ISSN 2618-1576 Vol. 4, Issue 4: 1-7, DOI: 10.25236/FSR.2022.040401

Emergency Response and Management for Mountain Marathon Cross-Country Events

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Abstract: *The cases of mountain marathon accidents in the past five years at home and abroad are combined with the domino theory of accident causation theory to analyze mountain cross-country marathon events. Conclusion: Equipment problems are the main cause of accidents, athletes' strain response is the decisive factor leading to accidents, and a sound rescue system is an important guarantee to avoid accidents; hidden danger investigation includes emergency training for emergencies, inspection of athletes' mandatory equipment, and inspection of guarantee measures; prevention of accidents requires enhanced awareness of risk prevention, more integrated development and implementation of policy requirements; experience learning includes education and training, assurance mechanisms, safety measures, epidemic prevention and control, emergency plans and communication systems; prevention of emergencies includes improving prevention mechanisms, holding outdoor safety education and training seminars, and pressing for accountability mechanisms.*

Keywords: *Mountain marathon trail race, emergencies, response, management*

1. Introduction

According to previous statistics from the UK and USA, the probability of sudden death in a marathon is 0.8 per 100,000 and 0.75 per 100,000 respectively, which means that only 1 out of approximately 130,000 marathon runners is likely to die suddenly (1 in 130,000). This means that only 1 sudden death (1/130,000) will occur in a marathon of approximately 130,000 runners. In fact, unlike marathons held in cities, cross-country races In fact, unlike marathons held in cities, cross-country races take place in mountainous areas where participants have to face complex geographical and weather conditions, which means that they are more difficult and dangerous, both for the organizers and the participants.

In 2021, a participant was found dead after being lost for several hours in the Kailash Mountain Run in Zhuhai, Guangdong Province, China, the exact cause of death has not yet been announced. 2021, a participant was killed in the Wumeng Mountain Supercross in Shaotong, Yunnan Province, China, after a sudden downpour of rain caused him to lose consciousness and hallucinations and missed the best time for rescue due to a landslide. 2020, Vietnam Dalat Marathon trail run, 1 participant was carried away by a flash flood while crossing a stream, the person in charge of the trail admitted to not having a proper plan for the trail in a storm. 2019, two participants in Romania fell into a ravine after possibly missing the safety ropes set up by the participants on a dangerous section of the trail due to a slippery path in the rain. 2018, Xiaoxiang 100 Tianmen Mountain International Trail Race, Zhangjiajie, Hunan Province, China In 2017, one participant died of sudden cardiac death at the Lingshan 100 International Mountain Cross Country Challenge in Beijing, China[1]. Keywords such as "cross-country Race", "death" and "Trail Race" were searched and it was found that in the cross-country Race fatalities in the past five years, one person was usually killed and the Race was stopped [2],Only two victims were found in a mountain marathon in Romania in 2019.In the case of the Yellow River Shilin Mountain Marathon 100km, there was no shortage of off-road experts among those killed. Among the victims of the Yellow River Shilin Mountain Marathon, there was no shortage of off-road masters - Liang Jing, the Jiangnan 100km champion in Ningbo, the Huang champion at the 10th National Paralympic Games and the 7th Special Olympics, and the first male runner in the disabled category of the athletics marathon at the 10th National Paralympic Games and the 7th Special Olympics. It should be noted that the casualties of the Yellow River Shilin Mountain Marathon 100km cross-country race were exceptionally tragic and unprecedented, and once this event was reported, it caused a strong and thought-provoking reaction from the community.

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After reviewing the literature, we found that most of the previous studies have focused on accident analysis in the field of outdoor sports, but there are few studies on accident analysis with mountain marathon as the main subject. Therefore, this paper uses the accident tree analysis method to establish a mountain marathon accident tree analysis model based on the cases of mountain marathon accidents in the past five years at home and abroad, and invokes the accident causation theory to develop the characteristics, causes, potential hazards, lessons learned, response and management of mountain marathon accidents, hoping to provide some guidance for the response and management of mountain marathon accidents.

2. Features of the Mountain marathon

The mountain marathon has the characteristics of an extreme sport, which is very challenging and exciting in the race. However, it shows the characteristics of suddenness, objectivity, uncertainty and real time in the development process.

