

# The “medicalization” of mountain rescue teams: a social and economic approach based on mortality evolution in the Central Pyrenees

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Received: 14.11.2017

Accepted: 08.06.2018

## Summary

**Introduction:** Mountaineering improve the physical and mental health of people who practices it. All sports have a collateral not wished effects: accidents and sport injuries. Although mountain rescue operations involve logistic and environmental difficulties that expose everybody to important risks, alpine countries have joined sanitary people in these rescue operations because they know shorten times of medical intervention and an appropriate treatment in place diminish mortality and sequels, and consequently, social and sanitary expenses. Many mountain regions in Spain have not medical services in mountain rescue teams.

**The facts of mountain casualties:** There were 5,4 fatalities for every 100 rescued people in mountains in Spain. There were 3,5 fatalities for every 100 rescued people in Aragon. 6,3% of rescued patients suffered polytraumatism. 63,7% of rescued people in mountains in Aragon presented a NACA index  $\geq$  III (that means they need medical assistance in the place of the accident). 11,3% of people rescued in Aragon between 1999 and 2008 had a Glasgow Index among 13 and 9 and 12,9% had a Glasgow Index  $<$  9. Mountain rescue operations are medicalized in Aragon since 1998.

Also, mountain rescues are medicalized in Asturias, Cantabria y Castilla-León.

**Effects of medicalized mountain rescue operations:** There are important differences between some regions in Spain about medical services in mountain rescues. Medicalization means to have a doctor or nurse specifically trained in Mountain Emergency Medicine integrated in rescue teams. This improves the efficiency of first treatments on the field, despite the difficulties of access, improving survival and diminishing morbidity. In Aragon, the rate of average mortality has changed from 9,32% before the medicalization of mountain rescue to 3,45% during medicalization with CUEMUM physicians and nurses, which supposes a decrease of 62% in 15 years. Whereas the rate of mortality in Spain was changed to 8,8% to 6,8% in the same period what supposes a decrease of 12,5%.

**Cost-benefit analysis:** We calculate downwards that mountain casualties in Spain costs more than 375 million € per year. They overcome 50 million € per year in Aragon. This region has save of more than 175 million € with this decrease of mortality of 62%.

**Conclusions:** Medicalization of mountain casualties is a human right and a duty with clear social and sanitary benefits. The medical assistance on the field diminishes morbidity and mortality and the public expenditure. Spain must to improve the prevention and to guarantee the medicalization of mountain rescues in the whole Spanish regions with nurses and physicians trained in Mountain Emergency Medicine.

## Key words:

Medicalization. Cost analysis. Mountaineering accidents.

## Medicalizar los equipos de rescate en montaña: justificación socio-económica en base a la evolución de la mortalidad en el Pirineo Central

### Resumen

**Introducción:** El montañismo mejora la salud física y mental de las personas que los practican contribuyendo a lograr un menor gasto socio-sanitario. Todos los deportes tienen efectos colaterales no deseados: accidentes y lesiones. Las operaciones de rescate en montaña implican dificultades logísticas y ambientales que exponen a numerosos e importantes riesgos, pero se han incorporado sanitarios en estas operaciones de rescate ya que acortar los tiempos de intervención médica y el tratamiento apropiado *in situ* disminuyen la morbi-mortalidad de los accidentados. En España hay muchas Comunidades Autónomas (CCAA) sin rescate en montaña medicalizado.

**La realidad de los accidentes de montaña:** En España hay 5,4 muertos por cada 100 rescatados en montaña. En Aragón, se contabilizan 3,5 muertos/100 accidentados rescatados. El 11,3% de los rescatados en Aragón entre 1999 y 2008 presentaba un índice Glasgow entre 13 y 9 y el 12,9% tenían un Glasgow  $<$  9 (grave). Un 6,3% de los pacientes rescatados sufrieron politraumatismos. Un 63,7% de los rescatados presentaban un índice de gravedad NACA  $\geq$  III que hace referencia a pacientes que requieren asistencia médica en el lugar del accidente. En Aragón se medicaliza el rescate en montaña desde 1998. También están medicalizados estos rescates en Asturias, Cantabria y Castilla-León.

**Los efectos de la medicalización del rescate en montaña:** Existen claras diferencias entre las prestaciones que establecen unas CCAA y otras. La “medicalización del rescate” supone un médico o enfermera específicamente formado en Medicina de Urgencias en Montaña integrado en los equipos de rescate. Esto mejora la eficacia del primer tratamiento en el lugar del accidente, por difícil que sea el acceso, mejorando la supervivencia y disminuyendo la morbilidad. En Aragón, la tasa de mortalidad media ha pasado del 9,32% antes de la medicalización del rescate al 3,45% en los 15 años de rescate medicalizado con médicos y enfermeras CUEMUM, lo que supone una disminución del 62%. Mientras que la tasa de mortalidad media en España en el mismo periodo ha pasado del 8,8% al 6,8%; lo que supone una disminución del 12,5%.

**La relación coste-beneficio:** Calculamos a la baja que los accidentes de montaña en España cuestan más de 375 millones € al año. En Aragón estimamos que superan los 50 millones € al año. La disminución de la tasa de mortalidad en un 62% ha supuesto un ahorro de más de 175 millones €.

