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วารสารวิทยาศาสตร์และเทคโนโลยีการกีฬา ปีที่ 16 ฉบับที่ 2, ธันวาคม 2559
Journal of Sports Science and Technology Volume 16, No. 2, December 2016

นิพนธ์ต้นฉบับ (Original article)

Case report

BODY COMPOSITION AND HEMATOLOGICAL FOLLOWING ASCENTS AND DESCENTS OF EXTREME ALTITUDE AT MT. EVEREST BASE CAMP IN A THAI ELDERLY MOUNTAINEERS

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ABSTRACT

High altitude environment have adverse effects on the normal functioning of body such as body composition and hematologic, this case study reported the male 65 year of age during Everest Mt. ascent. These case studies describe the body composition and hematological changes in the elderly that occur as a result of ascending and descending the Everest base camp. After descended Mt Everest body composition reduced 4.4% and hematocrit raised 18%, it took the subject 40 days for achieved base camp.

(Journal of Sports Science and Technology 2016; 16(2) : 1-8)

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INTRODUCTION

Increase numbers of elderly people go to high altitude for touring or trekking activities. High altitude mountaineering places demands on the human body that triggers physiological changes especially in the elderly. Few studies have explored the influence of aging on the tolerance to high altitude. Some adjustments, such as an increase in ventilation, are acute while others, such as changes to body composition and blood cells, take longer to develop.

Many studies of adaptation to high altitude have focused on the blood because of its role in oxygen transportation. High hemoglobin constitutes on ascent to high altitude resulting from a response to hypoxia by the body. Not only hematologic change but weight loss also consider frequently observed. The possible causes of altitude induced weight loss are decrease food intake, loss appetite, imbalance of energy intake and expenditure.

The magnitude of the changes and the degree to which these changes persist upon return to lower elevations is likely related to the altitude achieved and the duration of time spent at high altitude. Mt. Everest base camp 2(6420 m) are highly prized routes by mountaineers, yet there are no published studies comparing the physiological adaptations that occur from climbing in the elderly .The duration of the 6420 m expeditions depends on physical fitness. Whether these physical demands create physiological changes in the elderly is unknown.

OBJECTIVE

The purpose of this case study is to describe the body composition and hematological changes in the elderly that occur as a result of ascending and descending the Everest base camp

Material and method

A written informed consent was taken from subject before start interviewing him for the laboratory investigations. Blood sample was drawn from antecubital vein and collected in 3 ml EDTA vacationer in 5 days after descended. The blood sample was processed on the same day within 3-5 hours of collection using automated hematologic cell counter for hematogram (hemoglobin, hematocrit, red cell number, red cell indices and platelet) before and after achieved base camp in standard international unit. Measurement body composition by weighting scale in metric unit (kg) before and after achieved base camp.

Matched pairs test was used to compare “Pre” and “Post” variables. The differences in measured variables was analyzed in percentage

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CASE REPORT

The male participant has good fitness due to regular exercise, trekking and is an experienced high-altitude mountaineer with more than a dozen ascents above 19,685 ft (6000 m) and more than 2 dozen ascents above 16,405 ft(5000 m). He was 65 years of age during the Everest expedition. His altitude of residence is 4.9 ft(1.5 m) above sea level(Nakon Pathom). The ascents were voluntary and partly self-funded. The trekking and climbing portion of the Everest expedition took 40 days between April-May 2016. The mountain was climbed expedition style with several trips to higher camps at 7,200m. and took highest place on the 20th day of expedition. Trekking from Everest base camp (5,300 m) commenced from Lukla (2,840m) followed the Pang boche and Dling boche valley (4400m) for 7 days. Over six weeks in high altitude expenditure as show in figure. 1, 2 and 3

