

THE SPECIFIC OF TOURIST ACTIVITIES AND PHYSICAL EFFORT ON THE SOUTHERN FACE OF DAMAVAND MOUNTAIN (IRAN, ALBORZ MOUNTAINS)

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ABSTRACT. Mount Damavand is part of the 7th Volcano Circuit and is located in the central-southern part of the Alborz Mountains in Iran, 70 km north of Tehran. Due to its altitude of 5610 m, the mountain is a challenge for climbers and imposes a series of atmospheric conditions that induce certain physical stresses during the ascent to the top. The standard route is located on the southern face of the mountain and leaves from the village of Polour to two camps, Goosfand Sara (3000 m) and Bargah Sevom (4200 m). The access to the first camp can be done by car, and from there to the second camp on foot, the luggage being transported by mules by the locals. In the second camp, Bargah Sevom, is a modern stone refuge, which belongs to the Iranian Mountaineering Federation. Sports activities take place in two major stages: acclimatization and climbing to the top, for which at least 2-3 days are allocated. The present study, carried out on the occasion of a scientific, and sports expedition, aims to analyze the organization of tourist activities, the attractive potential and the peculiarities of the effort on the southern face of the mountain, between the altitudes of 3000 m and 5610 m.

Keywords: seven volcanoes circuit, mountaineering, mountain leisure, heart rate.

REZUMAT. *Specificul activităților turistice și al efortului fizic pe fața sudică a muntelui Damavand (Iran, Munții Alborz).* Muntele Damavand face parte din Circuitul 7 Vulcani și este situat în partea central-sudică a Munților Alborz din Iran, la 70 km nord de orașul Teheran. Prin altitudinea sa de 5610 m, muntele reprezintă o provocare pentru alpiniști și impune o serie de condiții atmosferice care induc anumite solicitări fizice în timpul ascensiunii spre vârf. Traseul standard este situat pe fața sudică a muntelui, și pleacă din localitatea Polour spre două tabere, Goosfand Sara (3000 m) și Bargah Sevom (4200 m). Accesul spre prima tabără se poate face cu mașina, iar de acolo spre tabăra a doua pe jos, bagajele fiind transportate cu cătării de către localnici. În tabăra a doua, Bargah Sevom, se află un refugiu modern din piatră, care aparține Federației Iraniene de Alpinism. Activitățile sportive se desfășoară în două etape mari:

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aclimatizarea și ascensiunea spre vârf, pentru care se alocă cel puțin 2-3 zile. Studiul de față, efectuat cu ocazia unei expediții științifice și sportive, își propune să analizeze organizarea activităților turistice, potențialul atractiv și particularitățile efortului pe fața sudică a muntelui, între altitudinile de 3000 m și 5610 m.

Cuvinte-cheie: *circuitul șapte vulcani, muntenărie, agrement montan, frecvență cardiacă, debit cardiac.*

Introduction

The last decade has seen an intensification of tourism in the high mountains, as a niche in mountain tourism, due to several causes, such as:

- opening the borders for tourism;
- technical progress registered in the sports materials industry (clothing, footwear, accessories) and specific nutrition (dry food, energy bars, gels, etc.);
- increasing free time;
- circulation of specialized information on media channels;
- increasing the number of travel agencies for mountain tourism;
- the appearance of online travel agencies;
- the desire for personal development;
- the desire for new experiences in the field of mountain recreation.

The tourist market of the high mountains includes the mountainous areas with altitudes of over 4500 m, here entering some peaks of the Alps (e.g. Mont Blanc, 4810 m; Duforuspitze, 4634 m; Ostspitze 4632 m; Grenzgipfel, 4618 m, etc.), and numerous peaks from the mountains located in North America (Cordillera Mountains), South America (Andes Mountains), Africa (Kenya, Kilimanjaro) and Asia (Ararat, Damavand, Hindukush, Karakorum, Himalaya, etc.).

In order to practice recreation in the high mountains, several requirements must be met, such as:

- good health and excellent physical condition, including good adaptation to the respective altimetric conditions (low pressure, low oxygen level);
- appropriate equipment (clothing, footwear, accessories);
- knowledge of trekking and mountaineering (rock climbing, ice climbing);
- experience in mountaineering;
- financial resources.

The teams of mountaineers vary in size, the number of members can be, in general, between 2 and 15 people, for several reasons, among which can be mentioned: better control of the technogenic risk factors, a safe ascent, the low capacity of shelters, high costs.