**Conclusiones:** La medicalización del rescate es un derecho y un deber con claros beneficios socio-sanitarios. La asistencia médica *in situ* disminuye la morbi-mortalidad y el gasto público. España debe mejorar la prevención, además de garantizar la medicalización de los rescates en todo el territorio con sanitarios formados en Medicina de Urgencias en Montaña.

## Palabras clave:

Medicalización. Análisis económico. Accidentes de montaña.

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## Introduction

Moscoso defines mountaineering as *“those physical activities which consist of progressing, ascending or otherwise, over mountainous terrain and are consciously performed in order to maintain or improve the health (physical and/or mental), interact with others, evade everyday life, experience sensations produced by the practice itself or, finally, to excel oneself and/or compete”*.

Sport improves the health<sup>2,3</sup>, but all sports involve injuries or accidents. Mountaineering is not the sport with most accidents or injuries. In most cases, it consists of a form of “adventure sport” or “active tourism”, which, when performed responsibly, is less dangerous than other sports not classified a priori as “high-risk” activities. It should be noted that:

According to the Royal Society for the Prevention of Accidents (ROSPA), in the UK, playing football or cricket involves a greater risk of injury than hiking or rock climbing<sup>4</sup>.

A micromort (MMI) is a unit of risk defined as a one-in-a-million chance of death. According to Blastand and Spiegelhatler,<sup>3</sup> the probability of dying travelling 100 km by motorcycle is 10 in a million (10 MM), running a marathon 7 MM, cutting down trees for one day 6 MM, climbing for one day 3 MM and skiing for two days 1.5 MM.

The problem with mountaineering is that an accident or injury in a difficult, isolated and hostile environment can involve serious consequences or even death. The implications of a sprain in a sports centre are not the same as those of a sprain at 3,000 metres, in bad weather and near nightfall.

Following the results of emergency assistance in the field during the Korean and Vietnam wars, numerous studies have shown that the early management of many potentially lethal medical conditions, particularly cardiovascular conditions, but also those related to traumatic injuries, decreases mortality and significantly reduces sequelae (morbidity). Consequently, shortening the intervention times involved in providing appropriate treatment has been the chief objective of medical care out of the hospital environment in developed countries since the 1960s<sup>5</sup>.

Mountain accidents have a high impact in terms of premature death and loss of health or quality of life in a significant number of people, most of them young<sup>6-9</sup>. Consequently, the Alpine countries have not hesitated to include medical professionals in their mountain rescue teams, but *are there objective grounds and evidence supporting the widescale applicability of this measure?* Not just any healthcare professional is suitable for this job, however, because the incorporation of medical specialists in mountain rescue teams requires that they be suitably trained in emergency medicine out of hospital environments, possess sufficient knowledge and skill to progress safely and quickly on mountains, in snow, on cliff faces, in ravines and in caves, and have the ability to work closely and safely with the mountain rescue specialists they accompany<sup>10,11</sup>. This calls for specific training with the involvement of many institutions, because these professionals will be providing their services in the public sphere. On the face of it, *is it worth the institutional and economic effort that all this requires?*

## The reality of mountain accidents

In Spain, there is no official record of mountain accidents, even though ever since the 2010 National Mountain Safety Congress, a Mountain Accident Observatory, one of the conclusions of Nerín’s thesis in 2002,<sup>12</sup> has been demanded. According to the theses of Sánchez<sup>13</sup> and Villota<sup>14</sup> on rescues throughout Spain in 2013, 3,000 people are rescued in the mountains each year, there being Autonomous Communities in which groups other than the Guardia Civil (Spanish military body with police duties) carry out rescue work. If we consider that mountain rescues represent<sup>12</sup> 5-10% of all accident victims (who also consume health and social, but not rescue resources), Sánchez<sup>13</sup> estimates 60,000 mountain accidents a year.

According to a 2014 Aragonese economic report<sup>15</sup>, active mountain tourism accounted for 10% of GDP: €3,350.20 million. Aragon, like other Spanish Autonomous Communities, sells nature, mountain and adventure tourism, which generates evident wealth and development in many of its districts. Due to the damage they cause and the human and economic cost they entail, mountain accidents are an undesired side effect of Mountain Tourism. That it is possible to apply methods of prevention and control, and that these methods are not being applied properly should be considered a public health problem in Aragon<sup>12</sup>.

There seems to be no interest in the economic impact that mountain accidents have on a country or region even though mountaineering has proven beneficial effects on people’s physical and mental health, and mountain tourism is an important economic driver. It is even more difficult to express the suffering of the victims of serious accidents, be they at work, on the road or in the mountains, in economic terms. No amount of money can compensate for the loss of a relative or a permanent disability.

The Guardia Civil carries out between 40 and 45% of all the mountain rescues it performs in Spain in Aragon. According to data provided by the Mountain Headquarters of the Guardia Civil, there are 7 deaths/100 accident victims among those rescued by the Guardia Civil in Spain. If we look at the figures of all the rescue groups in Spain, there are 5.4 deaths per 100 rescued. In Aragon, there 3.5 deaths/100 accident victims rescued. To get an idea of the seriousness of the problem, compare these figures to road safety statistics: in Spain, there are 4 deaths/100 traffic accidents<sup>16</sup>.

