Complementary Health Practice Review, Vol. 6, No. 1, Fall 2000

The Effect of Homeopathic Coca on High Altitude Mountain Sickness: Mt. Everest Base Camp

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Homeopathic coca was tested among high altitude trekkers en route to the Mt. Everest base camp to determine its effect on mountain sickness symptoms. Study participants (n = 24) took homeopathic coca while ascending from 8,000 ft. to 17,600 ft. Measurements included: heart rate, oxygen saturation, and a questionnaire detailing the occurrence and severity of symptoms. Questionnaire items regarding nausea, headaches, difficulty breathing while asleep all demonstrated statistical significance in the experimental group. Oxygen saturation in the experimental group was significantly higher. In this placebo-controlled, single-blinded, non-randomized study, homeopathic coca significantly reduced the effects of altitude on trekkers in the experimental group when compared with placebo.

One hundred and fifty years ago the Golden Age of mountaineering began and soon all the summits in the Alps and a few in the Andes and the Himalayas had been reached. Climbers described unpleasant symptoms on high peaks but had no formal explanation for their occurrence. The confirmation that the lack of oxygen due to decreased barometric pressure was the primary cause of mountain sickness was made by Paul Bert (Hultgren, 1997). Since this discovery, research in the clinical aspects of hypoxia-induced illnesses has increased rapidly. Most of this research has focused on not only the fundamental scientific questions about the mechanism for symptoms on illnesses such as High Altitude Pulmonary Edema (HAPE) and High Altitude Cerebral Edema (HACE), but also on the treatment of these symptoms. This study intends to investigate the effect that homeopathic Coca has on high altitude mountain sickness symptoms in trekkers who are not using conventional treatments to prevent their occurence.

Altitude is defined by four levels at which medical problems may occur—intermediate altitude 5,000 to 8,000 ft., high altitude 8,000 to 14,000 ft., very high altitude 14,000 to 18,000 ft. and extreme altitude 18,000 to 29,028 ft. Mt. Everest base camp is located at 17,600 ft and the 12-day trek required to reach the base camp originates at 8,000 ft. Most high altitude research has been conducted at the intermediate altitude level and has focused on physiological changes at altitude and treatment of effects of altitude using pharmaceutical medicines.

The most important effect of high altitude upon physiological processes is a decrease in the oxygen pressure and thus a decrease in the percentage of oxygen saturation in circulating blood. As the barometric pressure decreases at higher altitudes, the partial pressure of oxygen (PO_2) also decreases, even though the percentage of oxygen in the atmosphere at high altitude remains the same as at sea level (Hultgren, 1997). Thus, there is less pressure "pushing" oxygen into the alveolar space and the saturation of oxygen in blood is decreased.

Hypoxia is defined as a decrease in the partial pressure of oxygen in blood or tissue. High altitude hypoxia, which differs, is related to the decrease in barometric pressure and the resulting decrease in the partial pressure of inspired oxygen. An increase in ventilation occurs to compensate for a decrease in oxygen saturation, even though the rate of pulmonary ventilation ordinarily does not increase significantly until one has ascended to about 8,000 ft. At this point, the arterial oxygen saturation has fallen to approximately 93% from a physiologic norm of 97%. The resulting physiological effects of a decrease in partial pressure of inspired oxygen (hypoxia) are: drowsiness, lassitude, mental fatigue, headache, nausea, sleep difficulties and sometimes euphoria.

Acclimatization, the only preventive way to avoid symptoms of hypoxia, is achieved by remaining at high altitudes for days, weeks, or years, and consequently adjusting to the lower $P0_2$. Trekkers are advised to ascend no more than 1,000 ft. per day, and for every 1,000 ft. gained, a day of rest at the new altitude is advised. This causes fewer symptoms of hypoxia and allows for greater physical exertion at higher altitudes without experiencing hypoxic symptoms. Physiologically, acclimatization is achieved by increased pulmonary ventilation, increased hemoglobin in the blood, increased diffusing capacity in the lungs, increased vascularity of the tissues, increased ability of the cells to utilize oxygen despite the low $P0_2$ (Guyton, 1986).