In making an expedition, several steps must be followed, as follows:

- establishing the route (in commercial tourism the standard route is chosen, in general);
- team forming;
- purchase of plane tickets;
- contracting services (accommodation, meals, guiding, transfer);
- flight to the location and transfer to the base camp;
- moving to the intermediate camps;
- acclimatization;
- summit day.

The sporting dimension of tourism in the high mountains is given by the following objectives to which the participants adhere:

- physical stress imposed by the route;
- adaptation of the body to specific atmospheric conditions (lower amount of oxygen-less than 70%; low pressure-less than 700 mb, low temperatures, strong winds, precipitation, fog);
- overcoming the challenges imposed by atmospheric factors, climate and relief;
- reaching the top.

In this context, it should be noted that Mount Damavand is part of the Circuit 7 Volcanoes, which brings together the highest volcanic peaks on the seven continents (Fig. 1), and this study aims to highlight the peculiarities of an ascent on this mountain.

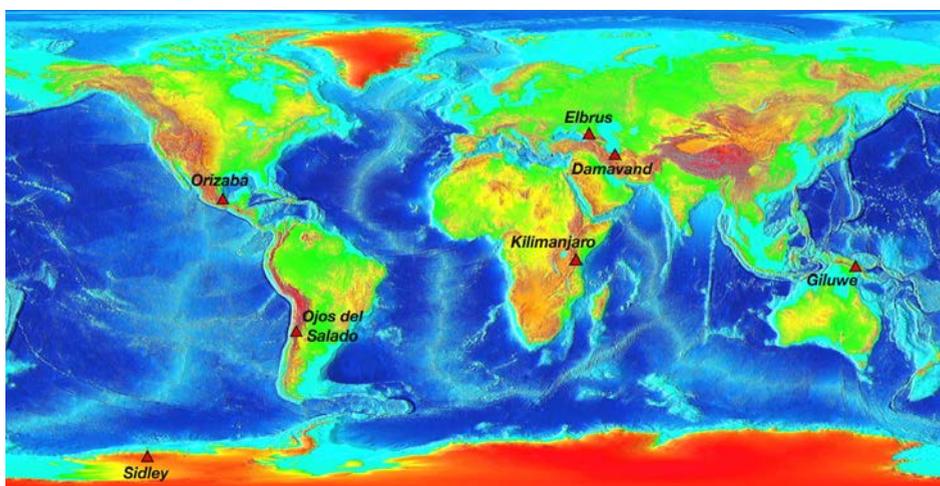


Fig. 1. The Volcanic Seven Summits
(Source: *en.wikipedia.org*)

Methodology

The theoretical preparation for the expedition to the top of Damavand was done in several stages, of which the following can be mentioned:

a) consulting the literature on the Damavand region (Amiri, et al. 2018; Berzins, et al., 2004; Davidson, et al., 2004; Ferrigno, 1991; Moghimi, et al., 2008; Nouraliee, et al., 2010; Shirazi, et al., 2014; Zareinejad, 2011);

b) consulting the tourist literature in the Damavand region (Rabieifar, et al., 2014; Yazdani, 2010) and some profile sites:

-<http://www.damawand.de/Home/About.html>;

-<http://damavandmt.blogspot.com/2010/01/bargah.html>;

-<http://www.damawand.de/How/Base.html>;

c) study of topographic maps downloaded from certain sites:

-<http://en-gb.topographic-map.com/places/Mount-Damavand>;

-http://elevation.maplogs.com/poi/mount_damavand_iran.325.html;

-<http://www.jahandar.ir/photograph/topographic-map-of-damavand/>;

d) consultation of works on the influence of altitude on the human body (Lundby, Hall, 2001; Ursta, 2006; Bärtsch, Gibbs, 2007; Boos et al., 2016);

e) establishing the route and the ascent stages;

f) conducting field observations on the tourist activities within this area (organization, infrastructure, flows) and on the factors that condition the development of tourism (climate, relief, behavior of the local population, economic activities, political factors);

g) making observations on the consequences resulting from the exposure of the human body to high altitudes; the working group consisted of four climbers, aged 55, 55, 54 and 42, whose level of effort was determined during the acclimatization period at altitudes of 3000-3500 m and 4200-4800 m, and of the ascent to the top (Fig. 2).



