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High Altitude and Related Illnesses Awareness among General Population in Albaha City

Saad A. Manakrwi, Thamer A.H. Alghamdi, Raed J.D. Alghamdi, Mohammed O.M. Alghamdi, Omair M.S. Alghamdi, Ghazi S.A. Alghamdi, Abdullah I.S. Alghamdi
Faculty of Medicine, Albaha University, Albaha, KSA

ABSTRACT

Background: high altitude illness (HAI) refers to a number of acute syndromes that may take place in individuals who are not acclimatized to high altitude, including acute mountain sickness, high altitude pulmonary edema and high altitude cerebral edema. Awareness of the general population about the manifestations and risk factors of high altitude illness may enhance the recognition of patients and ensure adequate management of acute cases.

Objective: this study was carried out to assess the awareness of general population of Albaha city regarding high altitude and related illnesses.

Methods: this questionnaire was distributed among the general public in Albaha city, Saudi Arabia. The questionnaire consisted of two sections: section 1 included personal data and section 2 was concerned with awareness and knowledge of people regarding high altitude illness. Only completed questionnaires without missing data were statistically analyzed.

Results: a high frequency of the participants identified the risk factors contributing to HAI including ascending too quickly, overexertion, dehydration and sleeping at high altitude. On the other hand, participants had some false believes about the risk factors, the gravity of the illness and the lowest level of altitude at which manifestations may develop. Only 30.1% identified the lowest altitude at which HAI can occur. About one third of the subjects had symptoms of HAI in the form of difficulty in breathing, exhaustion, headache, weakness and difficulty in sleeping.

Conclusion: overall, respondents were interested in learning more about high altitude sickness. Physicians and the internet were the most attractive sources of information for this population.

Keywords: high altitude illness, acute mountain sickness, survey, Saudi Arabia.

INTRODUCTION

High altitude illness is a term used to describe a number of acute syndromes that may occur in unacclimatized individuals at high altitude including acute mountain sickness (AMS), high altitude pulmonary edema (HAPE) and high altitude cerebral edema (HACE) [(1)].

As altitude increases ambient pressure falls and this leads to a lowered partial pressure of ambient oxygen and a decreased saturation of hemoglobin as a result [(2)]. High altitude begins at altitudes around 2500 m, where arterial oxygen saturation falls to values lower than 90%. High altitude illness is usually mild and self-limiting, but rarely it may progress to more severe forms, which can be life threatening. Risk factors for developing high altitude illness include the rate of ascent, the altitude reached, the altitude at which the personlsleeps and individual susceptibility [(3)].

Persons over 50 years of age were somewhat less susceptible to AMS than younger persons, whereas the incidence in children appears to be the same as that in adults. Women seem less susceptible to HAPE than men, but equally prone to AMS [(4-6)]. Pregnancy and common preexisting illnesses such as coronary artery disease, hypertension, diabetes, and chronic obstructive pulmonary disease do not affect the susceptibility to high altitude illness [(3)]. Interactions between genes and environment most likely explain this individual susceptibility or resistance to high altitude illness, especially HAPE. **Mortimer *et al*.** [(7)] reported a significant association between HAPE and specific polymorphisms of the endothelial nitric oxide synthase gene, the angiotensin converting enzyme gene and the human leukocyte antigens-DR6 and DQ4.

High altitude exposure triggers physiologic responses for maintaining an adequate tissue oxygenation [(8).] Subjects who adapted to these altitudes for many months or years may develop chronic mountain sickness, which is characterized by excessive production of red cells, hypoventilation, fatigue, dyspnea, cyanosis, clubbing of the fingers and leg edema [(9)].

High altitude induced changes in cardiac rhythm that may explain the higher rate of sudden cardiac death at high altitude [(10)]. High altitude residents have adaptive mechanisms to survive in such hypoxic environment [(11)].

