

## The role of acclimatization in preventing acute mountain sickness: research on a group of 36 climbers on climbing the mountain Muztagh Ata, China, between 3600 and 7546 m altitude

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**Abstract.** The aim of this study was to identify and compare the frequency and intensity of symptoms of acute mountain sickness in a group of climbers during their training for acclimatization and post-acclimatization at high altitude. *Material and Method.* The study included 36 climbers aged between 35-64 years who trained and acclimatized between 3600-6800m in Muztagh Ata (7546m), China, in order to climb the peak on skis or snowshoes. To diagnose acute mountain sickness (AMS), questionnaires based on the Lake Louise symptomatic and functional score of self-evaluation were distributed. These were afterwards collected and analyzed in relation to demographic data, the altitude reached and the rate of climb in camps set between 3600-6800m, before and after acclimatization. *Results.* the prevalence of AMS during the acclimatization between 3600-6800 m was 31.40% between 3600-4450m and 69.60% between 4450-6800 m. At 6,800 m it was 81.48%. After acclimatization, between 4450 -6800m, on average 44.81% of the subjects suffered from AMS, and at 7546m, 8 (66.66%) suffered from AMS, and 4 (33.34) not. Of the 36 climbers who wanted to reach the top, only 12 (33.83%) were able to meet the proposed target (7546 m). Of these, 4 (11.11%) showed no AMS. In total, 88.89% suffered from mild to moderate AMS at different altitudes, with 4.66% presenting reversible forms. *Conclusion.* the prevention of acute mountain sickness, of its severe complications and the success in climbing at high altitude (7546 m) are determined by many factors: age, health, training and stamina, technical climbing, ski touring, snowshoes, a good acclimatization by following all stages of acclimatization, the ascent rate, the adaptation to extreme weather conditions and teamwork.

**Key words:** high altitude, *altitude illness, acclimatization.*

### Introduction

Acute mountain sickness (AMS) is defined by a combination of cerebral, vascular and cardiopulmonary symptoms which appear as a result of the decrease in the partial pressure of oxygen in the inspired air in rapid ascent and without acclimatization to altitudes above 3000m. It occurs a few hours after reaching an altitude, more frequently during the night, and is manifested by fatigue, headache, nausea, dizziness, insomnia (1). Cerebral edema, defined as the alteration of consciousness, severe headache, vomiting (2) and pulmonary edema, manifested by severe fatigue at rest, irritating cough and expectoration (3), are severe forms of acute mountain sickness. Acclimatization is the gradual ascent of about 400 m between two consecutive nights between 2500 and 4000m and ideally of 150m over 4000m (4).

Research in mountain medicine developed gradually since 1950 due to competition among nations for the escalation of peaks of over 8000m (5). Development of tourism and mountain sports

due to transport facilities at high altitudes and the marking of alpine routes resulted in the development of research on segments of altitude between 2500 and 5500m. The increased prevalence of AMS in this area is largely due to the rapid ascent of many people of different ages with an affected health condition and inadequate training.

Today, a lot of studies are focused on determining the prevalence and determinant factors of acute mountain sickness and on the development of guidelines for prevention and treatment for mountaineers (6-11). In contrast, in Romania there is no extensive research on high altitude medicine, only few citations from literature, usually in the form of informative articles on various sites (12, 13). This research is meant to contribute to the development of research in this area in the context of an evident increase of interest of more and more Romanians in practising mountain sports in our Carpathians or in the high mountains of the world.

The primary objective of the study was to identify and compare the frequency and intensity of symptoms of acute mountain sickness (AMS) in a group of 36 climbers who train and acclimate while climbing between 3600-6800m to reach a peak of 7546m at the end of the acclimatization. The secondary objective was to answer the question: why under similar conditions of effort, altitude and climatic environment some climbers suffer from acute mountain sickness and some not, and what are the factors that trigger, aggravate or prevent acute mountain sickness?