One of the major medical complications of being at high altitude, very high altitudes or of poor acclimatization is high altitude pulmonary edema (HAPE) which occurs mainly in unacclimatized individuals who are rapidly exposed to altitudes in excess of 8,000 feet. Common symptoms of HAPE include dyspnea, cough, weakness, chest tightness and occasionally hemoptysis appears, usually one to three days after arrival. Descent to lower altitudes, nifedipine (Procardia: a calcium channel blocker which relaxes coronary vascular smooth muscle, increases myocardial oxygen delivery, dilates peripheral arteries), diamox (Acetazolamide: a carbonic anhydrase inhibitor that acts to reduce edema), oxygen administration, and bed rest can result in rapid clinical improvement. Most individuals who develop HAPE do not have a preexisting cardiovascular or pulmonary condition, and despite proper acclimatization, some visitors of high altitudes still develop symptoms of HAPE. If misdiagnosed, the condition can rapidly progress and become fatal—approximately 20 deaths are reported annually throughout the world despite educational efforts aimed at prevention, early detection and treatment (American Mountain Guides Association, 1989).

Another major medical complication of improper acclimatization and misdiagnosis of symptoms is high altitude cerebral edema (HACE)—a neurological syndrome which presents with symptoms of central nervous system dysfunction and damage resulting from the hypoxia of high altitude. Initial symptoms include headache, lethargy, and irrational behavior progressing to unconsciousness. Symptoms usually appear five days or more after a rapid ascent to altitudes of over 9,000 ft. and are commonly seen as a complication of HAPE. The exact mechanism which causes HACE is unclear, contributing factors include severe hypoxia combined with an increase in cerebral blood flow, consequent capillary hemorrhages and increase in cerebral blood. Treatment of HACE usually includes steroids (which are often taken prophylactically), prompt descent, the delivery of oxygen, or placement in a hyperbaric bag. Hyperbaric bags simulate lower atmospheric conditions such as sea level and its corresponding PO_2. Dexamethasone (a corticosteroid which acts primarily to reduce inflammation) may be used to treat a suspected case of HACE, but controlled studies in Peru have demonstrated no objective evidence that improvement is achieved in patients with HAPE treated with pharmaceuticals (Marticorena & Hultgren, 1979).

Despite many years of research in the prevention and treatment of high altitude sickness and its related complications, research has focused almost entirely on pharmaceutical treatment of the conditions. A literature review has revealed that research in the area of natural remedies or alternatives to steroids and pharmaceuticals is in its infancy, and that few research studies have been published to document the treatment of HAPE or HACE with alternative treatments. In one study, Gingko was shown to be significantly more effective than placebo in preventing acute altitude sickness and cold-related vascular problems in mountain climbers on a Himalayan expedition (Roncin, Schwartz, & Arbigny, 1996).

The inspiration for this research with homeopathic Coca came from primitive cultures and centuries-old practices in the treatment of ailments due to exposure to high altitude. In cultures that dwell in higher elevations (e.g., Peru, Tibet, China, the Andes) the coca plant is employed not only for medicinal but also cultural and religious purposes. According to Maria Rostoworowski de Diez Canseco, "the use of the coca plant lessens high altitude stress, it essentially makes life more bearable in the harsh vertical landscape of the Andean Mountains. It was used as a medicine and as stimulation to allay cold, fatigue, pain and hunger" (Rostworowski di Diez Canseco, 1988).

According to Dr. Samuel Hahnemann, founder and father of the science of homeopathy, the conventional treatment of diseases relies upon a view that a disease is physiochemical, it employs the use of large, frequently repeated doses of strong medicines that suppress symptoms without actually curing the disease, and may debilitate the patient and worsen the disease (O'Reilly, 1996). Homeopathy, according to Hahnemann, has a dynamic view of the disease, cures by means of balancing one's vital force, avoids the use of painful and debilitating treatments, and uses minute doses of simple, proven medicines to cure disease through the principle of "like cures like."

Homeopathic research in clinical applications is in its infancy in the modern era, and certainly in the mountaineering arena and high altitude setting. As more attention is being focused on alternative methods of treatment, some clinical trials using homeopathy have been conducted. In September 1997, the *Lancet* published the most significant and comprehensive review of homeopathic research published to date. In a meta-analysis of 89 blinded, randomized, placebo-controlled trials, the authors concluded that the clinical effects of homeopathy were not simply the result of placebo (Linde, 1997).

