing" OR "hiking" OR "hiking expedition" OR "trekking" OR "altitude" AND "adults" OR "adult" OR "middle-aged" OR "young adult" AND "preparedness" OR "wilderness" "medicine" OR "wilderness".

Articles were required to meet the following inclusion criteria: a) investigate equipment for hiking and trekking, providing a clear explanation of the equipment; b) elaborate on the role and relevance of equipment tools in outdoor pursuits; and c) elucidate the prevailing challenges commonly encountered during hiking and trekking. The Exclusion criteria have been as follows: a) articles written in languages other than English; b) the original full-text text was not accessible; c) did not explain the equipment needed for outdoor activities.

Data Collection

Using a standardized, piloted data extraction form, one author independently extracted data on participant characteristics, relevant outcomes, and risk of bias, while a second author verified the results.

Data Synthesis

A formal statistical meta-analysis of the trials was not deemed adequate due to the lack of studies that met the inclusion criteria and the variability of the study design, demographic, and outcome measures utilized in the identified investigations. Using the instructions provided by the Economic and Social Research Council, a different approach known as narrative synthesis was used to explain and summarize the findings of the included studies (Popay et al., 2006) Initially, the trials were classified based on the type of outdoor activities, the hiking preparedness equipment, and the outcomes focused on the prerequisite gear for trekking and hiking.

Results

A PRISMA flow diagram (Figure 1) depicts the single steps of the selection process, deriving a final number of 14 articles for review out of the total number of 3,505 articles found in the two databases.

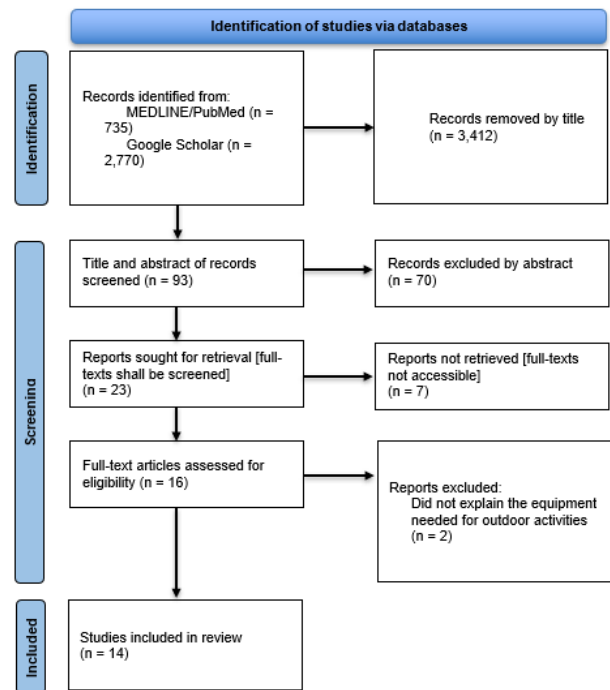


Figure 1. PRISMA flow diagram

Fourteen studies reported about recommended preparation, of which ten focused on hiking and four on trekking. Six of the ten studies on trekking preparation were survey-based, while the other four were observational. Four studies indicated that orientation tools such as maps are essential, while four studies suggested preparing a medical pack is crucial. One study underlined the importance of additional clothes, food, water, proper physical fitness, knowledge, and equipment, like gear lights, fire starters, and knives. Table 1 summarizes the necessary equipment for hiking and trekking.

Table 1.
The summary of the equipment necessary for hiking and trekking.

No.	Authors	Subjects	Study design	Essential tools
1	Mason, et al. (2013)	199 hikers (119 males, 80 females) Ages: 18-79 years	Cross-sectional study (Questionnaire)	- Map - Compass - Extra clothing - Rain gear - Firestarter - Light - Extra food and water - Knife - First aid kit - Whistle - Fire
2	Daniel, et al. (2021)	961 hikers (555 males, 405 females) Ages: 18-80 years	Cross-sectional study (Questionnaire)	- First-aid supplies - Hydration - Illumination - Insulation - Navigation - Nutrition - Shelter - Sun protection - Tools
3	Johannis, et al. (2020)	3 expert hikers Ages: 20-24 years	Qualitative study (interview)	- Physical fitness - Level of knowledge - Equipment
4	Bradenburg, et al. (2016)	326 hikers (214 males, 112 females) Ages: 18-74 years	Cross-sectional study (Questionnaire)	Medical kit
5	Wu et al. (2020)	300 hikers (151 males, 149 females) Ages: 56-65 years	Direct observation (Questionnaire, on-site interviews)	- Knowledge - Behavior

6	Heggie et al. (2004)	804 hikers (507 males, 297 females) Ages: 39 ± 6.2 years	Daily on-site exit interviews	- First aid kit - Footwear - Water - Appropriate clothes
7	Gardner et al. (2002)	155 hikers Ages: 45.2 ± 4.8 years	Brief report (Interviews)	- Physical conditioning - Medicine knowledge

Table 2.