Fig. 2. The four climbers who participate in the study

Study Area

The Damavand Massif is located in Iran, in the central group of the Alborz Mountains, 70 km NE of Tehran, in the Amol region, Mazandaran Province (Fig. 3). From a geological point of view, the massif is a stratovolcano, with a volume of 400 km³, consisting of lava flows (trachyte, andesite, basalt) and pyroclastite (ash, gravel, blocks, slag) (Davidson et al., 2004). The volcanic structure is delimited to the south and east by the Haraz valley (tributary of the Caspian Sea), to the north by the Panjab valley (tributary of the Haraz), and to the west by the Lar valley (tributary of the Haraz valley) (Fig. 4).

The volcanic processes that built the Damavand volcano took place over several episodes in the time interval between 1.8 million years-7300 years BC. From a geomorphological perspective, the volcanic edifice consists of two compartments: the surrounding plateaus, developed between 2600-3400 m and the cone itself, with a relatively symmetrical appearance, the western flank being steeper, built from 3400 m upwards (Fig. 5).

At the top, the volcanic edifice has a collapsed crater, with a diameter of 200 m, in which rests a small glacier, evidence of the Pleistocene glaciation, which retreated since 1930 (Ferrigno, 1991). This glacier continues on the northern slope with the Sioleh and Dobi Sel glaciers. On the southern frame of the crater is the highest point of the volcano, located at 5610 m. Below the peak, on the southeast side, is a fumarole, which emits sulfur vapor, and around the cone there are several hot springs (Nouraliee et al., 2010), which confirms the dormant volcano stage of the Damavand massif.



Fig. 3. Geographical position of Mount Damavand on Elburz Mountains
(Source: www.freeworldmaps.net)