Homeopathic Coca, as described by Allen, is prescribed for the effects from mountain climbing (Allen, 1990) and was chosen for use in this study for its precise application at high altitude settings. Farrington comments that Coca "prevents all the symptoms arising from the fatigue of the journey and from the disproportion between the internal and external atmospheric pressures. We may make use of this in persons who are weak, particularly for old people who get out of breath easily and particularly if they cannot stand a rarefied atmosphere" (Farrington, 1992, p. 521). Boericke calls Coca "the mountaineers remedy. Useful in a variety of complaints, incidental to mountain climbing such as palpitation, dsypnoea, anxiety and insomnia"(Boericke, 1993, p 173). Clark comments that coca "has been used for centuries by natives of West South America . . . for 'veta,' the condition induced in persons on coming to live in the high lands" (Clark, 1995, pp. 539-543).

METHODS

The experimental group consisted of 11 members of the 1998 Everest Challenge Expedition. The expedition was led by a climber who is a below-the-knee amputee and was the only disabled climber on the team. Baseline heart rate and oxygen saturation measurements were obtained before leaving the United States. The control group participants (n = 13) were enlisted in the study once in Nepal and thus were unable to give baseline measurements of heart rate and oxygen saturation from the United States. The control group did not share an affiliation to any expedition, were traveling separately from each other but were also trekking with a final destination of the Mt. Everest base camp.

Subjects signed consent forms and were informed of criteria for participation in the study—filling out a 10-question survey at approximately the same time daily for 14 days, providing heart rate and oxygen saturation measurements to the study data collector each day, and taking a homeopathic remedy once a day. Subjects were not paid for their participation in this study and names were not used in data collection. The experimental group traveled together for the duration of this study and the data were collected by the same individual daily. The control group was not traveling together as a group. The members were instructed to leave their questionnaires and objective measurements at a medical clinic in a small village to be picked up later by the study data collector.

The study was conducted in a placebo–controlled, nonrandomized and single-blinded format. The experimental group began taking one dose of homeopathic Coca 200c daily for 12 days from the altitude of 8,000 ft. until their arrival at the Mt. Everest base camp, 17,600 ft. The control group took neutral homeopathic pellets once daily for 12 days also from 8,000 ft. to their arrival at the Mt. Everest base camp. Participants did not know if they were in the experimental group or not, the data collector did know which group was taking the homeopathic Coca. Subjects in both groups were instructed to take the remedy only once per day; however, on some occasions, subjects in both groups took more than one dose at the onset of symptoms. This was recorded on their daily questionnaires.

Subjective information from participants about their physical experience of being at high altitude was collected by the general high altitude questionnaire (GHAQ).The questionnaires were filled out daily for 12 days during the ascent up the Khumbu valley and for two days after arrival at the Mt. Everest base camp. The questionnaire measured the frequency and severity of several possible symptoms of acute mountain sickness (AMS) on a 10-point Likert scale. The subjective assessment included: nausea, headaches, shortness of breath, weakness, fatigue, changes in appetite, memory impairment and duration of sleep (Sampson & Kobrick, 1980).

Heart rate and oxygen saturation were the only objective measurements taken throughout the study. Oxygen saturation measurements were taken with a Nonin 3200 O_2 pulse oximetry device and the same machine was used for all measurements taken in this study. The machine was calibrated before leaving the United States and was not calibrated on the trek. The experimental group had a study data collector taking oxygen saturation measurements daily and the control group had an appointed person to collect the oxygen saturation readings.

Subjects in both groups took their own 1 minute resting heart rate measurements and reported them on their questionnaires.

Subjects excluded from participation in the study included those who had preexisting respiratory problems (e.g., cystic fibrosis, emphysema, asthma, chronic bronchitis, or documented pulmonary fibrosis) or who were already taking dexamethasone or diamox prophylactically. A history of cigarette smoking was not considered an exclusionary criterion for study participation.

