

What Effects does Altitude have on Reaction Time?

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Abstract

Doing research on altitude and reaction time is important because our reaction time is one of the main components of our defensive mechanisms. An area that is not well studied, or too broad of a topic is the effects of altitude on the brain as a whole. We gathered information from carefully chosen articles to sustain our hypothesis, and studied graphs on the topic to ensure our information is correct. We have found that, at higher altitudes, there is a lack of oxygen being transported to the brain stem region. This region has a responsibility over our reaction time, so a lack of oxygen impairs the functionality of said brain region which ultimately affects the speed of our motor movements

Introduction

The surface of the Earth is uneven, and in comparison to its crust, humans are very small. There are many changes in the altitude from the sea level up, with some towns being even 5,000 meters above the sea level (3 miles). Oxygen itself has weight, and so this gas mainly accumulates at lower altitudes. Humans, like any other organism, have a great need for oxygen to live and an even greater amount to function properly. With lower oxygen levels at higher altitudes, humans living in those conditions are prone to impairments in the nervous system. “The largest and most important impact of living in a high altitude is hypoxia, which is caused by a reduction of oxygen in the air and affects cognition” (Nature, Wang, paragraph 2). Specifically, the motor response called the *reaction time* is affected significantly. “High altitude exposure has a detrimental effect on cognitive functions with slower reaction times and reduced psychomotor vigilance i.e., slower reaction times as a measure of reduced sustained attention (high altitude, 1,500–3,500 m); impaired learning, spatial and working memory (very high altitude, 3,500–5,500 m) and impaired memory retrieval (extreme altitude, >5,500 m)” (Frontiers, Jean-paul Richalet, paragraph 6). It is believed that, at higher altitudes, humans will have a slower reaction time. This is because there is a lower concentration of oxygen at higher altitudes, and therefore restricts oxygen flow to the thalamus and corpus callosum regions of the brain which are responsible for reaction times.

Results

There are, in fact, lower amounts of oxygen as you go higher in altitude from the sea level. Lack of appropriate oxygen levels being transported to the brain shows effects on the Thalamus and Corpus Callosum brain regions, or the brain stem. An illness develops within such victims, which is called hypoxia. This illness is known for causing symptoms such as confusion, restlessness, and difficulty breathing. The Corpus Callosum and Thalamus play a part in the speed of one's reaction time. Observing those who live in high altitude regions, the individuals with lower oxygen levels in their nervous system prove to have slower reaction times. Additionally, it has been established that those who live at high altitudes may experience severe illnesses, such as High-Altitude Pulmonary Edema (HAPE) and/or High-Altitude Cerebral Edema (HACE). Although these findings may be concerning, further studies are being conducted to enhance our understanding of their effects, and fortunately there are methods to prevent and avoid them.