2.1 Suddenness

Mountain marathons are inherently challenging and unknown when they are run in the wild. Athletes who are not careful about slipping on their feet during their journey can easily cause sports injuries, ranging from skin abrasions to joint sprains or fractures, or even falls into gullies. The danger can occur at great discretion, perhaps on a rough hill climb, or on a flat road. The suddenness of the injury is the most common feature of mountain marathons, as it occurs without warning, often in a matter of seconds [3].

2.2 Uncertainty

The possibility of an accident in any sport has a certain objective existence. In disciplines such as economics or insurance, risk is defined as the possibility of an event causing damage or injury. Sporting risk is the possibility and uncertainty of causing injury in sport. In the case of a mountain marathon, it can be greatly affected by weather, road conditions and wildlife. The physical condition of the athletes during the race is also a contributing factor that cannot be ignored.

2.3 The unknown

The many factors that influence mountain marathons, combined with the presence of potentially unknowable influences, make the timing, location and form of mountain marathon incidents highly uncertain. However, it is possible to reduce this uncertainty through the scientific organization and management of the event.

2.4 Hazards

In the event of danger in a mountain marathon, athletes are likely to be at risk of broken bones and disability, or even death. In the light of this, they may not be able to compete for a period of time, or they may lose their lives, and this can also be traumatic for the event organizers, and the industry as a whole.

2.5 Real time

Large-scale mountain marathon events often have great attention and radiation, their events will be shown in the way of live or broadcast, if an accident occurs, will be quickly known by all parties, will cause great impact and loss to the organisers.

3. Causes of accidents in mountain marathons

By analyzing the accidents in mountain marathons in the past five years, we have established an accident analysis chart for mountain marathons, as shown in Figure 1. From Figure 1, it is easy to find that mountain marathon accidents are caused by a variety of factors, any one of which can lead to a major accident. Further analysis shows that the lack of equipment, ageing and sudden changes in the environment are the main causes of accidents, the response of the athletes is a decisive factor in

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whether an accident can occur, and a sound rescue system is an important safeguard to avoid accidents.

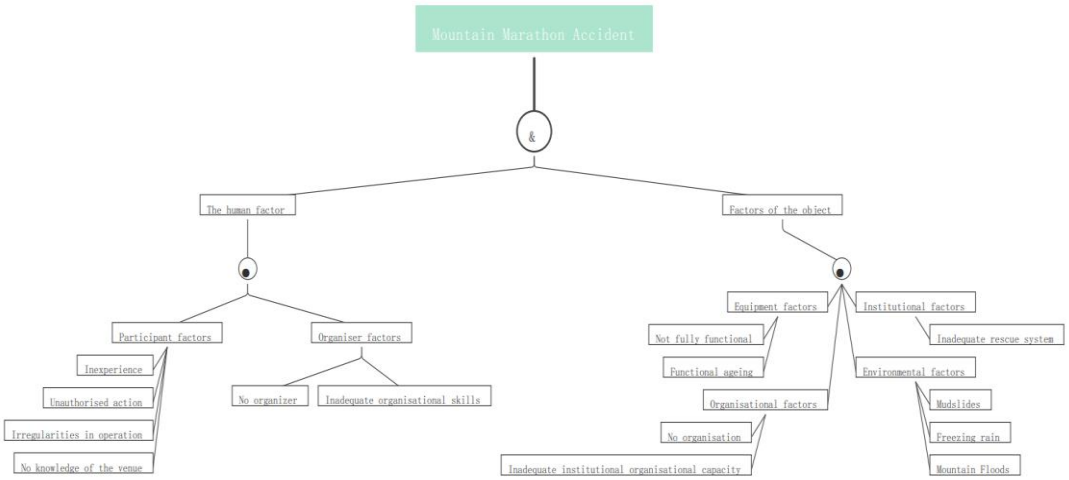


Figure 1: Mountain Marathon Incident Map

Through the domino theory of accident causation, accidents occur due to the unsafe behavior of athletes, which is caused by the shortcomings of athletes, which originate from the unstable natural environment. According to the accident tree analysis diagram, the occurrence of accidents in mountain marathons can be divided into four aspects: human factors, environmental factors, equipment factors and rescue factors according to the theory of "human, environment, equipment and rescue", among which human factors include athletes' inexperience, wrong judgements and blind confidence; environmental factors include mudslides, freezing rain, flash floods and other environmental factors include natural disasters such as mudslides, freezing rain and flash floods; equipment factors include the ageing and lack of equipment; and rescue factors are the absence or inadequacy of a rescue system.