Of the 2,135 clinical reports of patients rescued in Aragon between 1999 and 2008, Soteris<sup>8</sup> considers that 63.7% of rescues had a NACA severity score of  $\geq$ III, which refers to patients who require medical assistance at the scene of the accident, according to Schuster<sup>17</sup> and Kaufmann,<sup>6</sup> 67% of these had trauma-related problems, while the rest had medical or environmental conditions. Another severity index is the Glasgow scale. 11.3% of those rescued had a score between 13 and 9 (moderate severity) and 12.9% had a Glasgow score of <9 (severe). 6.3% of patients suffered multiple injuries. Only 13% of those rescued by helicopter emergency medical services could be considered uninjured. Soteris insists that rescue services with medical care should be available 24 hours a day; despite the infrequency of accidents requiring on-the-spot assistance, these rescue operations are much longer and complex than normal ones. Gosteli *et al.*<sup>18</sup> also indicate that the median time on

site for rescue teams in high-energy mountain accidents, characterised by a large proportion of severe traumas and axial injuries, is greater and that half of these cases involve at least one environmental or site-related difficulty. The authors conclude that these interventions are longer and more complex. Chen *et al.*<sup>19</sup> show that criteria such as a Glasgow score of <13, with a respiratory rate of less than 10 or more than 29 respirations per minute, or the presence of haemo- or pneumothorax warrant HEMS intervention because it leads to a 22% increase in the likelihood of survival (OR 1.22, 95% CI 1.03-1.45,  $p = 0.02$ ).

In Aragon, mountain rescue has been “medicalized” since 1998 (with placement students studying Mountain Emergency Medicine Specialisation University Courses (CUEMUM) and, since 1999, professionals). CUEMUM medical staff also take part in mountain rescues in Asturias, Cantabria and Castile-Leon.

## The effects of “medicalizing” mountain rescue

One important issue centres on the fact that the medical personnel need to be mentally and physically prepared to take part in difficult rescues, because such operations not only imply logistical difficulties<sup>20</sup>, but also last longer and involve greater severity<sup>5-7,9</sup>. In order to address such situations, they require regulated, specialized training in both organised rescue and mountaineering techniques, in addition to HEMS training according to the recommendations of the International Commission for Alpine Rescue, which insists on training in emergency situations, mountain-specific training and air and ground rescue training<sup>10,21</sup>. The fact that Aragon has doctors and nurses trained to work with mountain rescue groups is thanks to the CUEMUM, initiated by Dr José Ramón Morandeira in 1996, which trained 400 health specialists in 18 years. Since 2016, CUEMUM training has been resumed through the *Official Master’s Degree in Emergency Medicine in Mountain and Inhospitable Environments* (MUMMI) at Universidad Camilo José Cela, which is recognised throughout the European Higher Education Area (EHEA): <http://www.jrmorandeira.org/formacion>

When we refer to “medicalizing rescue services”<sup>21</sup>, we do not mean that the medical professionals need to be professional rescuers; we mean that a doctor or nurse specifically trained in Mountain Emergency Medicine according to internationally accepted criteria goes to the site of the accident and attends to the injured person there, be it on a rock face, the top of a mountain, a ravine, cave or a snow-laden slope, where emergency training or HEMS (Helicopter Emergency Medical Service) training is not sufficient. That is to say, we refer to medical professionals who are<sup>8,10,21</sup>:

- Comfortable in exposed situations
- Aware of their own safety
- Able to work under extreme conditions

Article 43 of the Spanish Constitution states: “*The right to health protection is recognised. It is incumbent upon the public authorities to organize and safeguard public health through preventive measures and the provision of the necessary assistance and services (...)*”. It should be noted that “*the right to health*” is linked with something so essential and so unconditionable as the right to life. In fact, this is the principle

of taking charge of the medical care of the population, including those suffering from diseases derived from tobacco, drugs, alcohol, obesity and a sedentary lifestyle, even though these are the result of ‘recklessness’ and ‘risky behaviour’ as far as health is concerned. Most mountaineering activities are aerobic physical activities, suitable for gaining physical fitness, losing weight and reducing the risk of cardiovascular disease. Yet public opinion, the insurance companies and the government itself tend to mistakenly consider them a form of ‘risk behaviour’.

The study *Actividad física y prevalencia de patologías en la población española* (Physical activity and prevalence of disease in the Spanish population)<sup>2</sup> shows that “*increasing physical activity in the Spanish population could reduce health spending by 10% and lead to annual savings of 5,000 million euros*”. If members of the public suffer injuries or illnesses as a result of physical activity in mountain environments -which helps reduce health spending by improving physical and mental health-, shouldn’t the public health system guarantee care with the necessary diligence and with the same guarantees in all the country’s Autonomous Communities?

If we refer to the General Health Act (14/1986 of 25 April), Article 3.2 states: “*Public health care shall be given to the entire Spanish population. Access and health services shall be provided in conditions of effective equality*”. This is argument enough to demand the provision of “medicalized” rescue services in all the Autonomous Communities, while in fact they only exist in Asturias, Cantabria, Castile-Leon and Aragon. The Autonomous Communities are responsible for: Health Planning, Public Health and Health Care.

However, clear differences can be observed between the services established in different Communities regarding the provision of medical care as part of mountain rescue. If we put ourselves in the shoes of those in charge of health and civil protection, we should wonder if it is necessary for health professionals to reach the victim of the accident instead of waiting for the rescue to bring him or her to them? Isn’t the shortening of rescue and transfer times thanks to helicopter rescue enough to assist those who suffer mountain accidents?