### Material and Method

In conducting the research I correlated the stages of acclimatization with the prevalence of AMS. The research was conducted in July and August 2012 on Muztagh Ata (7546m) located in the western Tibetan Plateau. The western face of the mountain can technically be climbed on snow from the altitude of 5000m on skis and/or snowshoes. Weather conditions over 4500m are variable from one day to another, often with fog, heavy snow and wind; the average temperature at night is  $-24^{\circ}\text{C}$  at 6800m and below  $-10^{\circ}\text{C}$  in the base camp (BC) (4450m), with positive values during the day. The atmospheric pressure at sea level is 760mmHg, 499mmHg at 3600m (66%  $\text{O}_2$  saturation), 420mmHg at 5000m (55%  $\text{O}_2$  saturation), 333mmHg at 6800m ( $\text{O}_2$  saturation 44%) and 301 mmHg at 7546m (40%  $\text{O}_2$  saturation). The climbing started from 3600m up to the base camp (BC), at 4450m; the equipment (about 20kg) was transported by jeep and camel from BC to higher camps and then individually by successive ascents and descents. The research sample included 36 climbers (including the physician, author of the study), all men aged between 35 and 64 (for demographics see table nr. 1), with different nationalities (23 from the EU, from areas with an average altitude, around the Alps), 1 from Romania, 6 from Russia and 6 from Iran, from lower altitude areas.

The chronic diseases reported were hypertension under treatment for six cases, aged between 52 and 64 years, 1 case of coronary artery disease with stent implantation (62 years), 2 cases of chronic bronchitis (smokers). The camps are situated as follows: the start is at 3600m, then BC at 4450m, camp 1(C1) at 5300m, camp 2 at 6200m (C2), and camp 3 at 6800m (C3). Camps BC, C2 and C3 are equipped with oxygen, but there is no doctor available in BC.

The questionnaire Lake Louise (Lake Louise Scoring System) (14), which comprises five questions referring to AMS symptoms and a functional score, was used to assess the frequency and intensity of AMS. Acute mountain sickness is diagnosed based on a Lake Louise score greater than or equal to 3. The self-evaluation score takes into account five symptoms on a scale of 0 to 3. Headache: 0- none, 1- mild, 2- moderate, and 3- severe; digestive manifestations: 0 - normal appetite, 1 - decreased appetite and nausea, 2 - nausea or vomiting, moderate, 3 - severe nausea and vomiting; fatigue: 0 - lack of fatigue, 1 - feels a slight fatigue, 2 - moderate fatigue, 3 - severe fatigue, exhaustion; dizziness: 0 - no, 1 - mild sensations of dizziness and blocked ears, 2 - moderate, 3 - severe disabling; Insomnia: 0 - normal, 1 - a little more than usual, 2 - wake several times during the night, 3 - the impression was that of not sleeping at all.

The clinical score: contains three symptoms rated from 0 to 2 and 4. State of consciousness: 0 - normal, 1 - lethargy, 2 - disorientation, confusion, 3 - altered consciousness, 4 - coma; ataxia: 0 - normal, 1 - going unbalanced, 2 - cannot go right, 3 - falls, 4 - cannot stand up and remain standing; peripheral edema: 0 - absence, 1 - a location, 2 - multiple locations.

The functional score: - Stage 0: no symptoms; Stage 1: symptoms are present, but do not influence the activity; Stage 2: the subject is forced to reduce activity; Stage 3: the subject feels the need to lie; Stage 4: life is endangered.

Questionnaires were distributed to the climbers who had shown interest in the study and gave their informed consent throughout the ascent. Self-evaluation questionnaires with clinical score were completed within 24 hours after a stage of ascent or descent. The functional score was assessed by clinical examination and anamnesis in BC and at 5300m. The climbing rate between the camps in comparison with breathing is the following: between 4000 and 5000m - one step per inhale-exhales; 5000-6000m - one step per 2 inhale-exhales; 6000-7000m - one step per 3 inhale-exhales.