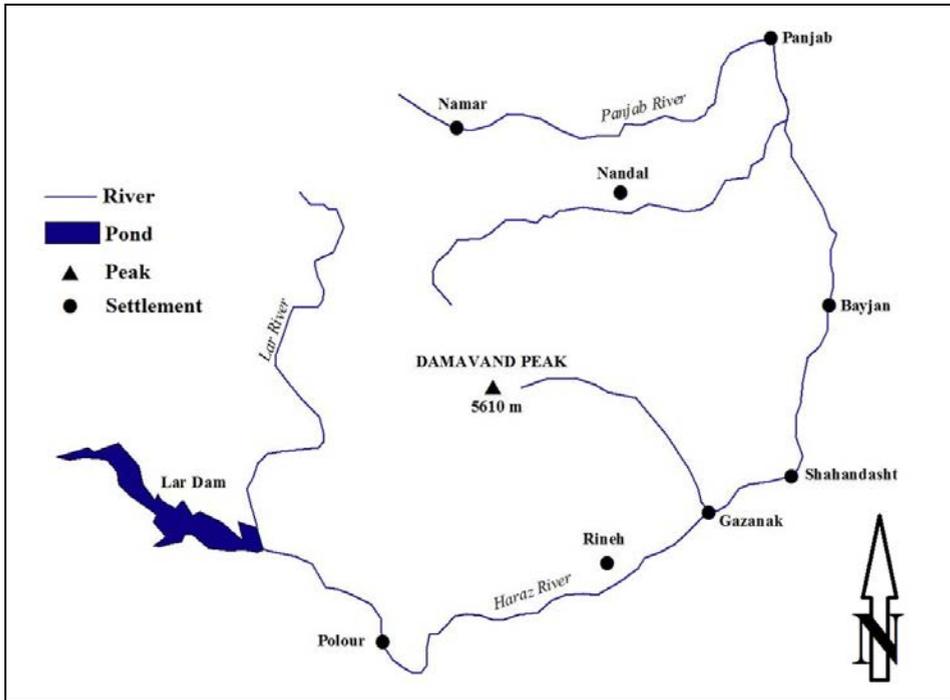


Fig. 4. The geographical limits of Mount Damavand

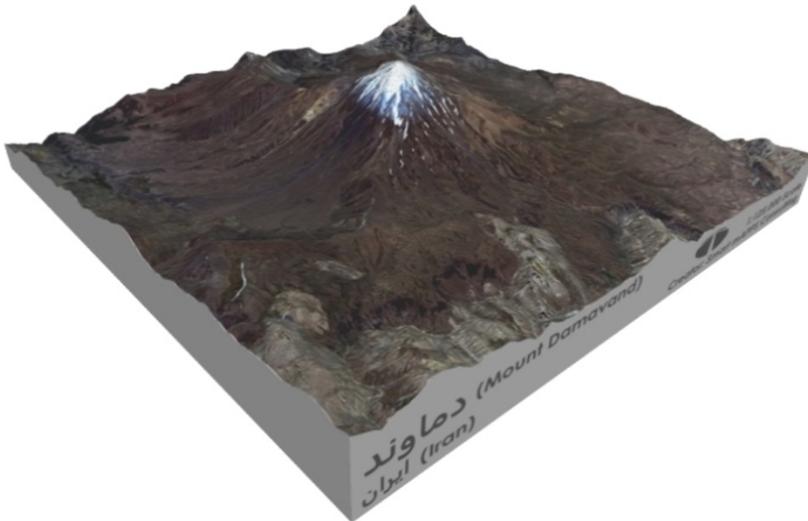


Fig. 5. The 3D perspective on Mount Damavand
(Source: <https://www.shapeways.com/mount-damavand>)

The external modeling developed between the eruptive episodes and after the cessation of the volcanic activity dissected the volcanic cone, resulting in deep valleys, with the appearance of microcannions, flared at the top, separated by radiant-divergent rocky interflaves.

Damavand Volcano is distinguished by several elements of attractiveness, such as it is the highest peak in the Middle East, it is the 12th most prominent peak in the world (4667 m), the second most prominent peak in Asia, after Mount Everest, is the highest peak in Iran, is the highest volcano in Asia (after Kunlun in Tibet), is the fifth-highest volcano in 7 Volcanoes Circuit and the third highest volcano in the northern hemisphere, after Elbrus (5642 m) in Russia (the highest volcano on the European continent), and Pico de Orizaba (5636 m), the highest volcano on the North American continent.

At the foot of the Damavand massif lies the Lar National Park, with an area of 30,000 hectares. It was established in 1976 and was declared a protected area in 1982 by the Iranian Department of the Environment. Hunting in the park has been banned since 1991. Inside the Park is a reservoir and the Lar Dam, which is a major tourist attraction, just 70 km northeast of Tehran. The park is accessible by car on the Haraz route (Road 77).

In addition to its geological dimensions, Damavand Volcano has some cultural significance, as it is the place from which the legendary Arash launched his magic arrow to mark Iran's border with the Turan and because it is the symbol of Iranian resistance against despotism and foreign domination, it is present in Persian poetry and literature, in the texts of the prophet Zoroaster and in mythology.

Results and Discussions

a) Geographical aspects

Our research focused on the southern face of Mount Damavand, which is the most popular, due to easy access, less difficulty and the presence of the two base camps, Goosfand Sara (3000 m) and Bargah Sevom (4200 m) (Fig. 6). In this sector we have identified the following tourist elements:

- a) the headquarters of the Iranian Mountaineering Federation, in Polour;
- b) tourist localities: Reineh and Polour, which offer different services (accommodation, meals, information);
- c) the classic ascent route, represented by a dirt road between Polour and the Goosfand Sara camp, then through a very little marked path, on soil and volcanic rock, between Goosfand Sara-Bargah Sevom-Damavand peak;

d) tourist refuges:

- Goosfand Sara-Mosque (3000 m);
- Bargah Sevom (4200 m).

The attractions in this sector are the following:

- volcanic cone, composed of trachytes, basalts and andesites;
- the crater, with glacier;
- detail relief on the edge of the crater: towers, blocks;
- fumarole below the top;
- Abshar Yakhi ice waterfall, with a height of 12 m, located at 5000 m;
- the rugged volcanic ridges that descend to the neighboring areas (planeze);
- deep valleys carved on the volcanic cone (barrancos);
- penitences on the snow patches located at 4900-5000 m;
- volcanic landscape and viewpoints to the Haraz Valley and the Alborz Mountains;
- traditional activities: shepherding (sheep, goats, mules), luggage transport with mules, beekeeping.



Fig. 6. The South Face of Mount Damavand

(Source: <https://www.tappersia.com/wp-content/uploads/Damavand-RoadRoute-Map>)

b) Sport and medical aspects

Access to the route and to the Goosfand Sara and Bargah Sevom camps is based on the permit issued by the Iranian Mountaineering Federation in Polour. Here, the members of the Federation provide information and assistance to the mountaineers.