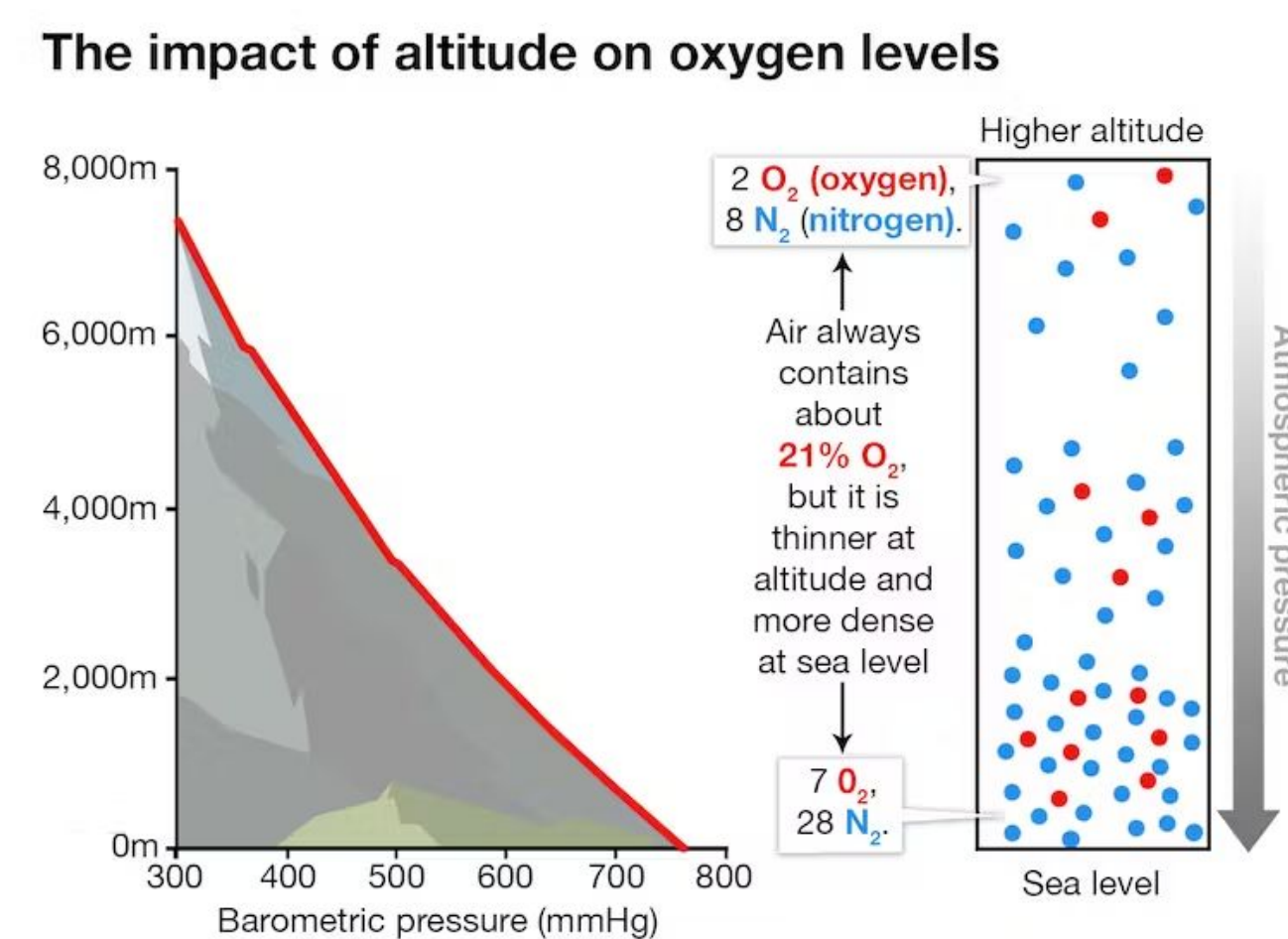


Figure 1. At high altitudes, oxygen molecules are further apart because there is less pressure to “push” them together. This effectively means there are fewer oxygen molecules in the same volume of air as we inhale. In scientific studies, this is often referred to as “hypoxia”.