The acclimatization period ended after 7 days when all members of the group descended in BC. The self-evaluation questionnaires were collected and there was a brief clinical examination and anamnesis. We analyzed the questionnaires of each member of the group, and the data were summarized in tables for each of the 5 symptoms

per altitudes between 3600 and 6800m. The data processing programme used was IBM SPSS Statistics, Version 20. Significance of difference (see table nr. 5) was calculated by parametric t-student test. P value less than 0.05 was considered statistically significant,  $p=0.01$  and  $p = \text{or} < 0.001$  highly significant statistically. In the case of homogeneous variables I used the non-parametric Mann Whitney U.

## Results

The results have been summarized in table I-V. At 3600m, AMS was diagnosed in nine climbers (24.48%). This altitude was reached by means of transport, so there was no physical effort from the climbers. There were 34 mild symptoms (18.88%) and 10 moderate (5.55%). 27 climbers were asymptomatic or 1-2 symptoms resolved after a period of rest. At 4450m AMS was diagnosed in 14 cases (38.33%) with mild symptoms (49, 27.22%) and moderate (20, 11.11%). 22 climbers (61.67%) showed no AMS.

After three nights in BC (4450m), 36 climbers left for the camp at 5300m (850m level difference) climbing in 5-6 hours with an equipment of 18kg on average and on ground combined with snow. Of these, 19 (50.55%) showed AMS with 53 (29.44%) mild symptoms, 36 (20.55%) moderate symptoms and 2 (1.11%) severe symptoms. Symptoms were mainly mild to moderate headache, insomnia and fatigue. 17 climbers had 1-2 mild symptoms, but no acute mountain sickness. After rest and hydration, symptoms have gradually resolved, so the next day, at different moments of the day they started climbing to C2 (6200m), with a level difference of 850 m. 14 of them (38%) have climbed on skis and 22 (61.11%) on snowshoes. When climbing, ski touring involves a relatively low effort and ascents and descents can be made with a level difference of 300-400m, thus facilitating better acclimatization and adaptation.

In C2 (6200m), 27 climbers (75%) installed their tents in teams of 1, 2 and 4 members. Between C1 and C2 nine climbers retreated, accusing malaise manifested by intense fatigue, headache and nausea. Of these, five could continue climbing, but from their experience anticipated that their situation will not improve and returned to C1, resuming the ascent the next day. The psychological factor is very important, sometimes decisive, in taking the decision to return or continue. The number of mild symptoms was of

38 (28.14%), moderate 39 (28.88%) and severe 9 (16.66%). 10 climbers (27.77%) reported three mild and moderate reversible symptoms.

Between 6200-6800m (level difference of 600m, covered in 6-7 hours on average), the effort is intense, the climbing takes place at a rate of one step - three inspirations, three expirations. The weather was favorable. Between camps 2 and 3, of the 27 climbers, 8 withdrew at different altitudes. 6 of them were on snowshoes and two on skis, so they reached the camp at 6800m in the evening. 19 (52.77%) climbers dug platforms and set their tents. The descent before C3 was due to the state of extreme exhaustion, intense headache, and nausea. Three of them had severe symptoms (nausea, vomiting, headache and high altitude pulmonary edema-HAPE, high altitude cerebral edema - HACE), being unable to continue the ascent; so they returned to C2.

29 (30.52%) of the symptoms were mild, 32 (33.68%) moderate and the number of severe symptoms increased to 11.57% (3 times). These subjects showed severe headache (which did not disappear after the administration of relievers) with nausea, vomiting and extreme fatigue, symptoms associated with pre-HAPE and HACE. To prevent the worsening of their condition over night, two of them received oxygen by mask until improved symptomatically and could be easily hydrated, even though at that altitude 3-4 l of water (to which salts are added) are difficult to be obtained through snowmelt. The next day, they went down to C2, joined by teammates. In C3, 74.73% (14 climbers) showed AMS and 5 (25.27%) did not. The total number of climbers with AMS between 6200 and 6800 m amounted to 22 (81.48%), 5 showed no AMS (18.51%). In total, between 3600-6800m, AMS was manifest in 86.11% of subjects.