These adaptive mechanisms, although generally tolerated by most healthy subjects, may induce

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major problems in patients with preexisting cardiovascular diseases (CVD) [8]. Exposure to high altitude may unmask coronary artery disease, left ventricular dysfunction or pulmonary hypertension that was asymptomatic at sea level. For patients with CVD, the high altitude environment poses some physiological challenges than normal subjects [12]. In Saudi Arabia high altitude is considered to be a risk factor for several diseases. **Ellatif *et al.*** [13] reported that risk assessment regarding high altitude exposure of patients with coronary heart disease is of increasing interest in Saudi Arabia. Moreover, **Abu Eshy *et al.*** [14] reported a high prevalence of gallstone disease in a high altitude Saudi population. Albaha City, located in the south west of Saudi Arabia, is at an altitude of 2155 m above sea level and to the best of our knowledge, no study has been conducted to investigate the awareness among general population of Albaha city regarding high altitude and related illnesses. Therefore, the aim of the present study was to investigate the awareness of general population of Albaha city towards high altitude and related illnesses and to aassess the practices related to the prevention and management of high altitude related illnesses.

METHODS

Ethical considerations

This study design was approved by the institutional review board of the Faculty of Medicine, Albaha University. An informed consent was obtained from each participant.

Study design

This study had a random cross-sectional design that was used to assess awareness of general population about high altitude and related illnesses. This study was carried out from the beginning of May, 2017 to the end of July, 2017, among the general population of Albaha city. A sample size of 596 participants (both males and females), aged between 18 to 60 years were randomly recruited from the population in Albaha city. People who approved to participate in this study were included, but those who did not achieve inclusion criteria and those with incomplete data were excluded from this study.

A self-administered questionnaire was used for data collection. The questionnaire had two parts. The first part was about personal information of the participants. The second part was about awareness and knowledge of people regarding causes and symptoms of high altitude illnesses. The questionnaire was distributed to the participants by direct contact with them. Data were confirmed then coded and entered to a personal computer. Appreciations were used to inspire the participants to be involved in this study.

The study was done after approval of ethical board of Albaha university.

Statistical design

Qualitative data were expressed as number and percentage of the participants and Chi square goodness of fit test was performed. Significance was adopted at $p < 0.05$ for interpretation of results of tests.

RESULTS

In this study, 336 participants were recruited. A significantly higher frequency of the participants were in the age groups >35-45 and >45 - 55 (25.6 and 24.4 % respectively), while the least frequency was in age group >60 years ($p <0.001$). Male participants significantly outnumbered females (90.5 vs 9.5% respectively; $p<0.001$). The majority of participants were married (82.4%; $p<0.001$). A significantly high frequency of the participants had high education, followed by secondary education, then post graduate degrees (60.7%, 28% and 10.4% respectively; $p<0.001$). The highest frequency were professionals followed by employees (39.9 and 28.9%; $p<0.001$) (**Table 1**). Most of the patients heard before about high altitude illness (60.4%), but 41.4% of participants were unsure if high altitude illness was life threatening and 37.8% agreed that it was life threatening. As regards the symptoms of high altitude illness, most of the participants choose difficulty in breathing (92.6%), followed by physical exhaustion (71.7%), headache (70.8%) and difficulty in sleeping (63.7%) (**Table 2**). The percentage of subjects who experienced symptoms of high altitude illness was 31%, while 51% denied their exposure to these symptoms and 18% were unsure (**Figure 1**). The most frequently stated symptom was difficult breathing (14.6%), followed by exhaustion (13.1%), headache (8.9%), weakness and difficulty in sleeping (each 7.4%) (**Figure2**).

As regards the lowest altitude at which HAI can occur, the highest frequency of subjects considered it to be at 5000 feet (36.9%), followed by the altitude of 10000 feet (30.1%). Most of the subjects had an ambient sleeping hours (28.9% sleep for 5 hours, 34.8% had 6 hour sleep, while 21.4% sleep for more than 6 hours).

Ascending too quickly was thought by 61.3% of subjects to be a contributing cause to HAI, followed by breathing cold air (56.8%), overexertion (51.8%) and dehydration (45.8%).

More than half the participants (56.5%) were smoking cigarettes (**Table 3**).

Cardiovascular disorders had the highest frequencies reported by the participants of the diseases related to high altitudes (62.8%), hypertension (72.6%) and angina (40.5%). Asthma and bronchitis were chosen by 56.8% and 38.1% respectively (**Table 4**).

