

PHYSIOLOGICAL PARAMETERS OF HIGH ALTITUDE ULTRA MARATHON RUNNERS

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Abstract

The purpose of present study was to find the status of physiological parameters of blood pressure (BP), heart rate (HR) and Oxygen Saturations (SpO₂) levels of athletes participated Khardungla challenge an ultra marathon event in Ladakh in 2022. 100 male athletes from almost all the parts of the India and outside except the locals/non-ladakhi athletes, who were participated in Khardungla challenge an ultra marathon event held in UT Ladakh in September 2022. The Participants were in age range of year 1957-1995 males from outside U.T Ladakh. Physiological variables of heart rate (HR), blood pressure (BP) and oxygen saturation (SpO₂) were measured. SpO₂ and heart rate (HR) were measured by Finger Pulse Oximeter (Nellcor N-20P, Nellcor Puritan Bennett Ltd, UK) on warm hands in seated position. During recording, the volunteers breathed room air. SaO₂ values were recorded after they remained constant for at least one minute. Blood pressure was measured through sphygmomanometer. Descriptive statistics were performed to analysis mean, median, mode and standard deviation. the Mean of blood pressure is 134.27/ 87.35, Median: 130/90 and Mode: 120/80 of all participants, no such abnormalities in blood pressure were seen in participants before the starting of event. the heart rate of all samples has Mean score of 85.47, Median: 84 and Mode: 80. The Oxygen Saturation (SpO₂) level of Mean: 90.38%, Median: 92% and Mode: 92%. All shows that all the athletes were having a normal SpO₂ at such level of high altitude. This Study found that there is no such negative aspects in any of these three physiological parameters were found.

Keywords: Blood Pressure, Heart Rate, Oxygen Saturation, high altitude.

Introduction

Ladakh, one of the world's highest inhabited regions, is located at the northern most Trans-Himalayan part of India. It is a cold-arid desert at over 3000 meters means sea level (MSL). Having very harsh climate characterised by extreme temperature (-40 °C in winter and 35 °C in summer); low relative humidity and oxygen level (nearly 60-70 percent of the oxygen concentration at sea level); high UV radiations and wind erosion. To have survival and adaptability at cold as well as hypobaric hypoxic conditions, the human and other species inhabiting such harsh environment have developed certain unique physiological adaptation including comparatively higher aerobic performance, low hypoxic pulmonary vasoconstrictor response, better levels of oxygen saturation (SpO₂), high hemoglobin (Hb) level, increased flow of oxygen carrying blood and higher oxygen diffusion from blood to tissues/cells. The Ladakh Marathon event is the highest and amongst the toughest marathons in the world. Out of the six races, the event offers ultra-race too— the 72 km Khardung-La Challenge (5370 m) which is presently the world's highest ultra-marathon in the world. The Khardung-La challenge begins from Khardung village (3975 m, / 13,042 ft). The race route involves a gentle but steady

climb to the top of Khardung La (5370 m), one of the highest motorable passes in the world from it is downhill all the way to Leh town (3500 m / 11,500 ft). The event is restricted for the participants of 200 runners every year as it is amongst the toughest and ultimate challenging endurance for the serious runners who wants to push his or her limits to the extreme. Running at 3500 m above sea level have the athletes to get acclimatised to the high altitude which tests the limits of human endurance. Unlike other marathons, the Ladakh Marathon requires participants to arrive in Leh atleast a week in advance to acclimatise for the race day. Ladakh Marathon became a full member of AIMS (Association of International Marathons and Distance Races) in 2015 and has been profiled in various International Sports magazines and listed as being amongst the most beautiful breath taking and awe-inspiring marathons in the world. This Marathon event not only challenge the mental aspects of the runners but it also challenges participant's physiological aspects like changes in the oxygen saturation (SpO₂) level of the blood, in the blood pressure(BP) and in the heart rate (HR). The acclimatised individuals could maintain their SpO₂ during prolonged exercise better than non-acclimatised individuals. The Heart rate (HR) of acclimatised people was consistently lower at the same work level than that of non-acclimatised individuals. Acclimatised individuals were able to reach higher levels of exercise than when they had first arrived at altitude. These data imply that acclimatization to altitude improves the delivery of oxygen to the tissues. The mechanism of this is not certain, but it may be concerned with a reduction in the degree of ventilation-perfusion inequality of the lung which occurs on exposure to high altitude (Stoneham et al., Pethybridge et al., 1993). Oxygen saturation (SpO₂) is tightly regulated within the body because hypoxemia can lead to many acute adverse effects on individual organ systems. These include the brain, heart, and kidneys. Oxygen saturation (SpO₂) is a measure of how much haemoglobin (Hg) is currently bound to oxygen compared to how much haemoglobin remains unbound. In endurance sports, the heart rate variability (HRV) has been given a high priority in recent years to optimise the timing and intensity of training for optimal preparation for competition highlights (Nakamura et al., 2015) Although Ultra marathon event like Khardung-La challenge an extreme aerobic performance decline with increasing altitude is a long-known observation made by mountaineers and scientists as well. Most endurance competitions are performed at rather moderate altitudes (2,000–3,000 m) than high altitudes (3,000–4,500 m). Whether the time course of acclimatization and performance recovery is different between moderate and higher altitudes cannot be assessed with certainty because there are only few comprehensive data sets available for moderate altitudes. Townsend and colleagues evaluated effects of a 2-week altitude training camp (2,700 m) in 7 elite cyclists (Townsend et al., 2016). After the 2-week period they ascertained elevated hypoxic chemosensitivity (increased HVR) associated with higher ventilation (VE), peripheral oxygen saturation (SpO₂), and lower end-tidal carbon dioxide (pETCO₂) values during exercise and improved cycling performance. These changes are well in agreement with those observed at higher altitudes (see above). Notably, the authors did not observe this correlation between VE, pETCO₂ and SpO₂ when exercising at sea level (Townsend et al., 2016). At sea level, endurance athletes typically show relatively low exercising VE because of a blunted respiratory