On balance, the process of acclimatization can be summarized as follows: after 7 days of ascent and descent, returning to base camp, four climbers were diagnosed with mild AMS, reversible on the first day; 32 were asymptomatic. The functional clinical score showed that 56.45% fell under level 0; 25.55% under level 1 and 18 under level 2 (see Table 3). The average age of the group was 48.29 years with a range between 35 and 64. The average age of those with AMS was 45.8 years and for those without AMS 52.6 years. AMS was more frequently present with subjects under 50 years due to the association of individual factors and determined by the higher number among

smokers (19.44%), less trained (47.22%), less experienced at altitude, with more effort at climbing on snowshoes (44.44%).

From those without AMS, 5.55% are smokers, 22.22% are better trained, have experience at altitudes of over 4500m, practise skiing and reside mainly around the Alps, at medium altitude. They also know better the initial symptoms of AMS and their prevention, their climb rate; they hydrate better and use a diet richer in carbohydrates. Skiers can ascend and descend about 300 m 1-2 times a day, adapting better to the mountain climate.

The average difference between two consecutive nights of ascension and between 3600-6800 m was 800 m/day, with 400-600m more than the recommended values, creating the risk of acute mountain sickness. The average speed of ascent compared to the difference in altitude of 4200m during 7 nights was 600 m/day. The average speed of ascent between 4450 -6800m was 390m/day, compared to the optimal average 150-200m/day. The most common AMS symptoms were fatigue (25.27%) and sleep disorders (24.72%).

After the acclimatization period all climbers returned to BC. Due to adverse weather conditions over 5000m (snowstorm, fog, snow) they stayed in BC for five days, reducing the optimal time to reach the peak to a maximum of six days until leaving the mountain. The 36 climbers left BC already acclimatized in different groups and at a space of 1-2 days; 14 climbed on skis and snowshoes and 22 only on snowshoes. Higher camps were already equipped, thus reducing effort for transporting equipment. On departure from BC all climbers were well acclimatized, without AMS. The weather was unstable with thick layer of fresh snow, making it difficult to climb. At 5300m, 8 cases (22.22%) had mild (15.55%) and medium (7.77%) symptoms of AMS. 28 (77.77%) showed no AMS.

36 subjects climbed to 6200m, of which two (6.55%) returned to the previous camp due to a state of extreme exhaustion induced by intense effort on fresh snow. 34 climbers spent the night at 6200m. The symptoms were: 36 (21.17%) mild AMS, 26 (15.29%) moderate and 3 (1.66%) severe. So, a total of 15 climbers (41.66%) had AMS and 21 (58.33) had 1-2 mild, reversible symptoms. 34 climbers left to 6800 m, combining skis and snowshoes. Intense effort on fresh snow,

associated with AMS, made 10 climbers (24.41%) descend to C2 and C1. Only 24 (66.60%) reached the camp at 6800 m. Of these, 15 (44.11%) had AMS while in C3. In total, between 6200 and 6800 m, 66.65% climbers suffered from AMS. Serious forms of AMS have been diagnosed in 3 cases with severe symptoms, especially extreme fatigue and headache, symptoms that gradually resolved after administration of analgesics and hydration. They went down to the lower camps the next day.

After 2 nights in C3, 24 climbers went to the top during the night and in the morning in heavy wind conditions. On the route to the summit, 12 (50%) withdrew because of extreme fatigue, sleep disturbances and headache, and 12 (50%) continued to rise to the top (8 on skis and 4 on snowshoes). They reached the peak after 6-8 hours returning back to C2 in 4 hours. Examination of records and the anamnesis revealed that 8 (66.66%) climbers reported mild to moderate symptoms of AMS, and 4 (33.34%) were asymptomatic. All have returned to C2 and the next day in BC.

The symptoms that defined AMS between 5200 and 7546 m were particularly fatigue (26.45%) and sleep disorders (21.07%) with 4.93% severe forms of HACE that associated the preceding symptoms, but which resolved by going down to the lower camps (see table IV). Acute mountain sickness between 4550 and 6800 m (see table nr. 5) was on average 68.70% in non-acclimatized subjects (31.38% of non-acclimatized subjects were without AMS), and 44.80% of acclimatized subjects had AMS, while 55.19% not (a statistically significant correlation).