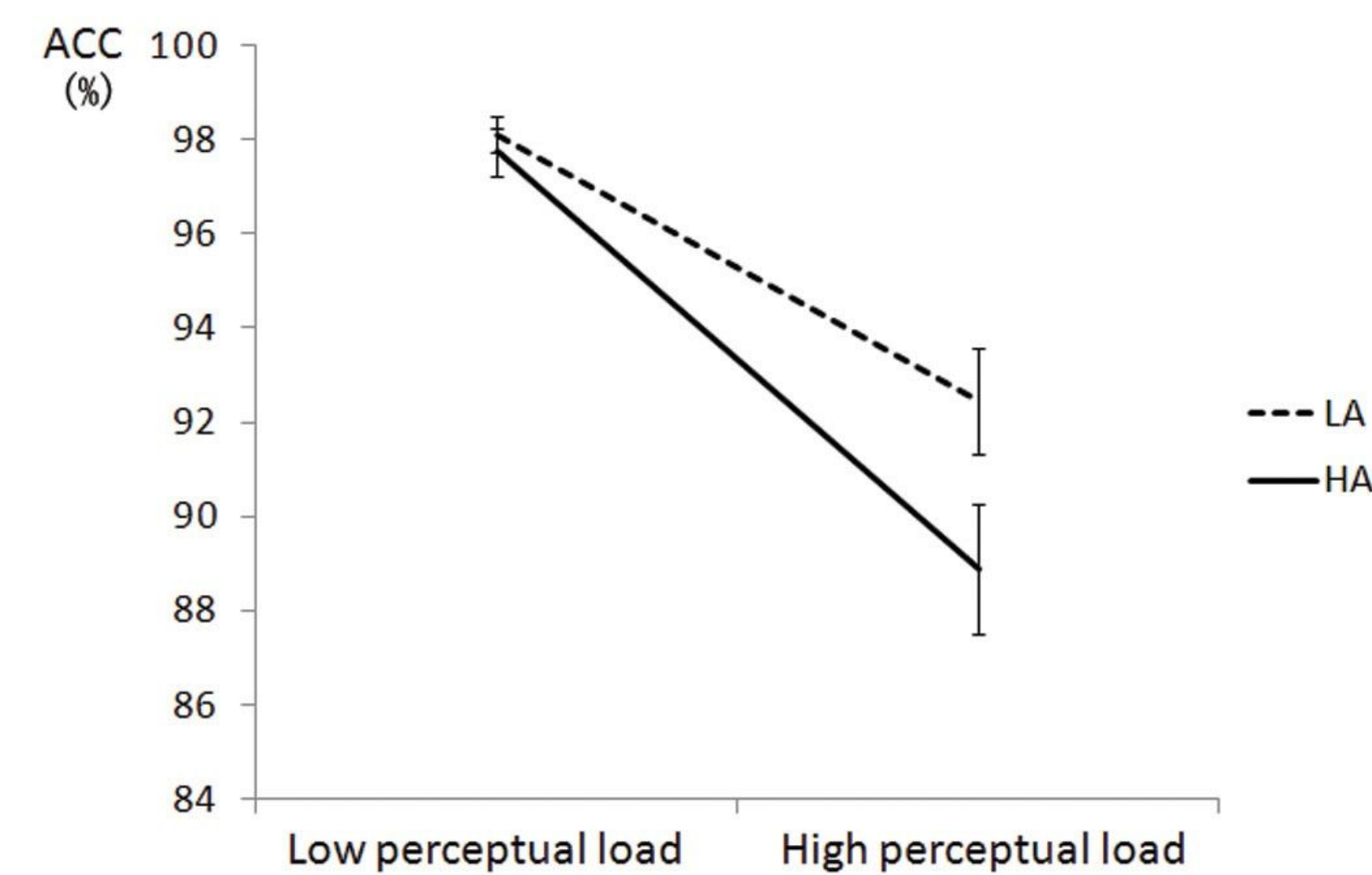
In Figure 1, within seconds of exposure to altitude, ventilation is increased, meaning we start trying to breathe more, as the body responds to less oxygen in each breath, and attempts to increase oxygen uptake. Despite this response, there's still less oxygen throughout your circulatory system, meaning less oxygen reaches your muscles. This will obviously limit exercise performance.”

Materials and Methods

Being a literature review, we have researched and extensively looked over many articles to come up with this cessation. By using academic search engines, such as Google Scholar and ProQuest, we put in the following key terms:

- “Altitude Effects”
- “Oxygen Levels”
- “Nervous System/Brain Stem”
- “Brain-Oxygen Functionality”
- “Impairments”

Throughout time, there have been many civilizations that have been living at elevated altitudes. However, it would be tough to study oxygen and impairments to such civilizations, so all research has been selected in the year 2012 and above. The articles we've selected researched this topic in North, Central, and Southern parts of the Americas. It also ranged to China, Mt. Everest, Himalayas, Karakoram, and East Africa. We were able to select these articles by searching for locations, accurate numbers, and specific brain regions, such as the Brain Stem area. We also considered author reliability, and the references within the articles. We were able to confirm legitimacy of these articles by alluding to reputable sources, running background checks on the authors, and making sure that the articles actually refer to legitimate locations and ran reliable tests.



In Figure 2, LA is referring to Low altitude and HA is referred to high altitude. According to LA or HA the accuracy of reaction time is significantly lower when in HA areas compared to LA areas.

Conclusion

From the data, which has been supported by extensive research, it can be concluded that higher altitudes have an effect on one's reaction time, because there is a higher restriction on oxygen flow to the brain and impairs the thalamus and corpus callosum brain regions which are responsible for cognitive functions and motor movements.

Discussion

There isn't a large amount of people residing in higher conditions, so the effect of high altitude and hypoxia isn't significant on the larger scale of the world's population. However, it is still important to study these effects on human beings in order for us to make sure that we are prepared for future references. Our reaction time plays a big part in our defensive mechanisms, especially in a “Fight or Flight” mode, and it is imperative that we understand what can hinder this.

For future studies on this topic, we could have done a more thorough search for resources and articles. Being a literature review, we are limited to the information that is on websites, and unable to do our own customized research. For a future experiment, we could run exercises that primarily focus on reaction times at a low altitude, and then take an expedition to the Alps to do the same and compare the results afterwards.

Works Cited

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