As regards the diseases suffered by the participants, the most frequently reported included hypertension (9.2%), asthma (2.7%) and angina (2.1%) (**Figure 3**).The majority of participants (78.9%) wanted to know more about AMS. Among the best ways to know about AMS, campaigns had the highest frequency (47.9%), followed by the internet (36.6%), health personnel (36%), while books had the lowest frequencies (5.7% and 3.9% respectively).

Internet was reported by the a higher percentage of the subjects (68.2%) as the way they learned about AMS, the second in frequency was TV (23.5%), then health professionals (19.6%) followed by books and lectures (17.6% each). Magazines had the lowest frequency (4.2%).

Table 1: Socio-demographic data of the studied participants

		Participants (N= 336)		Chi square goodness of fit test	
		N	%	X^2	p
Age (years)	18-25	57	17.0%	54.393	<0.001*
	>25-35	46	13.7%		
	>35-45	86	25.6%		
	>45-55	82	24.4%		
	>55-60	44	13.1%		
	> 60	21	6.3%		
Sex	Female	32	9.5%	220.190	<0.001*
	Male	304	90.5%		
Marital status	Single	56	16.7%	377.161	<0.001*
	Married	277	82.4%		
	Divorced	3	0.9%		
Education	Primary	3	0.9%	279.310	<0.001*
	Secondary	94	28.0%		
	High	204	60.7%		
	Postgraduate	35	10.4%		
Occupation	Employee	97	28.9%	227.214	<0.001*
	Housewife	1	0.3%		
	Professional	134	39.9%		
	Retired	54	16.1%		
	Student	23	6.8%		
	Unemployed	27	8.0%		

Table 2: awareness about the symptoms of high altitude illness

		Participants (N= 336)		Chi square goodness of fit test	
		N	%	X^2	p
Have you ever heard about high altitude illness?	No	133	39.6%	14.583	<0.001*
	Yes	203	60.4%		
Is high altitude illness a life threatening disease?	No	70	20.8%	24.268	<0.001* No obs < hypo Yes & don't know obs > hypo
	I don't Know	139	41.4%		
	Yes	127	37.8%		
Which of the following are symptoms of high altitude illness?					
Difficulty in breathing		311	92.6%		
Physical exhaustion		241	71.7%		
Headache		238	70.8%		
Difficulty in sleeping		214	63.7%		
Weakness		168	50.0%		
Vomiting		164	48.8%		
Loss of appetite		124	36.9%		
Depression		123	36.6%		
Dim vision		122	36.3%		

Table 3: awareness of the participants about the contributing factors to high altitude illness

		Participants (N= 336)		Chi square goodness of fit test	
		N	%	X^2	p
What is the lowest altitude at which high altitude illness can occur?	5000 feet	124	36.9%	42.310	<0.001*
	10000 feet	101	30.1%		
	15000 feet	51	15.2%		
	20000 feet	60	17.9%		
How many hours do you sleep at night?	≤ 4 hours	50	14.9%	30.452	<0.001*
	5 hours	97	28.9%		
	6 hours	117	34.8%		
	> 6 hours	72	21.4%		
What contributes to cause high altitude illness?	Ascending too quickly	206	61.3%		
	Breathing cold air	191	56.8%		
	Overexertion	174	51.8%		
	Dehydration	154	45.8%		
	Smoking	131	39.0%		
	Malnutrition	119	35.4%		
	Sleeping at high altitude	115	34.2%		
Have you ever smoked tobacco cigarettes?		190	56.5%		