	Day	Day	Place	elevation m	Distance km
	Day 1	17-Apr	Lukla	2840	0
	Day 1	17-Apr	Phakding	2600	7.8
	Day 2	18-Apr	Namche	3300	10.4
	Day 3	19-Apr	Namche	3300	0
	Day 4	20-Apr	Pang boche	3800	12.8
	Day 5	21-Apr	Ding boche	4400	6.5
	Day 6	22-Apr	Ding boche	4400	0
	Day 7	23-Apr	Base camp	5300	17.4
	Day 8	24-Apr	Base camp	5300	0
	Day 9	25-Apr	Base camp	5300	0
	Day 10	26-Apr	Base camp	5300	0
	Day 11	27-Apr	Camp 1	6020	3.5
	Day 12	28-Apr	camp 2	6400	0
	Day 13	29-Apr	camp 2	6700	2
	Day 13	29-Apr	camp 2	6400	0
	Day 14	30-Apr	Base camp	5300	3.5
	Day 15	1-May	Base camp	5300	0
	Day 16	2-May	Base camp	5300	0
	Day 17	3-May	Base camp	5300	0
	Day 18	4-May	camp 1	6020	0
	Day 19	5-May	camp 2	6400	3.3
	Day 20	6-May	camp 3	7220	2
	Day 21	7-May	camp 2	6400	2.03
	Day 22	8-May	Base camp	5300	6.8
	Day 23	9-May	Ding boche	4400	17.4
	Day 24	10-May	Ding boche	4400	0
	Day 25	11-May	Ding boche	4400	0
	Day 26	12-May	Base camp	5300	17.4
	Day 27	13-May	Base camp	5300	0
	Day 28	14-May	camp 1	6020	3.5
	Day 29	15-May	camp 2	6400	3.3
	Day 30	16-May	camp 2	6400	0
	Day 31	17-May	Base camp	5300	6.8
	Day 32	18-May	Base camp	5300	0
	Day 33	19-May	Base camp	5300	0
	Day 34	20-May	Base camp	5300	0
	Day 35	21-May	Base camp	5300	0
	Day 36	22-May	Base camp	5300	0
	Day 37-42	23-May	KTM	2800	0
	Day 43	29-May	Thai	1	0
				total distance	126.43

Figure. 1

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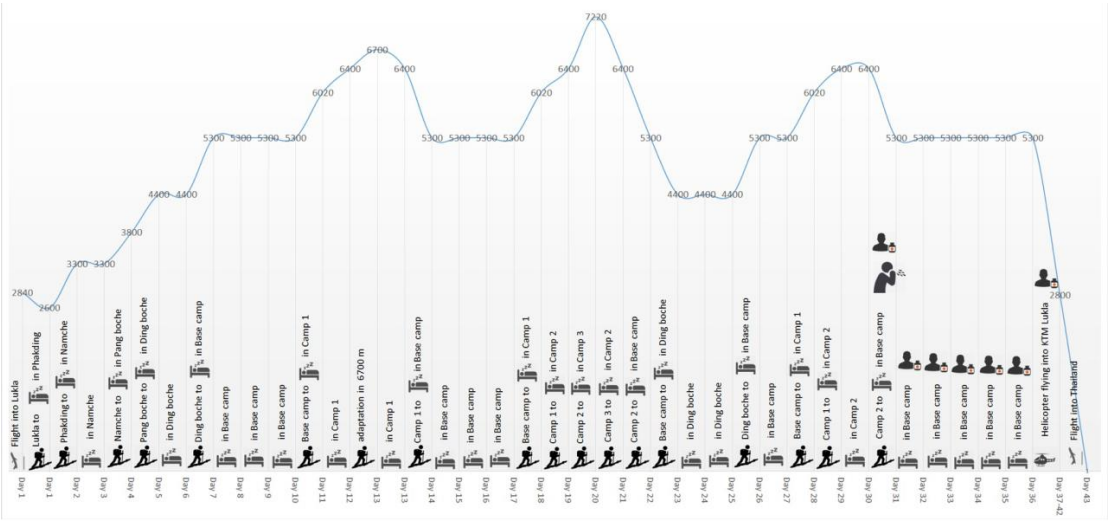

