Effect of Personality Traits on Development of Acute Mountain Sickness in Rapid Entry Population

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ABSTRACT

Background: *To investigate the effect of the personality traits on development of acute moun-tain sickness (AMS).*

Methods: *One hundred and eighty-nine healthy male subjects transported from the plains (Chengdu, China) to high altitude area (Tibet, China) were enrolled in this study. Ninety-six sub-jects experienced AMS within two days after arriving at the Tibet plateau (AMS group). There were 93 subjects without AMS (healthy control without AMS group). The symptoms of AMS, state trait anxiety and personality traits of subjects were assessed using self-assessment and AMS questionnaire (Chinese criteria).*

Results: *The AMS group had a significantly higher prevalence of self-assessed anxiety, compared with the healthy control group without AMS. Personality traits estimation based on data obtained by Eysenck personality questionnaire revealed higher neuroticism and extraver-sion scores in the AMS group. Neuroticism, extraversion and anxiety level expressed highly significant levels of mutual concordance.*

Conclusion: *The anxiety level was the highest in patients with AMS and it corroborated with neuroticism and extraversion level from the Eysenck scale. Psychological disturbances and extra-version can affect the development of AMS in rapid entry population. It would be helpful for people with anxiety-trait or personality traits to deal with the stress, in order to decrease the risk of developing AMS.*

Keywords: Acute mountain sickness, personality traits, trait anxiety scale

Efecto de los Rasgos de Personalidad en el Desarrollo del mal Agudo de Montaña en la Población de Entrada Rápida

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RESUMEN

Objetivo: *Investigar el efecto de los rasgos de personalidad en el desarrollo del mal agudo de montaña (MAM).*

Métodos: *Ciento ochenta y nueve hombres sanos transportados desde las llanuras (Chengdu, China) al área de altitudes altas (Tíbet, China) fueron incluidos en este estudio. Noventa y seis sujetos experimentaron MAM dentro de dos días después de llegar a la meseta del Tíbet (grupo con MAM), mientras que 93 sujetos permanecieron sanos, sin MAM (grupo de control). Los síntomas de MAM, ansiedad de estado-rasgo, y los rasgos de la personalidad de los sujetos fueron evaluados utilizando la autoevaluación y el cuestionario MAM (criterios de China).*

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Resultados: *El grupo MAM tuvo una prevalencia significativamente mayor de ansiedad autoevaluada, en comparación con el grupo de control sano sin MAM. La valoración de los rasgos de personalidad basada en datos obtenidos mediante el cuestionario de personalidad de Eysenck arrojó puntuaciones de mayor neuroticismo y extraversión en el grupo MAM. El nivel de neuroticismo, extraversión y ansiedad expresó un nivel de concordancia mutua altamente significativo.*

Conclusión: *El nivel de ansiedad fue mayor en los pacientes con MAM y se correspondió con el nivel de neuroticismo y extraversión de la escala de Eysenck. La extraversión y los disturbios psicológicos pueden afectar el desarrollo de MAM en la población de entrada rápida. Sería útil para las personas con rasgos de ansiedad rasgo o rasgos de personalidad lidiar con el estrés, con el fin de disminuir el riesgo de desarrollo de MAM.*

Palabras claves: Mal agudo de montaña, rasgos de personalidad, escala de ansiedad de rasgo

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INTRODUCTION

Acute mountain sickness (AMS) is a well-recognized illness at high altitudes, usually at an elevation of 2500 metres or higher. The manifestations of AMS include headache, fatigue or weakness, gastrointestinal indisposition, dizziness/ light-headedness and sleep disorder. Symptoms can begin to appear between four and eight hours and up to 96 hours after arrival at a high altitude location. Acute mountain sickness can sharply limit recreational activities and work, especially in the first few hours following arrival. If unrecognized and untreated, AMS progresses to high altitude cerebral oedema (HACE) or high altitude pulmonary oedema (HAPE) and may lead to death in just a few hours.

The risk of developing AMS is mainly determined by young age, speed of ascent, poor acclimatization and altitude. During ascent to high altitudes, barometric pressure falls leading to a drop in the partial pressure of oxygen, and ultimately resulting in hypobaric hypoxia-the major risk factor faced at high altitudes. In addition, many persons who got to a high altitude for the first time experienced emotional anxiety, tension, fear and physiological stress responses, including tachycardia, accelerated respiration and elevated blood pressure. Violent emotional responses and physiological stress may provoke the functional disturbance of the central nervous system, which consequently results in the disorders of major organs. Besides physical expression, psychological changes can occur as the altitude increases. Anxiety is the most common mood that accompanies stress associated with AMS. Anxiety is increased upon exposure to hypoxia in a hypobaric chamber and state-anxiety and AMS increase with altitude (1). It was also reported that subjects who are susceptible to AMS are significantly more anxious than those who are not (2–4). Personality traits have been also suggested as a reliable predictor of altitude pathology in hypobaric chambers (1).