Table 4: awareness of the participants about illnesses related to high altitude

		Participants (N= 336)		Chi square goodness of fit test	
		N	%	X^2	p
Do you consider asthma is an illness related to high altitude?	No	61	18.2%	85.946	<0.001 No & unsure obs < hypo Yes obs > hypo
	I don't know	84	25.0%		
	Yes	191	56.8%		
Do you consider bronchitis is an illness related to high altitude?	No	94	28.0%	5.214	0.074 No obs < hypo Yes obs > hypo
	I don't know	114	33.9%		
	Yes	128	38.1%		
Do you consider T.B. is an illness related to high altitude?	No	140	41.7%	76.946	<0.001 No & unsure obs > hypo Yes obs < hypo
	I don't know	159	47.3%		
	Yes	37	11.0%		
Do you consider cardiovascular disease is an illness related to high altitude?	No	55	16.4%	132.268	<0.001 No & unsure obs < hypo Yes obs > hypo
	I don't know	70	20.8%		
	Yes	211	62.8%		
Do you consider hypertension is an illness related to high altitude?	No	38	11.3%	234.500	<0.001 No & unsure obs < hypo Yes obs > hypo
	I don't know	54	16.1%		
	Yes	244	72.6%		
Do you consider gall stones is an illness related to high altitude?	No	158	47.0%	86.357	<0.001 No & unsure obs > hypo Yes obs < hypo
	I don't know	146	43.5%		
	Yes	32	9.5%		
Do you consider angina is an illness related to high altitude?	No	97	28.9%	7.875	0.019* No & unsure obs < hypo Yes obs > hypo
	I don't know	103	30.7%		
	Yes	136	40.5%		

Table 5: need of knowledge and methods of learning about high altitude illness

		N	%
Do you want to know more about AMS?	Unsure	39	11.6%
	No	32	9.5%
	Yes	265	78.9%
What do you think the best way to know about it?			
Campaigns		161	47.9%
Internet		123	36.6%
Health personnel		121	36.0%
Counseling		19	5.7%
Book		13	3.9%
How did you learn about it?			
Internet		229	68.2%
TV		79	23.5%
Health professional		66	19.6%
Books		59	17.6%
Lectures		59	17.6%
Magazines		14	4.2%

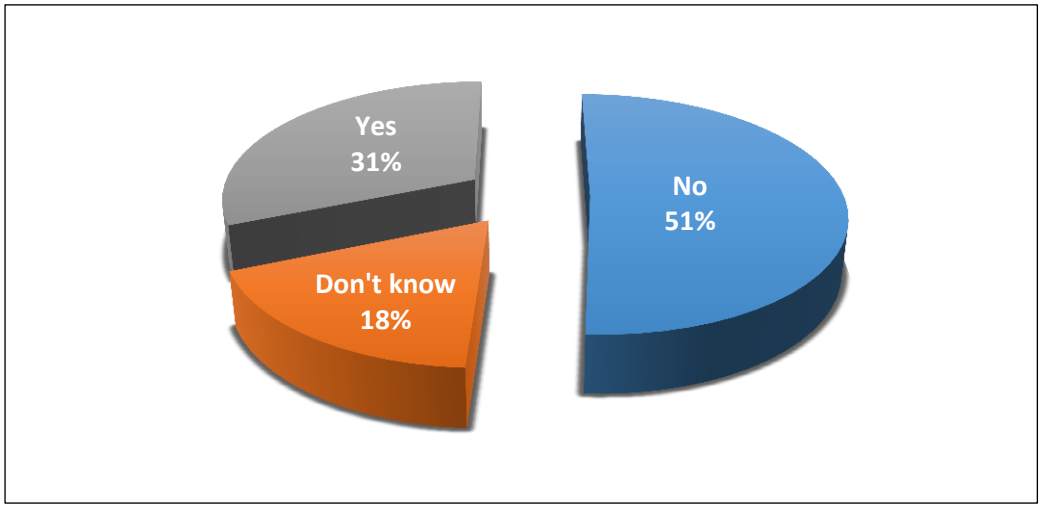

Figure 1: percentage of participants suffered from symptoms of high altitude illness.