Figure. 2

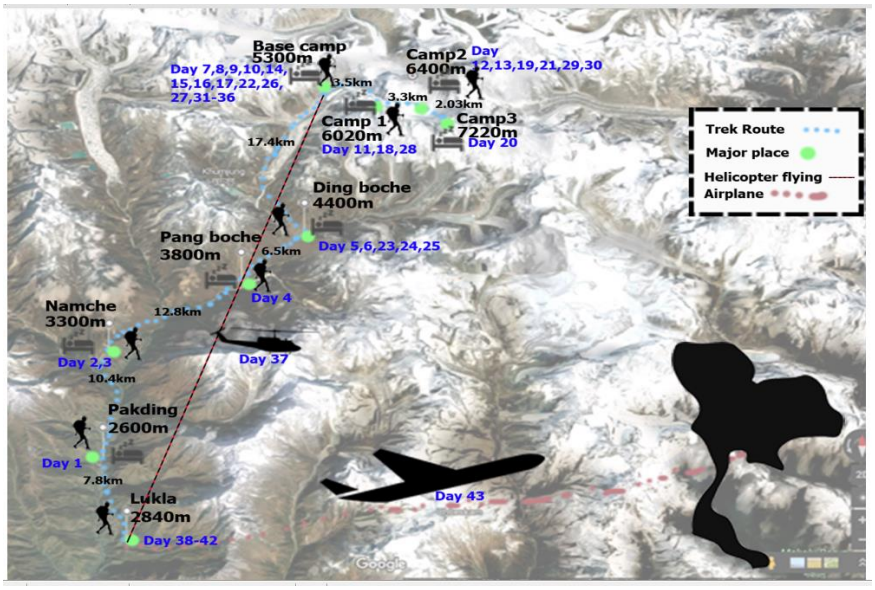

Figure. 3

The pre-expedition measurements body weight and blood test for complete blood count were taken at the participant's altitude of residence (1.5m) less than a week before the departure for expeditions. The post-expedition measurements were taken in the same location within 5 days after the climber return to altitude residence. The Data collection included a complete blood count (CBC), as well as measurements of body mass, pre- and post-measurements as well as change scores.

Following the expeditions, the body mass was reduced due to large losses of weight (68 kg to 65 kg). The CBC was increased in hematocrits, hemoglobin and red cell count following the Everest climb. The post-Everest base camp ascent values for mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) were unchanged.

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DISCUSSION

With increasing numbers of people ascending to altitude to mountaineer, trek or ski, weight loss is frequently observed following long stays at high altitude. It has been suggested that humans cannot maintain weight above 16,405 ft (5000 m) and that the magnitude of weight loss is dependent on the amount of time spent at high altitude.[1] This case report he also has weight loss 3 kg (4.4%) after descended Mt Everest same as the results from the previous study are consistent with that theory as the climber lost weight. The loss of 7% of body mass following the Everest expedition is identical to what has been reported for other Everest climbers.[3] It is clear that extended sojourns to high altitude promote weight loss; however, the pathophysiology of this negative energy balance is not completely understood. It is likely a combination of increased exertion, decreased appetite, increases in leptin concentrations, leptin is a key role hormone involved in neuroendocrine regulation of energy by reduced appetite and also increase basal metabolic rate, intestinal dysfunction there is malabsoption of food or change in intestinal permeability.[1] Ward et al.[2] noted that weight loss within the first 3 week of an expedition is typical due to a change from a semi-sedentary lifestyle to one that involves trekking long distances. However, more research is needed to determine what influence hypoxia has on weight loss independent of physical exertion.

Exposure to high altitude and, consequently, to low oxygen pressure, leads to a variety of physiological responses, which are driven by hypoxia. Among the proteins that are involved in these responses and whose expression is induced or enhanced by erythropoietin (EPO) plays a major role in increasing the number of circulating red blood cells (RBCs), thereby ensuring oxygen delivery. According to this case study CBC was done after Everest climb in fourteen day at that time hematocrits was rising about 18%, similar to another study shown after an exposure to high altitude hematocrits was rising about 15-20%.[2] In this case study the mountaineer was 65 years old, hematologic change including hematocrits hemoglobin level and red cell number were still similar to younger climbers responding to hypoxia in climbers between 20-55 years old. The effect of high altitude of hematologic change on the elderly and the physiological response to hypoxia in this elderly population was remarkably similar to that reported in younger, subjects.[5]

Altitude-related cough is a troublesome condition of uncertain etiology that affects many visitors to high altitude. There are a number of potential mechanisms; for example, acute mountain sickness (AMS), sub-clinical high altitude pulmonary edema, changes in the central and peripheral control of cough, loss of water from the respiratory tract, respiratory tract infections and bronchoconstriction etc. In this case the mountaineer developed acute dyspnea after several weeks in high altitude. The most likely etiological factors are infection or water loss from the respiratory tract leading to trauma of the respiratory mucosa and tracheobronchitis, and sub-clinical pulmonary edema. Respiratory water loss and sub-clinical pulmonary edema could both be precipitated or worsened by exercise[6]

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As with any case studies, the results cannot necessarily be generalized to other mountaineers and other expeditions. However, this study provides the first published record comparing the physiological changes in the elderly that take place as a result of ascending to the summits of Everest. As such, it provides a reference for other researchers and mountaineers.