- On the one hand, if we look specifically at HEMS rescue operations in mountainous and remote areas, studies show that at least two thirds of rescues require the use of mountaineering techniques to access and evacuate the victim<sup>21-23</sup>. Therefore, health professionals involved in mountain emergency services need specific training in Mountain Emergency Medicine in order to be able to provide health care at the site of the accident<sup>8,10,11,21</sup>.
- On the other hand, according to Cowley<sup>24</sup>, most victims of traumatic accidents could be saved if bleeding and blood pressure are controlled in less than an hour. The Golden Hour is an undisputed healthcare quality criterion in all developed countries. The European HEMS system pursues this goal; survival in isolated and hostile environments also depends on helicopters significantly shortening intervention times<sup>25</sup>. This optimal response time supposes arrival at the scene of the accident, treatment in the field and transfer to the appropriate hospital in less than an hour, having stabilised the patient using PHTLS and AMLS techniques.
- But there are circumstances in mountain emergencies which make the urban HEMS “golden hour” target impossible. Therefore, the

presence of a mountain emergency doctor/nurse greatly improve the victim's chance of survival. It is considered that this "golden hour" can be safely extended when there is a doctor at the accident site, as demonstrated by Osterwalder's study<sup>26</sup> comparing two groups of trauma patients. And as also shown by Durrer<sup>27,28</sup>, who indicates that the presence of doctors trained in air mountain rescue improves the effectiveness of primary treatment at the accident site, even in areas which are difficult to access<sup>25</sup>. The results of Soterias' study<sup>8</sup> support the evidence which indicates that the presence of doctors trained in air mountain rescue improves the effectiveness of primary treatment at the accident sites, however difficult access may be, improving the chance of survival and reducing morbidity. We are not talking about a HEMS helicopter "waiting" for the sick or injured person to be retrieved, but a mountain emergency doctor/nurse who forms part of a mountain rescue team treating the patient at the scene. This is what allows the "golden hour" to be "extended".

Sanz<sup>29</sup> reports the views of the groups involved in Aragon (Guardia Civil mountain rescue team members, members of mountain military units, health professionals from mountain health centres and CUEMUM doctors/nurses belonging to the 061 mountain emergency medical unit (UME)), shown here in Table 1: "All the actors surveyed highlighted a

reduction in health complications and mortality as a result of the current rescue with medical care service in operation in Aragon, where the technical part of the work is performed by the Guardia Civil mountain rescue groups and health care is provided at the accident site by specialised staff belonging to the Aragon Emergency Health Service (trained in Mountain Emergency Medicine)".

The opinions of those directly involved (which rarely coincide with the opinions of those who manage public health, who know little about the reality on the ground) are confirmed by concrete figures in the graphs describing the evolution of the mortality rate in Aragon and in Spain (Figures 1 and 2), produced using data provided by the Mountain Guardia Civil. Between 1981 and 1998, the annual mortality rate in Aragon was much higher than the mortality rate in Spain as a whole. Since medical professionals started to form part of the mountain rescue teams in Aragon, the mortality rate there has significantly dropped beneath the figures for Spain and even holds at 50% lower than the average rate in the country. The only Guardia Civil mountain rescue groups which include CUEMUM doctors and nurses are those in Aragon.

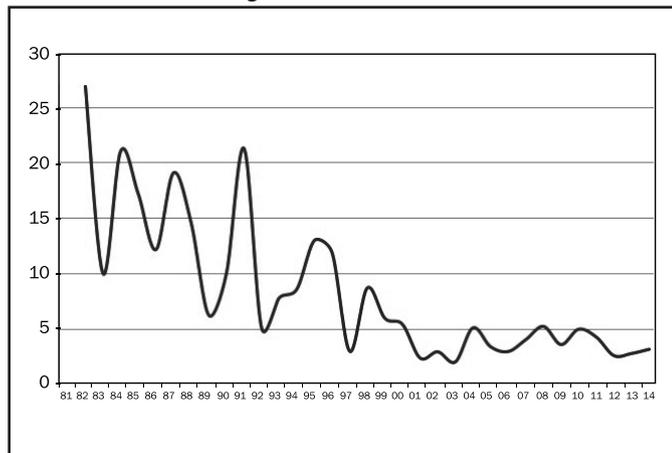
Let us take a more detailed look at the effect which "medicalization" has had on mountain rescue operations in Aragon. If we analyse the figures of casualties rescued, as provided by the Headquarters of the