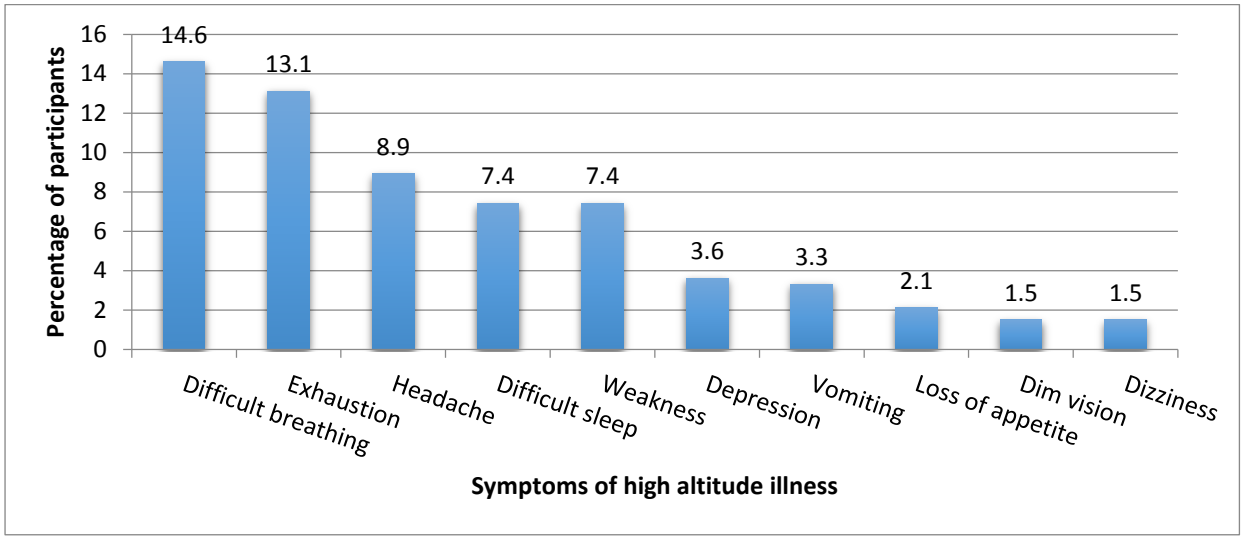

Figure 2: symptoms of high altitude illness.

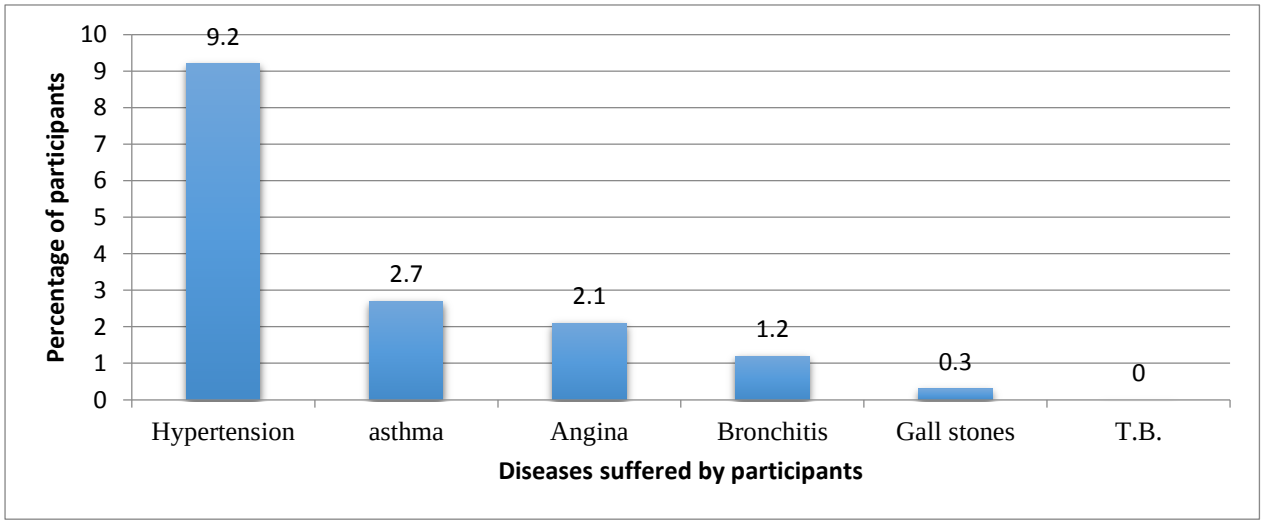

Figure 3: diseases suffered by the participants.

DISCUSSION

` In this study, most of the respondents were well educated and heard before about high altitude illness (HAI) and this was contributed to the high percentage of correct answers concerning the manifestations and risk factors HAI. However, there was a misconception about its gravity as 37.8% of subjects believed it to be life threatening and 41.4% were unsure. As regards the symptoms of high altitude illness, most of the respondents were able to identify common manifestations including difficulty in breathing (92.6%), physical exhaustion (71.7%), headache (70.8%) and difficulty in sleeping (63.7%).