## Discussion

The research aimed to meet the objectives set and studied many factors that determine AMS in the same lot of 36 subjects before and after the acclimatization period between 3600 and 7546m altitude. Prevalence of AMS during acclimatization between 3600-6800 was on average of 31.40% between 3600-4450 m and 69.60% between 4450 and 6800 m. At 6800 m it was 81.48%. After acclimatization, between 4450-6800 m, on average 44.81% had AMS, and at 7546 m, where 12 subjects climbed, 8 (66.66%) had AMS, and 4 (33.34%) not. Of the 36 climbers who wanted to reach the top, only 12 (33.83%) were able to meet the proposed target (7546m). Of these, 4 (11.11%) showed no AMS. In total,

88.89% had at different altitudes mild to moderate AMS, with 4.66% severe, reversible forms.

The average age was 48.79 years; of those with AMS 45.80 and of those without AMS 52.64 years. Climbers who did not suffer from AMS were those experienced in climbing at over 4500m, better acclimatized and trained; most of them climbed on skis and stayed with 2 nights more between 5300-6200 m. The majority lives around the Alps. AMS frequently under 50 years was determined by individual circumstances, reducing the period for acclimatization and increasing the climbing over 4450m, which was on average 800m per 2 nights (400m above the recommended values). Also, a very important role played the psychological factors such as the desire to get as quickly and as up as possible, ignoring the symptoms prior to AMS.

75% said they were healthy and 25% with chronic diseases. Smoking (25%) affects in a different way exercise tolerance. Chronic hypoxia induced by smoking may be a somewhat beneficial factor (15), 2 of the climbers who reached the peak smoking less than 10 cigarettes per day, but chronic bronchitis (2 cases) limited effort. Subjects did not climb over 6200m. Treated hypertension is well tolerated, but, cautious, these subjects did not force the ascent and reached 6800m. The state of dehydration and low carbohydrate intake because of extreme conditions reduce adaptability and acclimatization to severe exercise under hypoxia (16). Daily fluid needs, with the addition of salts, are less than 4.3 l/day at high altitude amount. This may be obtained from the melting snow. An important

factor observed in groups or individual members of the expedition is the psychological state (17).

The results of this research are a continuation of similar studies that I have conducted in expeditions in the high and very high mountains of the world. The first research on acclimatization and AMS was started in 1997, in the expedition to Huascarán (6768m, Peru). A more systematic approach was performed in the expedition on Baltoro Glacier (Pakistan) in 2010, from an altitude of 2500m (Skardu village) and the Gondogoro La Pass (5650m). It was a comparative study between 18 porters (living in the area, between 2500m (Skardu) and the village of Askole (3060m), who accompanied the expedition climbers and were well acclimatized), and 16 climbers. Acclimatization between 2500m (Skardu) and 5150m (K2 base camp) was done in 10 days in successive camps. Acute mountain sickness was diagnosed at an altitude of 5150 m in 4 climbers (25%) who experienced moderate forms of AMS. I did not record HAPE or HACE, but it was reported the case of a climber found dead in his tent at the altitude of 6700m (camp 2 in K2).

Another study, to be published, was conducted on a group of 160 hikers, aged between 35 and 65 years (from 2011-2013) who ascended from Busteni (800m) to Omu peak (2505m) and descended in one day. Blood pressure, heart rate and, where applicable, the electrocardiogram were monitored during the ascent and descent. Mild and moderate AMS was diagnosed (using the Hackett score) (18) in 31 hikers (19,37 %), but the symptoms disappeared after the descent.