controller gain, compared to non-athletes (Miyamoto et al., 2012). This adaptation is considered to be beneficial due to lower work of breathing and the not negatively affected blood flow to locomotor muscles by a respiratory metaboreflex (Scoggin et al., 1978; Harms et al., 1997; Dempsey and Wagner, 1999). When acutely exposed to moderate or in particular to high altitude, however, low exercise VE and reduced SpO₂ may be detrimental to performance, which was demonstrated to be more pronounced in individuals with higher aerobic capacity (Ferretti et al., 1997; Burtcher et al., 2006). Hence, VE, SpO₂ and performance may faster recover with acclimatization in highly trained individuals (Mellerowicz et al., 1971; Johnston and Turner, 1974; Burtcher et al., 2006). Not only the elevated HVR during a prolonged stay at high altitude but also increase of the HCVR (response to CO₂) may contribute to exercise hyperventilation and prevention of pronounced SpO₂ and performance decline (Sato et al., 1992).

Methods

The Participants for this study were 100 male athletes from almost all the parts of the India and outside except the local or non-ladakhi athletes who were participated in Khardungla challenge an ultra marathon event held in UT Ladakh in September 2022. Among 200 athletes participants with the age range of year 1957-1995 males from outside U.T Ladakh were selected as samples. Data were collected prior to the starting of event by the team of medical professionals who were appointed as on duty by the health department of the UT Ladakh.

Physiological measurements

Physiological variables of heart rate (HR), blood pressure (BP) and oxygen saturation (SpO₂) were measured. SpO₂ and heart rate (HR) were measured by Finger Pulse Oximeter (Nellcor N-20P, Nellcor Puritan Bennett Ltd, UK) on warm hands in seated position. During recording, the volunteers breathed room air. SaO₂ values were recorded after they remained constant for at least one minute. Blood pressure was measured through sphygmomanometer.

Data Analysis and Results

Descriptive statistics were performed to analysis mean, median, mode and standard deviation by using SPSS statistics software.

Table 1. Details analysis of blood pressure(BP), heart rate (HR) and Oxygen Saturations (SpO₂) levels of athletes participated Khardungla challenge event of Ultra marathon Ladakh in 2022.

	Blood Pressure (BP)	Heart Rate (HR)	Oxygen Saturation SpO₂(%)
Mean	134.27/87.35	85.47	90.38

Median	130/90	84	92
Mode	120/80	80	92
Standard Deviation		11.32	3.58
Minimum	100/64	59	81
Maximum	190/100	113	99

The table 1. contains the analysis of physiological parameters of blood pressure (BP), heart rate (HR) and Oxygen Saturations (SpO₂) levels of athletes participated in Khardungla challenge event of Ultra marathon Ladakh in 2022. the Mean of blood pressure is 134.27/87.35, Median: 130/90 and Mode: 120/80 of all participants, no such abnormalities in blood pressure were seen in participants before he starting of event. the heart rate of all samples has Mean score of 85.47, Median: 84 and Mode: 80. The Oxygen Saturation (SpO₂) level of Mean: 90.38%, Median: 92% and Mode: 92%. All shows that all the athletes were having a normal SpO₂ at such level of high altitude.

Conclusion

The Study came to the conclusion that there is no such negative aspects in any of these three physiological parameters blood pressure(BP), heart rate (HR) and Oxygen Saturations (SpO₂) levels of athletes participated Khardung-La challenge event of Ultra marathon Ladakh in 2022 were found. However further comprehensive and extensive study can helps to prove same parameters more reliable.

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