In the present study, only 31% of all subjects had symptoms of high altitude illness in the form of difficulty in breathing (14.6%), exhaustion (13.1%), headache (8.9%), weakness and difficulty in sleeping (each 7.4%). These manifestations resemble those of chronic mountain sickness (hypoventilation, fatigue, dyspnea and cyanosis) that develops in subjects adapted to high altitudes for months or years [(9)]. Reporting of headache in this study was relatively low considering that headache was among the most common high altitude complaints [(15)]. On the other hand, **Norris *et al.*** [(16)] conducted a study to evaluate high altitude headache (HAH) and acute mountain sickness (AMS) in military populations training at moderate (1,500–2,500 m) to high altitudes (>2,500 m). In a sample of 192 U.S. Navy and Marine Corps personnel, 14.6% reported AMS and 28.6% reported HAH.

In the current study, only 30.1% identified the lowest altitude at which HAI can occur (10000 feet, approximately 3048 meters). High altitude begins at an elevation of 1,500 m (5,000 feet), but symptoms were rare at 1,500 m and their incidence increased with rapid ascent to higher elevations [(17)]. From a physiological perspective, high altitude referred to altitudes approximately 2500 meters or more, where arterial oxygen saturation decreased below 90% [(1)]. Most of the subjects had an ambient sleeping hours (28.9% sleep for 5 hours, 34.8% had 6 hour sleep, while 21.4% sleep for more than 6 hours). A high frequency of the participants identified the risk factors contributing to HAI including ascending too quickly (61.3%), overexertion (51.8%), dehydration (45.8%) and sleeping at high altitude (34.2%). On the other hand, participants some false believed about the risk factors were observed such as breathing cold air (56.8%) and malnutrition (35.4%). Risk factors of high altitude illness comprised the rate of ascent, the altitude reached, the altitude at which the person sleeps and individual susceptibility [(3)] in addition to overexertion [(1)]. The diseases believed by the participants in this study to be related to HAI included cardiovascular disorders, which had the highest frequencies (62.8%), hypertension (72.6%) and angina (40.5%). In addition, the most frequently reported diseases suffered by the participants were hypertension (9.2%) and angina (2.1%). The adaptive physiological changes which take place at high altitudes comprised alterations in cardiac rhythm in response to hypoxia [(11)]. Additionally, exposure to high altitude resulted in higher circulating concentrations of vasoactive compounds, as a direct result of hypoxia or as adaptive response to chronic high-altitude exposure [(13)]. While, these changes were tolerated by normal individuals, they represented a challenge to patients with preexisting cardiovascular disease [(8)]. Moreover, some disorders such as coronary artery disease, left ventricular dysfunction or pulmonary hypertension may be asymptomatic at sea level and exposure to high altitudes may reveal them [(12)]. This may explain why the rate of sudden cardiac death was higher at high altitude [(10)]. Bronchial asthma was falsely believed by some respondents to be related to high altitudes. Moderate altitude was significantly associated with lower degree of asthma disease severity, lower need for controller medication and better quality of life [(18)].

The majority of participants (78.9%) expressed willingness to know more about HAI. The best methods they recommend for having information about HAI were campaigns, followed by the internet and through health personnel. Regarding the way the respondents learned about HAI, internet had the highest percentage, followed by TV, then health professionals, books and lectures. In partial agreement to these results, 30% of trekkers in a study conducted by **Glazer *et al.*** [(19)] stated that they would prefer to learn from the internet, and 27% preferred to ask a doctor. It could be inferred that population at risk of developing HAI would look for and profit from education about altitude sickness. Hence, education programs should focus on making the resources of information available on the internet or could be distributed through the health care facilities.

CONCLUSION

Despite the participation of a high percentage of well educated subjects, respondents showed some misconceptions about high altitude illness,

particularly the altitude at which the illness may start to manifest, which leaves them unprepared to recognize or treat their symptoms. Moreover, they seemed to exaggerate the risk of HAI once the symptoms developed. Educational programs should focus on these points. It is recommended to make the information concerning HAI available on the internet or to prepare hand outs or booklets to be distributed through the health care facilities.

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