**Table 1. Opinions of the groups involved in Aragon<sup>29</sup>.**

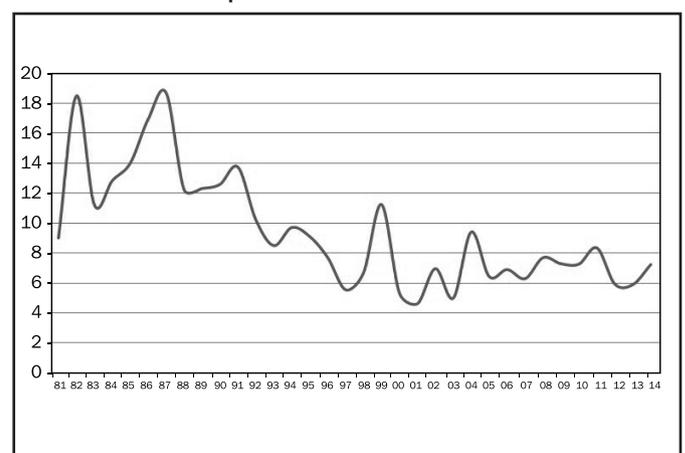
Agent	Reduction of health complications	Reduction of mortality
GREIM	Between 81% and 90%	Between 81% and 90%
GMAM	Between 51% and 60%	Between 21% and 30%
Sabiñánigo (Huesca) UME Health Professionals	Between 91% and 100%	Between 91% and 100%
Health Professionals at Huesca Health Centres located in mountain areas	Between 61% and 70%	Between 91% and 100%

GREIM - Guardia Civil Mountain Rescue and Intervention Groups.  
 GMAM - High Mountain Military Group at the Mountain and Special Operations Military School in Jaca (Huesca).  
 Sabiñánigo UME - 24-hour Advanced Life Support Unit where the mountain rescue health professionals are based.

**Figure 1. Deaths per 100 mountain accident victims rescued by the Guardia Civil in Aragon.**



**Figure 2. Deaths per 100 mountain accident victims rescued by the Guardia Civil in Spain.**



Mountain Guardia Civil in Aragon, the average mortality rate (deaths per 100 injured rescued) fell from 9.32% (between 1990 and 1999) prior to the introduction of medical professionals in rescue teams to 3.45% (between 2000 and 2014) in the 15 years of rescue with CUEMUM doctors and nurses; a 62% drop. Meanwhile, the average mortality rate in Spain fell from 8.8% (between 1990 and 1999) to 6.8% (between 2000 and 2014); a 12.5% decrease. This drop can be explained by the impact of the lower mortality rate in the mountains of Aragon on the total figures of the Guardia Civil rescues carried out in Spain.

Meyer *et al.*<sup>30</sup> demonstrated the effectiveness of HEMS in reducing morbidity and the average time spent in hospital. When HEMS services were combined with the creation of “Trauma Centres”, the mortality rate among the most seriously injured fell<sup>16</sup> from 50 to 39%. Therefore, the provision of medical care at mountain accident sites (almost 3,000 rescued in Spain, according Villota and Sanchez) reduces morbidity and mortality by rather more than one person by prolonging the “golden hour”, as evidenced by the evolution of the mortality rate in Aragon since 1999.

## Costs and benefits

These figures take us to the cost-benefit analysis conducted by Sanz<sup>29</sup> on accident victims rescued by the Guardia Civil in Aragon, where almost half the rescues carried out in Spain take place.

### Costs

According to figures provided by Guardia Civil mountain rescue specialists in Aragon, one helicopter flight hour costs around 3,000 euros and approximately three flight hours are needed to complete an operation. In Aragon, Guardia Civil helicopter flight hours in 2013 accounted for an annual “bill” of over two million euros. To this, we need to add the cost of rescue personnel, the doctor or nurse belonging to the emergency health service and the material resources used. The cost of rescues and Guardia Civil mountain rescue teams is met by the Spanish Government’s Ministry of the Interior.

Table 2 shows the estimated cost of technical rescue operations performed by the mountain Civil Guard according to type of rescue.

The approximate costs, calculated from an optimistic perspective (according to the Government of Aragon’s annual remuneration tables for 2013 by professional levels, without the work post supplement, special availability supplement, three-yearly bonuses or inclusion of the 13th and 14th monthly payments), according to the professional involved (excluding the consumption of the specific vehicles and material for mountain rescue) are shown in Table 3.

The additional cost of the Aragon Emergency Medical Service’s Special Mountain Rescue Unit compared to a conventional Emergency Medical Unit is 182,192 euros per year according to Soteras<sup>8</sup>. This includes: 3 more doctors, training time and night-time rescue hours, the health professionals’ personal equipment, the collective equipment and the specific health equipment for mountain rescues. This cost is borne

**Table 2. Mean cost of a rescue operation.**

Type of rescue	With helicopter	On foot
Short duration <sup>1</sup>	€3,534.30	€1,439.90
Medium duration <sup>2</sup>	€12,828.20	€4,057.90
Long duration <sup>3</sup>	€27,881.70	€15,708

<sup>1</sup>Short rescue: one that is resolved in a day.

<sup>2</sup>Medium rescue: one that is resolved in two days.

<sup>3</sup>Long rescue: one that is resolved in a week.

Source: Mountain Guardia Civil.