State anxiety (A-State) is conceptualized as a transitory emotional state or condition of the human organism that is characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity (5, 6). Trait anxiety (A-Trait) refers to relatively stable individual differences in anxiety proneness, that is, to differences among people in their tendency to respond to situations perceived as threatening with elevations in A-state intensity (7). Given that instruments assessing anxiety and depression tend to be highly correlated, with correlations ranging from 0.45 to 0.75, distinguishing between these two states has become an important focus of research (8, 9).

Human beings manifest variability in the incidence and severity of physical disease (10). This variability may partly depend on psychological factors, which have long been thought to contribute to the predisposition and to affect the onset and course of various physical illnesses. Some of the psychological factors that have been thought to affect physical illness are constant over-time, thus, reflecting stable individual differences. Among these variables are personality traits such as neuroticism and extraversion (11).

Neuroticism represents individual differences in the tendency to experience distress and in the cognitive and behavioural styles that follow from this tendency. Higher levels of neuroticism have been associated with higher levels of self-reported illness as well as with higher-in-

cidence and severity of coronary heart diseases, asthma, arthritis, ulcer, autoimmune diseases and infections (10). Extraversion is the personality characteristic that reflects an individual's preferences for dominance. Individuals high in extraversion are described as active, assertive and energetic, whereas individuals low in extraversion can be described as quiet, reserved, shy and withdrawn (12). Higher levels of extraversion were associated with more pain-reporting in comparison to introverted persons and with the frequency of gingival inflammation (10).

We hypothesized that the personality traits, the emotion and stress disturbances induced by the high altitude environment may contribute to the development of AMS. In the current study, young adult subjects who travelled to the plateau from the plains by air were recruited. The emotional anxiety and personality traits of the participants were investigated by questionnaires, respectively. The correlation of anxiety traits and personality traits with the development of AMS was analysed.

SUBJECTS AND METHODS

Subjects

The enrollment trial of new recruits from the plains (Chengdu area, elevation 560 meters) to an high altitude areas (Tibet plateau, elevation 3675 meters) was performed from November 2004 to March 2005. The inclusion criteria were as follows: (1) no organic disease, (2) age ≥ 17 years, (3) low-land dwellers from areas 400–1500 m, (4) had not been exposed to high altitudes in the previous year. The exclusion criteria were as follows: (1) altitude sickness related symptom, (2) autoimmune disease, malignancy, active infection, or bad cold, (3) age ≥ 25 years, (4) exposed to high altitude in the previous three months, (5) reluctant to cooperate with the investigation. According to the inclusion criteria and exclusion criteria, the altitude sickness symptom self-report scale of the subjects was measured and the positive cases were excluded. Finally 201 persons were enrolled in this trial. After surveying the SAI, TAI and personality scale, they were transported to Lhasa plateau by airplane. On the second day, the altitude sickness symptom self-assessed scale was filled. One hundred and eighty-nine persons with complete data were included for statistical analysis. Their ages were 17–21 years. Ninety-six (96/189, 50.79%) subjects experienced AMS within two days after arriving at the Tibet plateau (AMS group), with 93 (93/189, 49.21%) subjects without AMS (healthy control without AMS group). The demographic characteristics of them are shown in Table 1. This study was conducted in accordance with the Declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Xinqiao Hospital, Third Military Medical University. Written informed consent was obtained from all participants.

Table 1: Demographic characteristics of subjects

Group	Demographic characteristics	
	Male	Age (years, mean ± SD)
AMS	96	18.84 ± 0.94
Healthy control without AMS	93	18.86 ± 0.98
Total	189	18.85 ± 0.96

AMS: Acute mountain sickness

Assessment of acute mountain sickness symptoms

The symptoms of AMS were assessed according to the diagnosis standard of mountain sickness in China [GJB 1098–91] (13). The grading and scoring of symptoms were as follows: the headache was divided into grade (±), grade (+), grade (++) and grade (+++), with 1, 2, 4 and 7 points, respectively; the vomiting was divided into grade (+), grade (++) and grade (+++), with 2, 4 and 7 points, respectively; the other symptoms were not graded, and were scored with 1 point, respectively (Table 2).

Table 2: Grading and scoring of acute mountain sickness symptom

Symptom		Grade	Score (points)
Headache	Not obvious, no pain expression, not affect daily activities	±	1
	Light, with pain expression, improved after taking painkiller, not affect daily activities	+	2
	Severe, with pain expression, relieved after taking painkillers, affect daily activities	++	4
	Severe, cannot tolerate, completely bedridden, invalid after taking painkillers	+++	7
Vomiting	1–2 times every day, vomitus is mainly food, significantly improved after taking general antiemetic drugs, not affect daily activities	+	2
	3–4 times every day, vomitus is gastric juice, alleviated after taking general antiemetic drugs, affect daily activities	++	4
	≥ 5 times every day, completely bedridden, invalid after taking general antiemetic drugs	+++	7

Symptom		Grade	Score (points)
Others	Dizziness, nausea, chest tightness, shortness of breath, palpitation, dizziness, insomnia, lethargy, anorexia, abdominal distension, diarrohea, constipation, cyanotic lips, hands and feet numb	±	1

According to the total points of symptoms, the grading and scoring of AMS were performed as follows: without mountain sickness, 1–4 points; mild mountain sickness, 5–10 points; moderate mountain sickness, 11–15 points; severe mountain sickness, > 16 points (Table 3). The Cronbach's Alpha coefficient for reliability of mountain sickness scale was calculated as 0.760 (13).