Table 1 : **Body Composition and Hematological Changes following mountaineering expeditions to Mt. Everest**

Variable	Pre	Post	Change	% Change
Mass (kg)	68	65	-3.0	-4.4
Hemoglobin	14.9	17.4	2.5	16.7
RBC	5.0	5.9	0.9	1.8
Hematocrit	44	52	8.0	18.1
MCV	89	88	-1.0	-1.1
MCH	29.9	29.6	0.3	1.0
MCHC	33.6	33.6	0.0	0.0

RBC = red blood cells (x 10^6/mL); MCV 5 mean corpuscular volume (fl); MCH 5 mean corpus- cular hemoglobin (pg); MCHC 5 mean corpuscular hemoglobin concentration (g z dl^{21}).

High altitude significantly impacts overall body composition, reducing both fat and lean mass. However, these reductions appear more so in the adipose reserves than in the lean tissues of the body. Unfortunately this case did not record the subject's anthropometric (circumferences, skinfolds). The anthropometric results can be used to calculate the estimated percent of body fat, lean body weight, and fat weight of the subjects, so this case does not have evaluate of these data.

Table 2 : Summary of previous reports of Body Composition and Hematological Changes

Variable	Wagner(7)	Wagner(7)	Andrew(8)	Tanner(9)	This case
Age(years)	41	43	20.8	37.4	65
Height(m)	6962	8850	5260	6194	6420
Duration(day)	15	56	16	21	40
% change					
Mass (kg)	-3.0	-6.9	-4.0	-5.3	-4.4
Lean (kg)	0.7	1.1	NA	NA	NA
Fat (%)	-21%	-41	NA	-4.8	NA
Hemoglobin	-1.3	12.7	14.2	NA	16.7
Hematocrit	-1.5	4.8	NA	NA	18.1

CONCLUSION

High altitude mountaineering that spans several weeks stresses the human body, resulting in physiological changes included weight loss and increased in red blood cell parameters. The elderly is response to high altitude was remarkably similar to that reported in younger subjects.

REFERRENCES:

1. Hamad N, Travis SPL . Weight loss at high altitude: pathophysiology and practical implications. Eur J GastroenterolHepatol2006 ;18 : 5 – 10 .
2. Ward MP, Milledge JS, West JB . High altitude medicine and physiology , 3 rd ed. London : Arnold ; 2000 : 97-106 ; 170 .
3. Wiseman C, Freer L, Hung E . Physical and medical characteristics of successful and unsuccessful summiteers of Mount Everest in 2003 . Wilderness Environ Med 2006 ; 17 : 103– 8.
4. Rice L, Ruiz W, Driscoll T, Whitley CE, Tapia R, et al. Neocytolysis on descent from altitude: a newly recognized mechanism for the control of red cell mass. Ann Intern Med 2001; 134:652–6.
5. Shrivastava A, Goyal A, Negi KS. Effect of high altitude on haematological parameters. Indian J PrevSoc Med. 2010;41(1):2.

6. Mason, Nicholas P. “Altitude-Related Cough.” *Cough (London, England)* 9 (2013): 23. *PMC*.Web. 9 Sept. 2016.
7. Wagner DR. Body Composition and Hematological Changes Following Ascents of Mt. Aconcagua and Mt. Everest. aviat space environ med Aviation, Space, and Environmental Medicine. 2010Jan;81(11):1045–8.
8. Subudhi AW, Bourdillon N, Bucher J, Davis C, Elliott JE, Eutermoster M, et al. AltitudeOmics: The Integrative Physiology of Human Acclimatization to Hypobaric Hypoxia and Its Retention upon Reascent. PLoS ONE. 2014;9(3).
9. Tanner DA, Stager JM. 289 Weight And Body Composition Changes During A Mountaineering Expedition On Mt. Mckinley, Ak. Medicine & Science in Sports & Exercise. 1993;25