The summary of the equipment necessary for hiking and trekking.

8	Boore et al. (2013)	131 hikers (69 males, 62 females) Ages: 18-65 years	Retrospective study (Questionnaire)	- Knowledge - Clothes - First aid - Headlamp - Map/Compass - Communication device
9	Kogut et al. (1994)	301 hikers Ages: 18-84 years	Cross-sectional study (Interview)	- Health status - Hiking experience - Health problems encountered - First aid knowledge - First aid equipment
10	Scharfenberg et al. (2021)	453 trekkers Ages: >18 years	Quantitative study (Questionnaire)	First aid Knowledge
11	Drew et al. (2011)	669 trekkers	Cross-sectional study (Observation, questionnaire)	- First aid - Medical knowledge
12	Leon et al. (2004)	3 trekkers Ages: 29-31 years	Quasi-experimental study (Ques- tionnaire)	- Weather knowledge - Medical knowledge
13	Vardy et al. (2006)	130 trekkers	Quantitative study (Interview, yes/no question)	Medical knowledge
14	Schneider et al. (2002)	827 mountaineers (673 males, 154 females)	Cohort study (Questionnaire)	Physical training

Discussion

Our review identified 14 relevant studies, identifying a wide range of essential pieces of equipment before hiking and trekking. The results from this review showed that hiking and trekking have similar tools that should be prepared, such as a map, compass, extra clothing, rain gear, fire-starter, light, extra food and water, knife, medical kit, whistle, fire, hydration, illumination, insulation, navigation, nutrition, shelter, sun protection, tools/equipment, physical fitness, knowledge, behavior, footwear, physical fitness, communication device, health status, hiking experience, health problems encountered, weather prediction knowledge, and physical training. The equipment above is needed to alleviate the injury risk during the trip.

Essential equipment is required before embarking on a hiking and trekking expedition

Hiking has long been described as one of the most significant segments within nature-based tourism, and more and more people are taking part in hiking activities in different geographical locations (Chhetri et al., 2004; D'Antonio et al., 2012; Mason et al., 2013). In the Austrian Alps, for example, several million hikers of all age groups and sexes, with and without pre-existing medical conditions, are attracted by this mountain sports activity each year (Faulhaber et al., 2007). The synthesis of previous findings suggest the relevance of equipment and preparation before hiking and trekking. The essential tools such as a map, compass, extra clothing, rain gear, fire starter, light, extra food and water, knife, first aid kit, and whistle should be considered (Mason et al., 2013). A cross-sectional study

reported that hikers should be aware of their preparation before the hike, with survival, navigational, and signalling equipment like a whistle being the most important things to bring (Mason et al., 2013). In contrast, a previous study reported that increasing the number of items is not associated with fewer adverse events or hiker satisfaction, but extra water, food, clothing, and a medical kit were recommended (Daniel et al., 2021). Another study revealed that physical fitness, knowledge level, and equipment are vital for young adult hikers to reduce the risk of adverse effects during hikes (Johannis et al., 2020). Additionally, a medical kit, including BSL, materials for immobilization, pain medications, wound care supplies and medication, and flu-like illness, is essential during hiking in the mountains (Brandenburg & Locke, 2017). However, those studies reported that the first aid kit, signalling equipment (e.g., whistle), and navigation tools (i.e., maps and compass) are vital (Nemeth et al., 2021).

An investigation involving 453 adult trekkers recommended carrying first aid supplies and a thorough understanding of first aid techniques (Scharfenberg et al., 2021), which was also supported by (Drew et al., 2011). Based on an 46-day trip in the Canadian High Arctic, medical knowledge and expertise in predicting weather were reported essential in mitigating the potential hazards (Leon et al., 2004; Vardy et al., 2005). Moreover, physical training is also crucial before adventures (BALLI et al., 2017; Gardner et al., 2002; Schneider et al., 2002). Those studies advise to plan trips well, prepare required equipment in advance (especially first aid kit and related knowledge), and to obtain a proper physiological and psychological health state (Budiman, 2017). The earlier studies indicated that preparation before adventures is vital including orientation,

medical kit, and skills to reduce injury risk. In the later context, physical health is crucial to prepare before trekking. Moreover, appropriate equipment during the trip could prevent or reduce injury risk (Wu et al., 2021). Hikers are suggested to know and understand behavioural patterns to minimize problems during hiking.