The sports activities during the expedition were the following:

a) acclimatization:

The body's adaptation to the new atmospheric conditions was done in several stages, as follows:

-on the first day, there was an ascent from 3000 m to 3500 m, in a light rhythm, with breaks for relaxation and breathing; we slept in the Goosfand Sara camp (3000 m);

-the next day, we left the Goosfand Sara camp to the Bargah Sevom camp (4200 m), at a light pace, with breaks for relaxation and breathing; we slept in the Bargah Sevom camp;

-on the third day, there was an ascent from the altitude of 4200 m to the altitude of 4900 m, in a light rhythm, with breaks for relaxation and breathing; we slept in the Bargah Sevom camp (4200 m);

b) summit day:

-we climbed the top at 02.30 A.M., on the route between 4200-5610 m (level difference 1410 m);

-we reached the peak at 08.30 A.M. (5 hours), the average pace of movement being 282 m / hour / 100 m level difference;

It is known that during physical exertion, to ensure muscle energy, the body increases the heart rate (HR) and increases the heart flow (HF) and the volume of blood pumped into the aorta during a ventricular systole, which increases consumption of oxygen (VO₂) (Fig. 7). Since, at altitudes above 3000 m, the amount of oxygen in the air decreases, but the oxygen debt increases, the values of heart rate and heart flow increase, a situation in which it is necessary to dose the physical effort made by climbers.

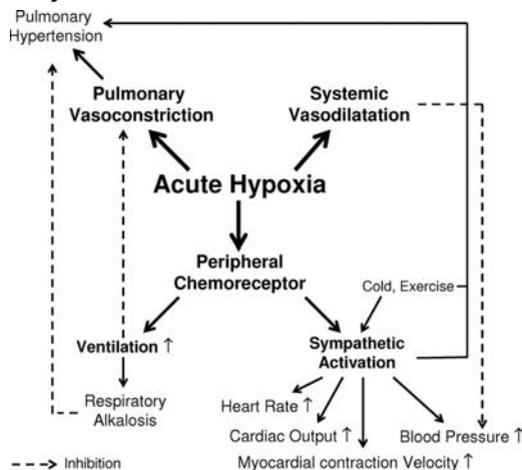


Fig.7. Effects of hypoxia on systemic and pulmonary circulation.

(Source: <https://www.ahajournals.org/doi/full/10.1161/CIRCULATIONAHA.106.650796>)

In this case, during the acclimatization days, observations were made on the heart rate, establishing the optimal heart rate for each member of the expedition, according to the formula: Optimal Heart Rate= Reserve Heart Rate x 75% + Resting Heart Rate. For this, we needed other parameters, presented in tables 1-3:

Expedition members	Age	Resting HR b/m
Member 1	55	85
Member 2	55	90
Member 3	54	82
Member 4	42	80

Table 1. Working group age and resting heart rate of members (3000 m, Goosfand Sara Refuge)

Expedition members	220-age formula	The value of maximum heart rate b/m
Member 1	220-55	165
Member 2	220-55	165
Member 3	220-54	166
Member 4	220-42	178

Table 2. The maximum heart rate of members

During the ascent from the Goosfand Sara refuge to an altitude of 3500 m, the value of the heart rate of the four climbers, determined at the level of the left radial artery, was between 100 and 120 b / m, so below the limit of maximum heart rate, which indicates an effort moderate, manifested by moving at a light pace, specific to acclimatization activities.

Expedition members	Maximum Heart rate-Resting Heart rate	The value of Reserve Heart rate b/m
Member 1	165-85	80
Member 2	165-90	75
Member 3	166-82	84
Member 4	178-80	98

Table 3. The reserve heart rate of members

In this case, the optimal heart rate during the acclimatization effort between altitudes 3000-3500 m was (table 4):

Expedition members	Reserve Heart rate $\times 75\%$ b/m	Resting Heart rate b/m	The value of optimal heart rate
Membru 1	$80 \times 75\% = 60$	85	145
Membru 2	$75 \times 75\% = 56,25$	90	146,25
Membru 3	$84 \times 75\% = 63$	82	145
Membru 4	$98 \times 75\% = 73,5$	80	153,5

Table 4. The optimal heart rate during the acclimatization effort between altitudes 3000-3500 m

As can be seen from table 4, the members of the expedition developed an optimal heart rate according to age, below the value of the maximum heart rate and based on a substantial reserve heart rate. In this case, the effort was moderate to intense, representing 86-88% of maximum heart rate.