By combining the "human, environmental, equipment and rescue" factors with the domino theory, the interrelationship between the causal factors is further analysed as shown in Figure 2. The environmental and equipment factors are the triggers for accidents, while the human factor is the fundamental factor that causes accidents. The rescue factor is the final guarantee to avoid accidents and is also an indirect factor that leads to accidents, and the degree of perfection of the rescue team will determine whether an accident can occur [4-7]. In terms of the degree of risk, the environmental factors are much more dangerous than the equipment factors, therefore, the environmental factors will be the first precautionary indicator and the equipment factors, the second precautionary indicator.

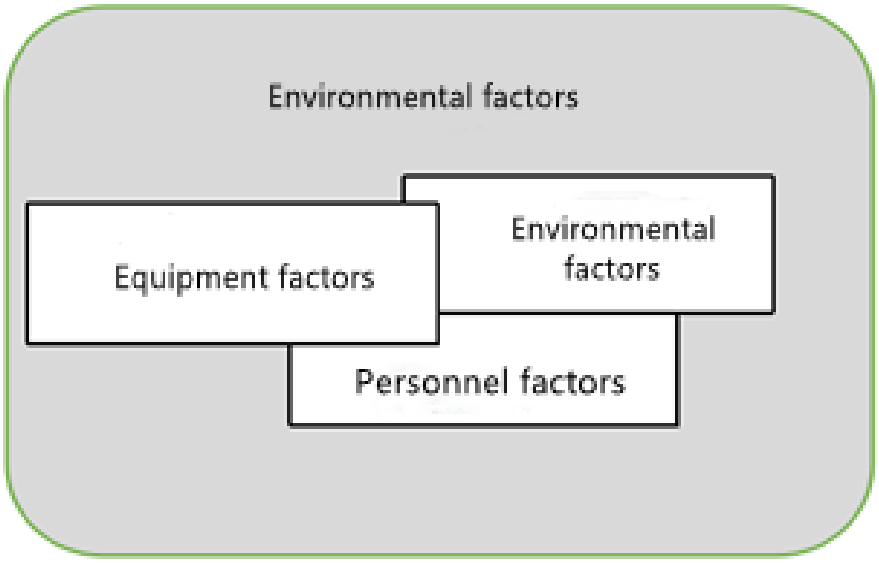
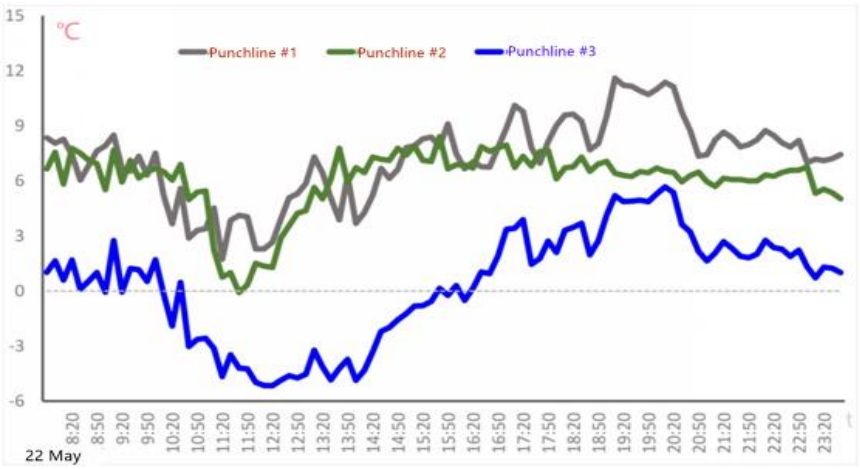


Figure 2: Diagram of the relationship between the causal factors of an accident

ISSN 2618-1576 Vol. 4, Issue 4: 1-7, DOI: 10.25236/FSR.2022.040401



(Data from the official website of Gansu Provincial People's Government)

Figure 3: Body temperature map of participating athletes

For a specific analysis of the Gansu Baiyin Mountain Marathon accident, the 100km cross-country route had the largest elevation climb from punching point 2 to punching point 3, performing from 1347m to 2230m, and obviously the most difficult section. On the day of the incident, the sky environment was relatively harsh, with a minimum temperature drop of 4 - 8℃ in Jingtai County, a temperature of 4 - 16℃, a maximum wind force of 7 - 8, and 0.2 - 7.2 mm of precipitation, which mainly occurred between 11:00 and 14:00 [8]. As a result, the sudden change in temperature, thin clothing and the failure of the organizers to terminate the race in time were the various factors that led to the death of some participants due to acute hypothermia. The body temperature map of the athletes competing in the race, as shown in Figure 3, was therefore a public safety liability incident that resulted in significant injuries and deaths due to poor organizational management and unprofessional operational execution of the event under the influence of severe weather.