**Table 3. Cost of the professionals involved<sup>8</sup>.**

Professional involved	Net cost/hour
Doctor: 061 UME-Sabiñánigo	€10.78
Nurse: 061 UME-Sabiñánigo	€8.74
Mountain Guardia Civil	€8.05
Medical transport technical staff	€7.06

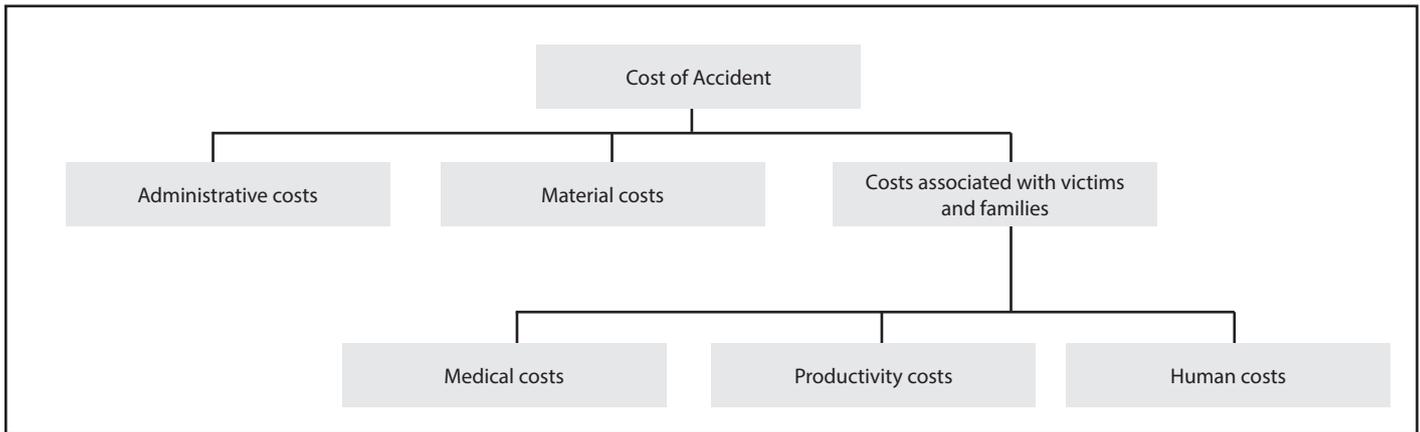
Sabiñánigo UME - 24-hour Advanced Life Support Unit where the mountain rescue health professionals were based until 2017.

by the Aragon Health Service, although the health care bill is being passed on to some of those injured.

But these are the costs that the Government of Aragon, the national press and public opinion always refer to; what we could call the “visible” part of the “iceberg” of the cost of accidents, a fraction of the actual costs described in an example provided later on in this article. First, let us analyse the diagram (Figure 3) of the Fundación Instituto Tecnológico para la Seguridad del Automóvil (Automobile Safety Technological Institute Foundation)<sup>31</sup> for road accidents, adapting it to our context.

- *Administrative costs.* These include the hours of the police, judges, lawyers, insurance companies, mountaineering federations, etc. to ‘administratively manage’ accidents: reports, forms, trials and procedures which may be required.
- *Material costs.* These refer to the costs of repair or replacement of the accident victim’s mountain equipment and belongings, and the loss or damage of other “apparatus” (paragliders, mountain bikes, etc.); there are not usually infrastructure repair costs, as occurs with traffic accidents.
- *Costs associated with the accident victims.* These account for the largest amounts:
  - *Medical costs:* healthcare on site, hospital and/or outpatients care, and care following discharge and throughout the recovery and rehabilitation process.
  - *Costs of lost production* as a result of sick leave or throughout the victim’s remaining working life, truncated by the accident (if the result is the death or total disability of the victim). The average age of mountain accident victims in Aragon is between 34 and 43<sup>9,29</sup>. If these people stop producing (due to death or sick leave), this adds up to huge losses for society, precisely when they are “returning” the investment made in education, health, etc. over 25 years and have a productive life ahead of them.

Figure 3. Cost of accidents<sup>16</sup>.



- *Human costs*: those associated with the suffering of victims and their loved ones, due either to death or disability. The cost of lifelong dependency (paraplegia, tetraplegia, amputations, brain injuries, etc.) should be added to these costs.

In a period of ten years (1998-2007), traffic accidents have accounted for a total cost to Spanish society of between 105,000 and 144,000 million euros<sup>16</sup>. An average cost was calculated at 12,500 million euros per 100,000 traffic accidents in Spain between 1998 and 2007<sup>16</sup>. If we establish a parallel in terms of the cost of injuries, deaths and disabilities, even though the death rate in mountain accidents is higher than that of traffic accidents, there is still no 30-day follow-up of mountain accidents -as Iglesias is doing in Asturias<sup>32</sup>- and many accident victims are not rescued, we can optimistically estimate that mountain accidents in Spain cost more than 125 million euros per year (on the basis of 1,000 people rescued by the Guardia Civil), 375 million if we consider the figures of Sánchez<sup>13</sup> and Villota<sup>14</sup>. If between 400 and 500 victims a year are rescued in Aragon, we can estimate the figure at around 50 million euros a year.

### Benefits

The benefits are mostly intangible, difficult to quantify with market prices and hard to specify in the absence of longitudinal epidemiological studies of “failure to provide extra-hospital care on-site”. At the same time, it is not possible to express the suffering of the victims of serious or fatal accidents and their relatives in economic terms. Be that as it may, we are talking about saving lives and reducing sequelae.

### Cost-benefit ratio

We can calculate the cost of *rescuing* a mountain accident victim with *on-the-spot medical care* at between 3,000 and 30,000 euros, depending on the duration of the operation and whether or not the support of a rescue helicopter and the emergency service’s HEMS (which can be calculated at between 3,000 and 6,000 euros per intervention -according to the rates of the Government of Aragon) is required to evacuate the

patient to a tertiary referral hospital once he/she has been stabilised at the scene of the accident by the rescue team doctor and evacuated to safety by the rescue team.