For the acclimatization from the altitude of 4200 m (Bargah Sevom Refuge) the data were presented according to tables 5-7:

Expedition members	Age	Resting Heart rate b/m
Member 1	55	90
Member 2	55	95
Member 3	54	90
Member 4	42	85

Table 5. Working group age and resting heart rate of the members (4200 m, Bargah Sevom Refuge)

Expedition members	220-age formula	The value of maximum heart rate b/m
Member 1	220-55	165
Member 2	220-55	165
Member 3	220-54	166
Member 4	220-42	178

Table 6. Maximum heart rate of members

During the ascent from 4200 m to 4800 m and to the top (5610 m), the heart rate of climbers was between 120 and 150 b/m, below the maximum heart rate, which indicates an increase in exercise intensity, under the influence of low pressure and of the reduced amount of oxygen.

Expedition members	Maximum Heart Rate- Resting Heart Rate	The value of reserve heart rate b/m
Member 1	165-90	75
Member 2	165-95	70
Member 3	166-90	76
Member 4	178-85	93

Table 7. The reserve heart rate of members

In this case, the optimal heart rate during the acclimatization effort between altitudes 4200-4800 m was (table 8):

Expedition members	Reserve Heart Rate $\times 75\% \text{ b/m}$	Resting Heart Rate b/m	The value of Optimal Heart Rate
Member 1	$75 \times 75\% = 56,25$	85	141,25
Member 2	$70 \times 75\% = 52,5$	90	142,5
Member 3	$76 \times 75\% = 57$	82	139
Member 4	$93 \times 75\% = 69,75$	80	149,75

Table 8. The optimal heart rate during the acclimatization effort between altitudes 4200-4800 m

In this situation, too, the optimal heart rate for each member of the expedition was below the maximum heart rate, and the intensity of the effort represented 83-86% of the maximum heart rate, which indicates an efficient dosing of the pace and proper management of the amount of oxygen existing in the air at that altitude (55-60%).

From 5000 m upwards the effects of altitude were felt in intensity, the physiological effects being represented by the decrease of the amount of oxygen in the tissues, the increase of the pulmonary vasoconstriction and the increase of the sympathetic nervous flow. As such, the pace of movement decreased, with more frequent breaks for rest and muscle recovery, against the background of symptoms such as: fatigue, drowsiness and the need for hyperventilation.

Conclusions

During the expedition to reach the summit, observations were made on the organization of tourist activities on the southern face of Mount Damavand, on the volcanic landscape and on the adaptation of the organism to effort in altimetric conditions specific to high mountains, between 3000 and 5610 m. The following conclusions were drawn:

-tourist activities are organized in such a way that the climbers respond to the challenges of the mountain based on personal physical and technical training, and the locals to obtain income from luggage transfer;

-the standard route starts from Polour and reaches Camp I (Goosfand Sara) and Camp II (Bargah Sevom);

-the route between Polour and Camp I can also be travelled by off-road vehicles;

-the route between Camp I-Camp II and Damavand peak is demanding, taking place on exposed volcanic rock and on a varied terrain such as slope, microrelief (rocks, boulders, ravines) and substrate (sandy soil, rock, gravel, slag);

-in Camp I the accommodation can be made in the Mosque refuge, but there is also an area arranged for camping, with several platforms for the placement of tents;

-in Camp II there is an old refuge, a modern stone refuge and platforms for placing tents;

-drinking water is captured from streams that feed on glaciers;

-there are no route signaling elements, such as: painted markings or direction indicators;

-the surrounding volcanic landscape, although desolate and austere, induces the atmosphere specific to the high mountains, where rocks and glaciers dominate;

-the number of visitors is high, and they either carry out trekking activities between Camp I and Camp II, or climb to the top;

-the origin of the visitors is varied: Iranians, Germans, Austrians, English, Italians, Russians, Romanians;

-atmospheric conditions were characterized by atmospheric pressure between 400-600 mb and oxygen content in the air of 55-60%;

-the adaptation of the organism to these atmospheric conditions, but also to those imposed by the terrain, was done gradually, during the acclimatization days, and the climbers subjected to physiological observations made a moderate to intense physical effort, which represents 83-88% of the potential, maximum physical condition, which indicates a very good physical condition, but also effort dosing techniques in geographical conditions specific to altitudes of 3000-5000 m;

-determining factors in the process of adaptation to these altitudes were: the pace and mode of movement, the duration of exposure to high altitudes and the maximum altitude reached, respectively 5600 m.

From a practical point of view, the data obtained can be used by the organizers of mountain tourism activities in the preparation and conduct of expeditions in the high mountains.

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