Table I. Demographics Data

Age (years)	Healthy subjects	Body Mass Index (BMI)	Chronic diseases	Smoke rs	Daily trained subjects		Experience in climbing over 4500 m	Recently acclimatized	Know the AMS symptoms
					YES	NO			
35-50 (24)	21 (58.33%)	25.8±2	4 (11,11%)	6	10	14	12	4	16
51-64 (12)	6 (16.66%)	27.2 ±3	5 (13,88%)	3	4	8	8	1	10
Total	27 (75%)		9 (25%)	9 (25%)	14 (38.88%)	22 (61.11%)	20 (55.55%)	5 (13.88%)	26 (72.22%)

**Table II.** Frequency and severity of AMS symptoms during acclimatization between 3600-6800 m and back to base camp (4450m)

Altitude	3600 m	4450m	5300m	6200 m	6800m	Total average	4450m
Nr. of cases	36	36	36	27	19	30,8	36
Nr. of cases x 5 symptoms	180	180	180	135	95	770	180
				(75%)	(52.77%)		
Nr. of cases with more than 3 symptoms	34	49	53	38	29	203	16 (8.88%)
1-mild	(18.88%)	(27.22%)	(29.44%)	(28.14%)	(30.52%)	(26.84%)	
2-moderate	10	20	36	39	32	137	6
	(5.55%)	(11.11%)	(20.55%)	(28.88%)	33.68%	(27.4%)	(3.33%)
3-severe	0	0	2	9	11	22	0
			(1.11%)	9 (6.66%)	(11.57%)	(73%)	
Total symptoms with AMS in camps 1-5	44	69	90	86	71	362	22
	(24.48%)	(38.33%)	(50.55%)	(63.70%)	(74.73%)	(50.35%)	(12.22%)
Nr. of cases with AMS in camps 1-5	9	14	19	17	14	73	3
Returned because of AMS between camps	0	0	0	9	8	18	
Total AMS	9	14	19	26	22	91	
	(24.48%)	(38.33%)	(50.55%)	(72.22%)	81.48%	(53.41%)	
Total without AMS	27	22	17	10	5		33 88.78%
	(75%)	(61.67%)	(49.44%)	27.77%	(18.51%)	(46.59%)	

**Table III.** The average LLS symptomatic score in relation to age, health and training; comparison between those with and without AMS during acclimatization

	Healthy subjects	Chronic Diseases	Smokers	Trained daily		Experience at over 4500 m	Skis	Snowshoes	Total
				YES	NO				
No	27	9	9	14	22	12	15	21	
	(75%)	(25%)	(25%)	(38.88%)	(61.11%)	(33.33%)	(38.88%)	(61.11%)	
Average Age	48.50	54.60	44.60	52.60	46.03	50	45.50	48.50	48,29
Without AMS between 4550-6850 m	11	2	2	8	5	8	7	5	12
	(30.55%)	(5.55%)	(5.55%)	(22.22%)	(13.88%)	(22.22%)	(19.44%)	(16.66%)	(33,33%)
With AMS	16	7	7	6	17	4	8	16	24
	(44.44%)	(19.44%)	(19.44%)	(16.66%)	(47.22%)	(11.11%)	(19.44%)	(44.44%)	(66.66%)

**Table IV.** Prevalence of acute mountain sickness between 4450 and 7546m in the group of 36 acclimatized climbers

Altitude	4450 m 1 night	5300m 1 night	6200m 1 night	6800m 2 night	Returned to prior camps before 6800m	Returned between 6800-7546 m	7546 m (the summit)
Nr. of cases	36	36	34	24	12	12	12
Nr. of cases x 5 symptoms	180	180	170	120	0	60	60
Mild Symptoms	0	28	36	41	5	24	18
		(15.55%)	(21.17%)	(24.11%)	(4.16%)	(20%)	(30.05%)
moderate	0	14	26	31	16	26	20
		(7.77%)	(15.29%)	(18.23%)	(17.50%)	(21.66%)	(33.33%)
severe	0	0	3	9	2	10	0
			(1.76%)	(5,29%)	(1.66%)	(8.33%)	
Total symptoms with AMS	0	42	65	81	0	60	38
		(23.33%)	(36.11%)	(47.64%)		(50%)	(63.33%)
Nr. of cases with AMS	0	8	13	15	0	12	8
		(22.22%)	(38.23%)	(44,11%)			(83.33%)
Returned between camps because of AMS	0	0	2	10	12	12	0
			(5.55%)	(29.41%)	(23.55%)	(50%)	
Total with AMS	0	8	15	24	0	20	4
		(23.33%)	(41.66%)	(66.66%)		(83.33%)	(16.66%)
Total without AMS	36	28	21	12	0	0	4
		(77.77%)	(58.33%)	(33.33%)			(16.66%)