To this initial intervention, it is necessary to add *hospital care*, time spent in hospital, rehabilitation, time off work, insurance payments and the cost of replacement at work. Taking into account that<sup>8</sup> the median age of accident victims treated between 1999 and 2008 was <sup>34</sup> (interquartile range: 26 to 47), and that victims aged between 3 and 95 years were rescued, the cost of a mountain accident grows exponentially.

In 2014, the average federated mountaineer circulating in the Aragonese mountains was 43 years old<sup>29</sup>, had university-level studies and was a member of the active working population. If this “typical user” suffers a serious accident, the social cost (what the dead or disabled person stops producing, plus the resources he/she “consumes”) is very high.

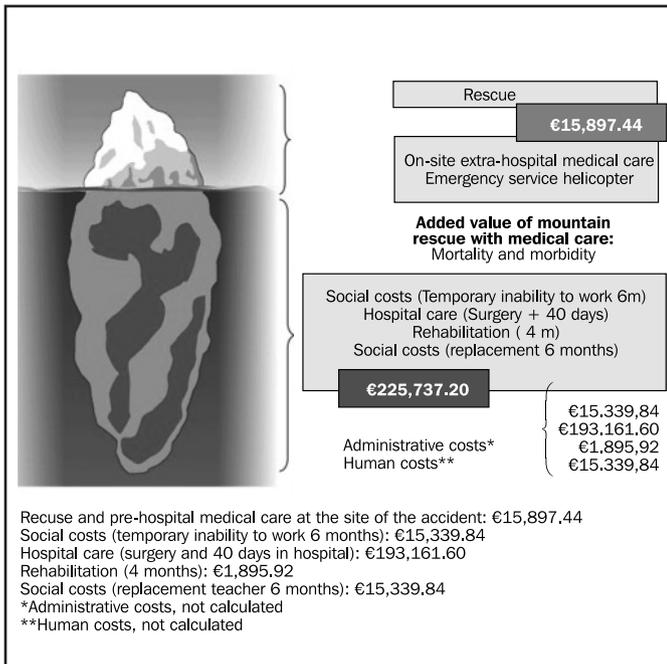
Let us take the example of a “typical mountaineer” who is 42 years old, educated to degree level, has suffered a broken pelvis and is attended to by a CUEMUM doctor or nurse from the moment in which the Guardia Civil rescue helicopter arrives, thereby allowing him to be stabilised haemodynamically while a long, difficult rescue operation is carried out on the face of Coll de Ladrões. Such a rescue means that he can reach a public tertiary hospital with surgical intensive care unit in Zaragoza in optimal conditions to be operated on (Aragon Health Service prices). On the other hand, the same patient has a good chance of reaching the hospital dead, in a state of practically irreversible shock or with paraplegia if he does not receive medical care in that first “golden hour” -extended in mountain accidents if there is a health professional at the site with specific training, as previously explained.

The breakdown of the costs involved in this example are shown in Figure 4.

The rescue and pre-hospital medical care of this polytraumatized patient costs €15,897. However, the real expense comes from the health care and social costs needed later: €225,737.

The social cost of a deceased person<sup>33</sup> is calculated according to the working years of life lost, among other indices. Given that the current

**Figure 4. Breakdown of mountain accident costs in the example.**



retirement age is 67, the approximate cost to society of the death in a mountaineering accident of a 42-year-old would be 875,000 euros (= 35,000 euros annual gross salary x 25 working years), to which the human cost, investments previously made in him/her, life insurance and human costs should be added. The bereavement benefits paid by the federation’s insurance policy in the event of accidental death in the mountains stand at 6,000–9,000 euros. Another cost to be taken into account arises if a third party is involved (such as a company that provided services), from which additional financial compensation could be claimed, although, of course, by no means would this compensate for loss of production or, less still, the human costs incurred.

We can also refer to<sup>33</sup> the Value of a Statistical Life (VSL) in Spain. The value of the life of a normal person is estimated at 1.3 million euros, which, after adding the net losses and medical and ambulance costs, gives us a Value of a Prevented Fatality (VPF) of 1.4 million euros. Using the hedonic wage method (revealed preferences), Riera<sup>34</sup> calculates a VSL range between €2 and €2.7 million. This VSL<sup>3</sup> is 1.6 million GBP in the UK (€1.8 million) and €5.2 million in the USA (\$6.2 million).

The estimated cost of permanent disability in Spain is €2,434,740, not counting indirect costs (health care, social care, caregiver, family, accessibility infrastructure at home and environment, etc.).

6.3% of rescued mountain accident victims in Aragon<sup>8</sup> between 1999 and 2008 had multiple injuries. If these patients had not received medical care on-site, many of them would have arrived dead at the hospital or have been left with serious sequelae. That the mortality rate in Aragon has decreased by 62% in fifteen years represents a saving of more than 175 million euros, to which the benefit of not losing a parent, husband or son must be added, not to mention the unknown number

of people who have avoided suffering a more or less serious disability, with everything that entails. Meanwhile, the estimated additional cost of the Sabiñánigo Emergency Medical Unit (UME) between 2000 and 2014 stood at approximately 2.7 million euros. The economic benefit is substantial. The moral and social benefit is incalculable.