Secondly, according to the domino theory of accident causation, the accident was caused by the athlete's unsafe behavior, which was caused by the athlete's shortcomings and mistakes, and the athlete's shortcomings and mistakes were caused by bad natural weather. The "people, environment, facilities and rescue" theory suggests that at least three factors contributed to the accident: firstly, the lack of warmth in the athlete's equipment; secondly, the inclement weather of freezing rain and plummeting temperatures; and thirdly, the lack of shelter in the high altitude section of the rescue system to keep out the wind and cold, and the lack of a shelter to protect the athlete from the elements. After the athletes sent out a distress signal, there was a lack of fast and mobile rescue teams; iv. The athletes lacked experience and did not terminate their exit from the race or the descent. As a result, irreversible and serious accidents were caused.

4. Mountain marathon hazard checklist

In order to reduce the occurrence of accidents, a list of potential hazards in the mountain marathon accident tree analysis is listed out accordingly. The first is the inspection of athletes, mainly including physical examination pre-race safety education athletic ethics inspection emergency response training, etc.[9]; the second is the inspection of the necessary equipment, mainly including athletes to protect themselves from cold, sun, bleeding, distress and other items, mainly including thermal blankets, rashers, down jackets, bandages, band-aids, mobile phones and other items; the third is the inspection of safeguards such as supply stations, whether the setting of shelters is adequate, whether rescue teams The third is to check the security measures such as supply stations, whether the shelters are adequately set up and whether the rescue team is complete.

5. Lessons from the mountain marathon accident

5.1 Enhance awareness of risk prevention

The concept of "two firsts" is not firmly established, and the awareness of preventing and resolving risks is not strong [10-11]. The government and relevant city and county departments are not

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sufficiently aware of the potential safety risks of such extreme sports as cross-country races, and the lack of risk assessment, imperfect prevention and response plans, and failure to guard the gates are the causes of casualties.

5.2 Increase integrated development efforts

The relevant departments show how to achieve safe development of new industries and new sectors, and the follow-up of safety measures is not timely. The role of mass sporting events such as the 100km cross-country race in promoting local characteristics and building a tourism brand has been taken more seriously, neglecting safety as the most basic element and guarantee, without putting "safety first" into practice, and the overall level of safety development needs to be improved.

5.3 Implementing policy requirements

The sports authorities have failed to fully implement the reform policy of "decentralisation"[12] and have "let go" of larger sports activities, which has led to a series of cross-country races with loopholes in safety, distress information, rescue search and other important parts. Therefore, it is imperative that sports-related authorities learn from the lessons and put the relevant policies and regulations into practice.

6. Response to emergencies in mountain marathons

6.1 Prevention aspects

6.1.1 Education and training

Organizing associations and sports management centers should strengthen skills and safety prevention training for organizers and practitioners of sporting events to improve the level of the event. Secondly, for the participating athletes to cultivate a good concept of honour, through conducting lectures, showing video educational clips and other ways, the mountain marathon risk identification, risk assessment and risk response knowledge for all athletes to master, to improve the athletes' ability to deal with risks.

6.1.2 Safeguarding mechanisms

Organizers of sporting events should put safeguards in place before the event is held, for example, they should establish a complete safeguarding mechanism for sporting events in conjunction with departments such as health and hygiene, emergency management, public security, communications and meteorology to improve the level of service safeguards for the event.

6.1.3 Safety measures

The organizers of sporting events should employ professional and technical staff to scrutinise the venue, equipment and facilities, and to check safety, communication, traffic, food and fire safety measures to ensure that emergencies can be dealt with decisively and in a timely manner. At the same time, a "meltdown" mechanism should be implemented to stop the event in time if conditions are not suitable for the event to continue.

6.1.4 Epidemic prevention and control

Under the strict implementation of the requirements of the Party Central Committee and the State Council on epidemic prevention and control, a thorough prevention and control plan will be formulated, such as: the event staff and athletes must present the "three possessions" before entering the competition area, i.e. the health code green code, the green travel card, and the 48-hour nucleic acid test report before boarding, and at the same time, a thorough contingency plan will be formulated.