**Table V.** Correlation between AMS during and after acclimatization between 4450-6800m

Altitude	4450 m	5200 m	6200 m	6800 m	7546 m (the summit)
Nr. of non-acclimatized	36	36	27	19	-
Nr. of non-acclimatized without AMS	22 (61.67%)	17 (49.44%)	10 (27.77%)	6 (16.66%)	-
Nr. of non-acclimatized with AMS	14 (38.33%)	19 (50.55%)	26 (72.22%)	30 (83.33%)	-
Nr. of acclimatized	36	36	34	24	12
Nr. of acclimatized without AMS	36	28 (77.77%)	21 (58.33%)	11 (30.55%)	4 (16.66%)
Nr. of acclimatized with AMS	0	8 (23.33%)	15 (41.66%)	25 (69.44%)	8 (83.33%)

\*  $p=0,009$  (cases of non-acclimatized and acclimatized without AMS) between 4450 and 6800 m

$p=0,012$  (cases of non-acclimatized and acclimatized with AMS) between 4450 and 6800 m

## Conclusions

Reaching the summit is, for each member, an opportunity to fulfill a dream for which he prepared extensively, not an adventure. Contrary to prior symptoms of AMS, some want to continue at any risk, thereby exposing themselves sometimes to fatal events. After a prolonged period of staying together in a tent, disagreement, tense situations between members of the group appear, with a negative effect on the desired performance. Also, prolonged staying at the same altitude of over 5500m gradually produces a mental, motivational state; the one who has a deeper motivation can ignore discomfort and monotony.

In the context of the discussions and the conclusions I drew some recommendations to prevent AMS with those who want to climb to high and extreme altitudes: - medical check before setting off for assessing health and a minimum medical kit, especially painkillers and rehydration salts; - consider all stages of proper acclimatization by climbing at a moderate speed and avoiding altitude differences (over 400 m) between two consecutive nights; - interrupt the ascent in case of AMS symptoms and going down to the lower camp; - avoid prolonged stay at extreme altitude (above 5500 m); - avoid excessive effort in the first days and maintain good hydration and a diet rich in carbohydrates; - avoid sleeping pills to combat sleep disorders; - medication recommended in acute mountain sickness (aspirin and paracetamol for headaches; Diamox to facilitate acclimatization in the first days of ascent, one tablet of 250 mg 2 times a day; for more severe cases and usually during the descend to lower altitude Adalat, to treat pulmonary edema, and a corticosteroid injection –

Soludecadron 4 mg, administered intramuscularly are useful in the treatment of cerebral edema; this medication should be considered when the diagnosis is already set; it can improve the respiratory and neurological condition for a few minutes and thus facilitate the quick descent) (19). The study was conducted in a location with extreme conditions; the number of participants, 36, was relatively small; they were all mountaineers who practice an extreme sport with very fast changing implications in health depending on altitude and climatic environment. The study shared a personal experience and sought to join the relatively small research in this area of particular interest to those who, through solitary or group expeditions, wish to climb to extreme altitudes at low risk.

The results obtained through personal research are sensitively comparable to other studies. Thus, 38.0% suffered from AMS at 3454m in the Eastern Alps as did 34.9% at 3817m in the Western Alps because ‘the lower mountaineering experience of mountaineers in the Eastern Alps turned out to be the only factor for explaining their higher AMS prevalence (20).

In the Swiss Alps at 3680m, after two to three days of climbing AMS was diagnosed in 34%, at 4559m in 53% and lung edema at 4559m, below 2%, in the Himalayas, India, at 5949m, after 1-2 days, AMS was diagnosed in 49% and pulmonary edema from 2.5% to 15.5%, depending on the days of acclimatization, in the Himalayas, Nepal, between 3000 and 5000m, AMS was present in 23% of the climbers, after 10-13 days of acclimatization, in Denali, Alaska, 6194m, after 3-7 days, AMS was present in 33% and pulmonary or cerebral edema in 2-3% (21).

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