The training of mountain emergency doctors and nurses costs around 15,000 euros (university tuition, travel and lodging, insurance, mountain materials and equipment), the Guardia Civil making a significant investment (human resources, materials and infrastructure) to train these professionals which is not passed on in tuition fees. Considering that these health professionals are going to carry out their work in the public sphere, their training should be subsidised by the government.

The origin of the absurd idea of not “medicalizing” rescue services and not investing in the training of health professional lies in the fact that everything is considered a “cost”, when it is clearly an “investment for the future” due to: the very significant reduction in costs to society implied, the lives saved, the reduction of sequelae, the added value of quality that health care for accident victims means for mountain tourism and the safety that training in Mountain Emergency Medicine implies for health professionals, accident victims and rescuers.

In all events, public investment should be made according to a cost-benefit criterion<sup>3</sup> which is often not applied or even known. It is relatively easy to estimate the cost of implementing a mountain safety campaign, but it is not so easy to assign a specific economic value to the savings made by preventing mountain accidents.

Tourism in Aragon generates over 3,000 million euros a year. Active tourism is an economic engine in all the mountainous regions of Spain and we should not forget that Spain is the second most mountainous country in Europe after Switzerland. It would be profitable to invest in providing “medicalized” rescue services to ensure a lower morbidity and mortality rate associated with mountain accidents, an undesired side effect of mountain tourism. You cannot sell mountain activities and then shy away when it comes to providing accident victims with on-site medical care. The study being carried out in Asturias<sup>32</sup> shows the clear benefits of “medicalized” mountain rescue operations in terms of human costs.

The cost-benefit ratio provides a sufficiently strong case on which to base the claim that the costs of the mountain operation (rescue and health care provided by doctors or nurses trained in Mountain Emergency Medicine) are more than justified and amply “pay off” if the victim does not die, is not paralysed and can return to his/her active working life. The example given shows that the costs of rescue with on-site medical care represent between 5 and 10% of the total costs of a serious accident, so there is no basis for beating around the bush as to whether the victim should be charged for the rescue operation or not. Furthermore, if we apply commercial terms, you cannot sell a product (mountain tourism) and then fail to guarantee an adequate after-sales service (rescue services with medical care).

The autonomous and central governments are unable to address this issue with the necessary rigour. The question forever under debate

is whether to 'charge for rescue operations' and/or 'charge for the extra-hospital health care involved', when:

- these costs are the least important in the overall calculation of the cost of mountain accidents,
- analgesia at the site of the accident is a human right,
- the accident victims were doing physical exercise -which improves their health and reduces health spending-,
- and not raising the alarm to be rescued (so as not to be financially penalised) would exacerbate the consequences of the accident.

Charging for rescue operation benefits neither the victim nor society. Prevention and training are the way forward. Those who advocate penalties are unaware of the full picture. The main topic for discussion, one which is not addressed, should be whether to "provide mountain accident rescue services with trained medical professionals in all the Autonomous Communities," because such a measure would entail significant human and economic benefits for society and the public coffers by reducing the deaths of and sequelae suffered by accident victims.

But we should also point out that "on-site medical assistance" is not everything. In 1996, Dr Morandeira said that "the best rescue is the one which does not need to be carried out because the accident has not taken place". There is still much to be done in the field of prevention, risk management and the training of mountain climbers and tourists. The launch of a *National Plan for the Prevention of Mountain Accidents and a Spanish Mountain Health and Safety Observatory* by the Spanish Federation of Mountain Sports and Climbing (FEDME) and the Higher Sports Council (CSD) to coordinate the actions of the institutions and groups involved in mountain sports is still a pending issue and an urgent necessity.

## Conclusions

- Sporting activities in the natural environment improve the physical and mental health of those who pursue them, helping to reduce social and health spending, and creating wealth and stabilising the population in mountain areas which would otherwise be doomed to poverty and depopulation. These sporting activities have unwanted side effects, accidents, which account for an estimated cost, calculated as a minimum, of 375 million euros a year in Spain; but what is truly expensive are the deaths and consequences suffered by accident victims, not the rescue operations.
- The provision of "medicalized" rescue services and analgesia at the accident site are a human right and a duty of the authorities.
- The provision of "medicalized" rescue services significantly reduces morbidity and mortality in mountain accident scenarios and, consequently, the cost of the accidents themselves. In Aragon, the provision of "medicalized" rescue services has led to a 62% reduction in mortality over the last 15 years and a non-quantifiable reduction in morbidity.
- The doctors and nurses involved in "medicalized" mountain rescue should meet the requirements set by the international community and the European Higher Education Area in order to ensure the safety of the operation and guarantee proper patient care in the field.
- "There is still much to do in terms of prevention, training and medi-

cal care. We understand that it is not a question of charging for the costs of rescue operations or on-site medical care, but of increasing safety to reduce the risk and, if accidents happen, of providing "medicalized" rescue services in all mountain regions involving doctors and nurses with post-graduate training in Emergency Medicine in Mountain and Inhospitable Environments".

- The creation of a Spanish Mountain Health and Safety Observatory with an annual budget and a stable team of specialists in the field, not politicians, is an urgent necessity in order to plan preventive and mitigating measures.

## Conflict of Interests

The authors declare that they are not subject to any type of conflict of interest.

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