RESULTS

The study measured the effectiveness of homeopathic Coca in alleviating the symptoms of high altitude mountain sickness. The results were analyzed using paired *t*-test and Levene's test for equality of variances and are summarized by category.

The results showed that homeopathic Coca is effective in alleviating several symptoms of high altitude mountain sickness. The experimental group showed increased overall average oxygen saturation levels during the entire ascent and, in general, had scores that reflected fewer symptoms on the general high altitude questionnaire (GHAQ). Statistically significant values were obtained for nausea, headache and difficulty breathing during the night for altitudes of 12,672 ft. through 17,600 ft. Details of specific measurements and results are included in the sections below.

Oxygen Saturation Levels

The oxygen saturation levels were averaged over the 12-day ascent from an altitude of 8,399 ft. to 17,600ft. (base camp) for both groups. Average oxygen saturation for the experimental group over the 12-day trek was 87.3%. In comparison, the control group averaged 83.4% oxygen saturation. Actual oxygen saturation levels recorded for the experimental group were significantly higher overall. These values were recorded on days in which ascent to higher altitude was made as well as on days when participants remained at altitude for acclimatization (Figure 1). Oxygen saturation values of statistical significance were observed on days 5, 6, 8 & 9 ($p = 0.026$, 0.031, 0.001 and 0.003, respectively). On Day 5 (acclimatization at day 1 at 12,672 ft.), average oxygen saturation among the experimental group was 87.9% as compared to 84.4% for the control group ($p = 0.026$). Day 6 values (acclimatization day 2 at 12,672 ft.) showed average oxygen saturation for the experimental group to be 87.0% with 83.8% for the control group ($p = 0.031$). This trend continued on Day 8 (ascent to 14,381 ft.: 87.6% vs. 80.2%) ($p = 0.001$) and Day 9 (acclimatization 14,381 ft.: 86.2% vs. 80.7%) ($p = 0.003$) (See Figure 2 and Table 1).

General High Altitude Questionnaire (GHAQ)

Average responses for all questions were plotted for both groups on each day of the trek. Higher than average responses correlated with increased severity of symptoms. The results not only reflected percentages of respondents who reported any type of symptom (response to question > 0), but also percentages of severity of symptoms reported.