Problems frequently occur during the adventures of hiking and trekking

Hiking and trekking are outdoor recreational activities that allow individuals to connect with the natural environment, traverse awe-inspiring terrains, and engage in physical and mental exertion. Nevertheless, these endeavours are not devoid of their own set of difficulties and issues. Irrespective of experience and skill levels, potential risks may be encountered during excursions. It is imperative to properly assess both the expected challenges during an excursion and the group's abilities in addition to adequate preparation to ensure personal safety (Prószyńska-Bordas & Baranowska, 2021).

Among 1,393 reported mountain accidents during hiking activities between 2009 and 2018, one of the most prevalent causes represented disorientation and getting off-track (Gasser, 2020). This occurrence can be attributed to a deficiency in map-reading abilities and compounding factors such as fatigue, anxiety, and tiredness. Similarly, a study with 20 hikers suggested that hiking alone represents a risk of injuries and getting lost (Coble et al., 2003). The authors advise to undergo training in map reading, medical expertise, and wilderness knowledge to address challenges encountered during survival situations effectively (Coble et al., 2003). She et al. (2019) have documented several incidents occurring during survival situations, including individuals getting lost, experiencing physical tiredness, contracting acute illnesses, and encountering issues related to public safety (She et al., 2019). These incidents may be due to insufficient trek preparation (She et al., 2019). Acute medical illnesses have been identified as a prevalent issue encountered during hiking activities (Yue et al., 2018). Concurrently, adults may experience cutaneous harm, hypothermia, dehydration, and sprain/strain injury during their adventures (Stephanides et al., 2007). Numerous challenges faced during survival can be attributed to the hikers' and trekkers' abilities, which have been associated with their inadequate level of readiness. A study conducted in Rocky Mountain National Parks, including 380 participants, suggested that hikers benefit from enhancing their medical and wilderness knowledge proficiency (Yue et al., 2018). Thus, hikers can improve their awareness of potential threats encountered in wilderness environments (Yue et al., 2018). Furthermore, physical fitness and abilities should be developed in preparation for an excursion and should be assessed accurately (She et al., 2019). In aggregate, to mitigate the most severe challenges, hikers should develop an understanding of medical treatment and wilderness in addition to obtaining appropriate physical conditions to encounter the challenges of an excursion. The importance of physical fitness

has become increasingly evident due to several injuries during expeditions that can be attributed to inadequate physical fitness levels (Chrusch et al., 2021). During the journey of the long-distance John Muir Trail in the Sierra Nevada, 771 individuals encountered bodily ailments, illnesses, and exhaustion (Chrusch et al., 2021). Furthermore, musculoskeletal injuries can occur due to insufficient physical conditioning before the expedition (Hamonko et al., 2011). Deficits in physical fitness can lead to various problems, implying the need for hikers and trekkers to be mindful of their preparative training.

We recognize that the studies investigated had methodological flaws and were susceptible to bias and confounding. None of the publications included information on the randomization or treatment allocation processes, and there was no attempt at "blinding" the subjects—keeping them in the dark about the kind of intervention they would get. Most studies are cross-sectional, quasi-experimental, and qualitative analyses. Additionally, none of the studies contain a group intervention comparison and instead primarily use questionnaires to gather information about participants' equipment preparedness, which increases the possibility of biases because the questionnaire's responses depend on the subjects' subjective opinions.

This review article only includes articles written in English, and the material is completely accessible. As a result it has certain limitation. Thus, this study does not include learning in languages other than English. There are not many references as a consequence.

Conclusions

The present review highlighted essential equipment for safe hiking expeditions. Orientation tools such as maps, signalling devices like whistles, and a comprehensive medical kit emerged as top recommendations. Disorientation during expeditions is frequently experienced due to inadequate proficiency in map reading and orientation skills, often occurring in conjunction with exhaustion or other physiological deficits. Therefore, ensuring appropriate physical fitness levels is highly recommended. Physical health and medical issues, such as illness and injury, are common concerns, due to inadequate preparedness. Thus, being adequately prepared (e.g., orientation skills, medical knowledge, and physical fitness) is crucial for safety during survival situations. This research contributes to improving outdoor safety practices, reducing injury rates and enhancing enjoyment for hikers and trekkers. These findings promote better understanding and raise awareness about the importance of preparation and proper equipment use. Future research is needed to investigate the problems that usually happen during the journey.

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Author Contributions

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used “Conceptualization, S., P.X.F., and S.K.; methodology, B.B.H and N.; formal analysis, S., S.S., P.X.F.; investigation, S., B.B.H.; resources, S and S.K.; writing—original draft preparation, S., S.K., Su., and P.X.F.; S.S. writing—review and editing, S., S.S., N., S.K., and Su.; project administration, S.S., S.K., and Su.; funding acquisition, S. and S.S. All authors have read and agreed to the published version of the manuscript.

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