6.2 Safeguarding aspects

6.2.1 Contingency planning

According to the setting of the difficulty of the route, the simulation of possible risks in the early stage of the competition, the establishment of the corresponding emergency plan [9]. It should include a comprehensive emergency organization and management command system, a strong emergency

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rescue and protection system, an integrated and coordinated, responsive mutual support system and a comprehensive rescue and emergency team.

6.2.2 Communication system

As the mountain marathon race route is set up to be many tens of kilometers long, in the event of danger, reliable communication is a prerequisite to ensure the implementation of rescue, therefore, communication base station facilities should be set up in advance to ensure that distress calls made by each team member when equipped with a fully charged mobile phone are unimpeded and also show the real-time positioning of each team member.

6.2.3 Replenishment stations and refuges

The corresponding number of supply stations is set according to the difficulty level of the route to ensure that athletes can receive timely energy replenishment during the stages of the route where the difficulty factor is high and physical exertion is high. At the same time, especially in highland areas, due to the rapid climate change and low temperatures, it is important to set up an adequate number of shelters in case of emergency.

6.2.4 Rescue

Upon receipt of a rescue call, the corresponding emergency plan is activated according to the level of risk. Under unified command, the rescue team rushes to the scene in the shortest possible time, quickly starts rescue work and keeps the command team informed of the scene.

6.2.5 Medical system

Between the stations, there is a need to increase the number of AP points (emergency first aid points) for the course where there is a risk or according to the course requirements, where in the safety recommendations of the International Trail Running Association, there is a requirement for at least two people to have an emergency first aid point in order to support the whole medical system. At the same time, there will be a number of AP points between the two CP points, so that the AP points in different places can be deployed in a rational way, for example by increasing the density in the second half of the race.

7. Management of prevention of emergencies in mountain marathons

In order to further regulate the conduct of sports events, to ensure that sports events are conducted in a safe and orderly and civilized manner and to create a civilized and orderly competition environment, both macro and micro perspectives should be addressed.

7.1 From a macro perspective

Governments at all levels and relevant departments should strictly follow the State Council's Regulations on the Safety Management of Large-scale Mass Events[13] and establish a perfect prevention, supervision and precautionary mechanism for large-scale sports events, always judging the organization of events, guiding public opinion on events, controlling the order of athletes' competitions, and decisively taking emergency plans if special circumstances arise.

Each regional mountaineering association initiates an annual outdoor safety education and training programme and regularly organizes a series of activities such as safety education lectures and outdoor professional skills training to guide outdoor sports enthusiasts to pay attention to and focus on outdoor safety and to further strengthen their safety awareness and outdoor risk prevention capabilities in order to prevent outdoor safety accidents from occurring.

Sports-related departments should formulate a system for the management of the conduct of the field, and establish the basic principle of "who is in charge, who supervises" and "who does the work, who is responsible" for the management of the conduct of the sports field. The accountability mechanism should be done at all levels of control and responsibility [14].

When organising outdoor events, organizers should follow the principle of "whoever organises (undertakes) the event is responsible", take into account the extreme weather, emergencies and other types of safety risks in the actual venue, study effective preventive measures, formulate targeted prevention and control plans, and follow the "one race In accordance with the requirements of "one strategy", safety strategies and emergency plans are formulated respectively.

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7.2 From a micro perspective

The mountain marathon is getting bigger and bigger every year, and the community is paying more and more attention to the event. If the cultural value of the event itself is to be realise, it is particularly important for the organizers to invite relevant experts to give on-site guidance and conduct the necessary pre-, mid- and post-event business training.

The organisational and management behaviour and modus operandi of the event in its management needs to be in line with the corresponding appropriate. For organizers, it is important to organise a high-quality, real-time detectable and dynamically adjustable event in a spirit of excellence, science and rigorous work. For outdoor sports enthusiasts, it is important to study the route in advance, anticipate the risks, prepare your belongings and travel within your means when participating in various outdoor activity events.

In an era when mountain marathons are used to create local outdoor sports cards, it is imperative that safety comes first. It is strictly forbidden for either the organisers, participants or spectators of sporting events to engage in violence on the course or to interfere in any way with the orderly conduct of the race [15].

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