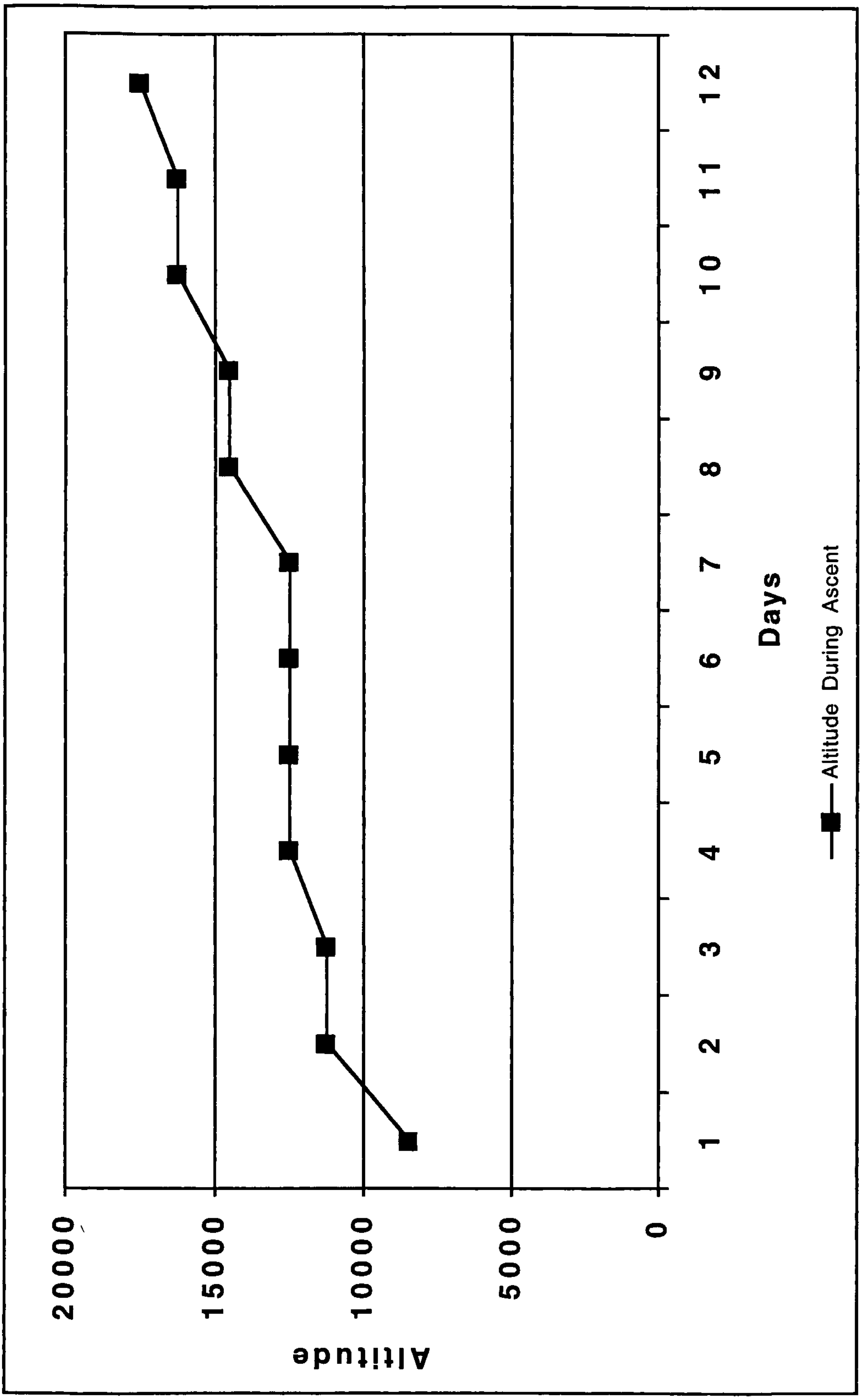

Figure 1 Altitude During Ascent

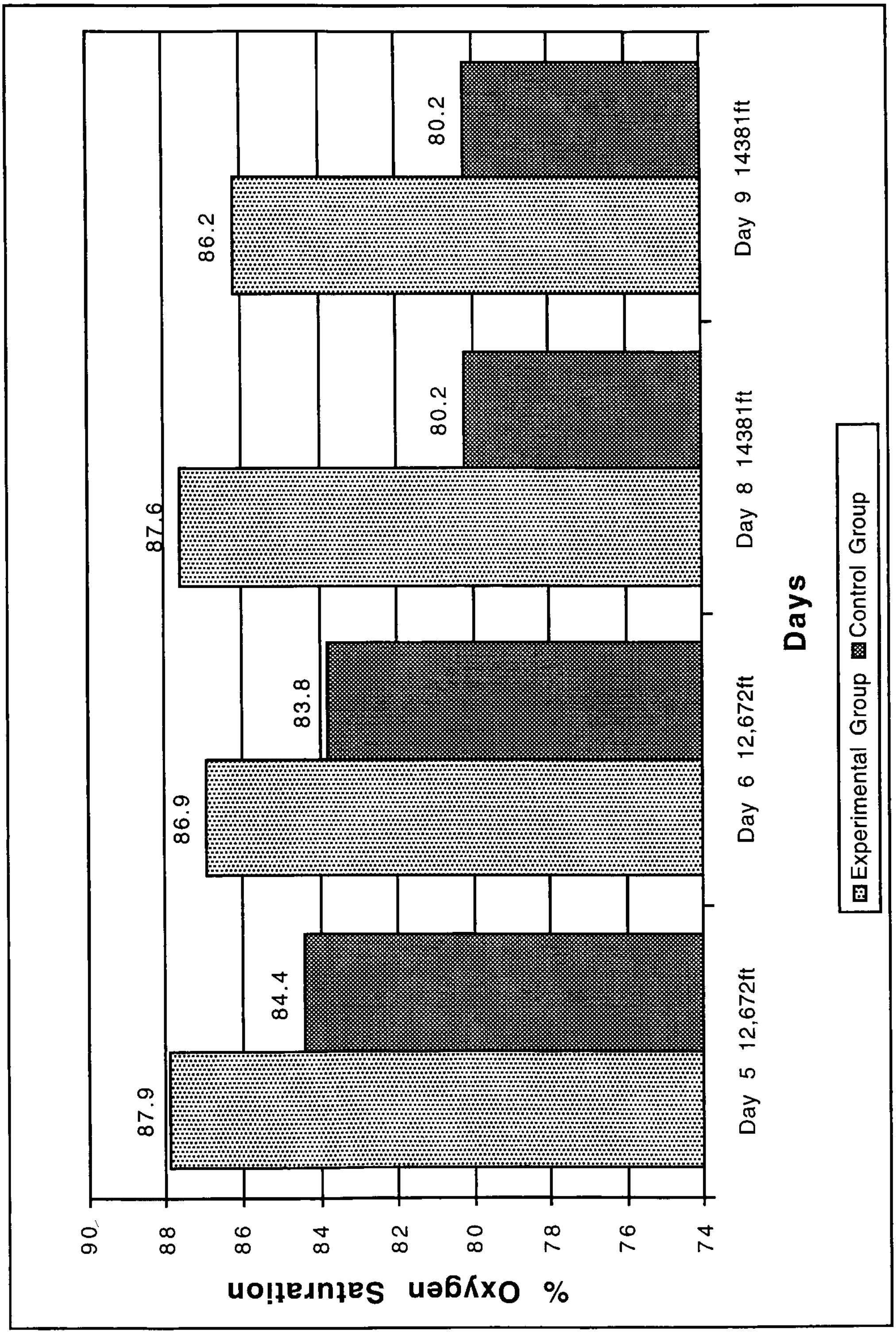

Figure 2. Oxygen Saturation Levels

Altitude 8,399 ft. to 12,672 ft.

During the initial 4 days of the trek, the control group respondents reported fewer signs and symptoms and a lessened severity of symptoms. The control group did not report any shortness of breath, fatigue, loss of appetite or reduced quality and quantity of sleep. Conversely, the experimental group reported some symptoms for shortness of breath, fatigue, and appetite. On Day 1, the experimental group recorded the following symptoms: 36% reported being a little short of breath ($p = 0.016$), 55% reported some level of fatigue ($p = 0.002$), 9% reported above-average tiredness ($p = 0.002$), and 27% reported a decrease in appetite ($p = 0.046$). On Day 2, values of significance were recorded for both the quality and quantity of sleep. Only 45% of the experimental group reported sleeping very well, compared to 92% of the control group. In addition, 72% of the experimenters reported waking once or twice during the night, with only 23% of the control reporting the same.

During the trek and acclimatization to 12,672 ft., the control group had no loss of appetite, reporting "a very good appetite for all food" (Days 1, 2, 3, 4 and 6). In contrast, the experimental group reported some decrease in appetite during these days (p-values = 0.046, 0.046, 0.046, 0.016 and 0.014, respectively).

Altitude 12,672 ft. to 17,600 ft. (Base camp)

Beginning at altitude 12,672 ft. and continuing to 17,600 ft., values of statistical significance favored the experimental group. They reported fewer signs and symptoms of nausea, headache and difficulty breathing at night, and on several days reported less severe symptoms as altitude increased. Values of statistical significance recorded on the GHAQ are presented in Table 1.

Question 1—Nausea

Lower average scores regarding nausea were recorded for the experimental group on most days. Overall, the experimental group reported less nausea, and in most cases, less severe symptoms. Significant values were recorded on Days 6-9, 11 and 12. $p$values for these days are presented in Table 1.

Question 4—Headache

The symptom of headache at altitude was significantly reduced by the coca for the experimental group. The control group clearly reported higher average scores on the questionnaire corresponding to an increased number of symptoms, as well as an increase in severity. These values were recorded for days 4-9 during the trek. $p$values for question 4, days 4-9, are presented in Table 1.

Question 10—Difficulty Breathing at Night

The experimental group showed significant improvement over the control group in ability to breathe during the night. This improvement was noted beginning Day 4 on ascent to altitude 12,672 ft., and continued through Day 12 during the final ascent to 17,600 ft. The control group showed a significant increase in the number reporting difficulty breathing during the night, as well as in the severity of the symptom. P-values for question 10, days 4-12, are presented in Table 1.

TABLE 1. P-Values for GHAQ Nausea, Headache, Difficulty Breathing at Night

Day	*p*-Values	Altitude
Question 1–Nausea		
6	0.011	Acclimitization day 2 at 12,672 ft
7	0.001	12,672 ft
8	0.041	14,381 ft
9	0.002	Acclimitization day at 14,381 ft
11	0.016	Acclimitization dat at 16,262 ft
12	0.003	17,600ft
Question 4–Headache		
4	0.042	12,672 ft
5	0.007	Acclimitization day at 1 at 12,672 ft
6	0.000	Acclimitization day at 2 at 12,672 ft
7	0.000	12,761 ft
8	0.014	14,381 ft
9	0.008	Acclimitization day at 14,381 ft
Question 10–Difficulty Breathing at Night		
4	0.036	12,672 ft
5	0.029	Acclimitization day 1 at 12,672
6	0.000	Acclimitization day 2 at 12,672
7	0.001	12,672 ft
8	0.001	14,381
9	0.001	Acclimitization day 14,381
10	0.000	16,262
11	0.000	Acclimitization day at 16,262
12	0.000	17,600 ft

DISCUSSION

Oxygen saturation levels were improved in the experimental group beginning on Day 5 of the ascent to the Mt. Everest base camp (12, 672 ft.). It may be that the members of both the experimental and control groups had been at either intermediate or high altitude for a number of days which allowed them to avoid some initial symptoms of being at high altitude until they arrived at 12, 672 ft. on Day 5. Generally speaking, most people who live at or near sea level experience some degree of high altitude symptoms before reaching 12,000 ft. Proper acclimatization may have been achieved until Day 5 and it is also possible that the symptoms experienced matched those produced by homeopathic Coca and thus the Coca became more effective as the symptoms progressed from Day 5 on.

It is more difficult to explain the decrease in severity of symptoms among the control group from 8,399 ft. to 12,672 ft. when compared with the experimental group, as both groups were recording responses on the GHAQ at the same altitudes. It is possible that the control group had been at altitude for longer periods as it was unconfirmed if this was their first trek for the season. It is also unclear whether the members of the control group were carrying any equipment on the trek—if no equipment was carried, their ventilation rate was not further increased and thus the physiological effects of a decreased partial pressure of oxygen was not seen.

Subjectively, the experimental group had improved shortness of breath, less nausea, fewer headaches and were able to breathe better at night than the control group from 12,672 ft. to 17,600 ft. as demonstrated on the GHAQ. This is corroborated with the objective findings of the oxygen saturation level being significantly higher overall than those reported for the control group.

The physiologic differences in the disabled climber in the experimental group for heart rate and oxygen saturation were not determined; however, it is not expected that any differences related to the disabiltiy affected the findings significantly.

CONCLUSION

This preliminary research on the use of homeopathic Coca at high altitude serves as an initial investigation into the use and efficacy of homeopathic medicine not only in the high altitude setting but also in an arena where pharmaceutical drugs are seen as the only medical intervention available for the reduction of symptoms associated with being at high altitude. The ramifications of this research, although preliminary, are wide as an ever growing number of homeopathic practitioners apply the use of homeopathics to other medical situations.

Further research needs to be conducted to verify these results. Specifically, this particular study design could be improved upon by controlling for more variables between the groups: current health status and respiratory function as confirmed by spirometry. Baseline objective data taken from the country of origin before departing for Nepal, information regarding the altitude at which members typically live, similar affiliation of the control group members, documentation about acclimatization methods and trekking itinerary would be important information to include in future study information. Future research should also attempt to quantify the amount of physical work members of each group are doing, for example, setting up tents, cooking, and carrying backpacks. Additionally, improving inter-rater reliability by having the same person collect objective data for both the experimental and control groups and using a double-blind study design would benefit the strength of these findings. Although it is not recommended by the manufacturer of the Nonin 3200 O_2 pulse oximetry device, calibration of the machine may lend more reliability to results as the effect of high altitude on its operation is not known. Ideally, future research to confirm these results will employ an increase in numbers of participants for both the experimental and control groups.

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