Table 3: Grading and scoring of acute mountain sickness

Grade	Score
Without (±)	1–4 points
Mild (+)	Headache (+), vomiting (+) or totally 5−10 points
Moderate (++)	Headache (++), vomiting (++) or totally 11−15 points
Severe (+++)	Headache (+++), vomiting (+++) or totally more than 16 points

Assessment of state-trait anxiety

One day before arriving at the Tibet Plateau, subjects completed a self-assessed State ± Trait Anxiety Inventory (STAI) questionnaire. State and trait anxiety were measured using the STAI (Spielberger, Gorusch, Lushene, Vagg and Jacobs, 1983). Twenty statements assess state anxiety and twenty assess trait anxiety. For state anxiety they are asked to rate how they felt "at this moment", whereas for trait anxiety they were asked to rate how they felt "generally in life". For each statement, they reported how well the statement describes them on a four-point scale (from "almost never" to "almost always"). Half of the items were reverse scored and then summed separately for state and trait anxiety. Scores ranged from 20 to 80 with higher scores indicating higher levels of anxiety (14). Test ± retest reliabilities for the trait scale are high, ranging from 0.73 ± 0.86. Concurrent validity with other anxiety questionnaires ranged from 0.73 ± 0.85 (14).

Assessment of personality traits

The 3D feature of personality traits were assessed by trained psychiatrist, using personality traits scales from Eysenck personality questionnaire-Aault (EPQ-A) [88 items], which composed of four subscales: psychoticism (P), extraversion (E), neuroticism (N) and lie (L). EPQ had good construct validity, in which E and N were the most determined dimensions. The reliability coefficient of EPQ was satisfied. All subscales were re-examined within one-month interval, and the correlation coefficient was 0.83–0.90, with internal consistency coefficient of 0.68–0.81 (15).

Statistical analysis

After coding, all the answers were systematized in the common database and the following statistical analyses were performed: The Kolmogorov-Smirnoff Z test and confidence interval calculator were used to evaluate the sufficiency of the sample. The results were satisfactory: all the values belonged to normal distribution, which made them adequate for the subsequent statistical testing. Besides the usual parameters of central tendency (descriptive statistics: mean, standard deviation, extreme values); Pearson's Chi-squared, Kruskal-Wallis and one-way analysis of variance (ANOVA) with Bonfferoni *post hoc* correction test were used to show the differences in the scores obtained during the psychological and quality of life testing. The eventual correlations have been tested using Pearson's and Kendall's tau-b bivariate correlation coefficient. The entire testing was performed at 95% level of confidence.

RESULTS

Effect of state anxiety on acute mountain sickness

According to the state anxiety inventory (SAI) rating scales (Table 4), the score of SAI state of population with AMS was 46.17 ± 6.62, which was significantly higher than 40.63 ± 4.99 in healthy controls without AMS. Bonferroni *post hoc* correction emphasized AMS as the group with the highest scores of anxiety. The Kruskal-Wallis test outlined the differences in the distribution of patients based on the severity of anxiety and *post hoc* Chi-square emphasized the highest number of patients with the mild-to-severe anxiety in the group of AMS (Table 4).

Effects of trait anxiety on acute motion sickness

According to the trait anxiety inventory (TAI) rating scales, the score of SAI state of the population with AMS

Table 4: Self activity inventory scores in two groups

Group	SAI score	Without SAI	Mild SAI	Moderate SAI	Severe SAI
AMS (96)	46.17 ± 6.62†	16	16	23	41
Healthy control without AMS (93)	40.63 ± 4.99	39	34	17	4

AMS: Acute mountain sickness; SAI: self activity inventory
Post hoc Chi-square = 47.41; df = 3; $p = 0.000$.
†ANOVA: F = 42.88; df = 1, 187; $p = 0.000$.

was 47.74 ± 4.46, which was significantly higher than 38.71 ± 5.62 in the healthy control without AMS. Bonferroni *post hoc* correction emphasized AMS as the group with the highest scores of anxiety. The Kruskal-Wallis test outlined the differences in the distribution of patients based on the severity of anxiety and *post hoc* Chi-square emphasized the highest number of patients with the mild-to-severe anxiety in the group of AMS (Table 5).

Correlation analysis of state anxiety, trait anxiety, personality traits and acute motion sickness

As shown in Table 7, the Kendall's tau-b correlation coefficient of state anxiety, trait anxiety, neuroticism and extraversion with AMS ranged from 0.453 to 0.669 ($p < 0.0001$). Other items in the Eysenck test did not differ among the obtained groups.

Table 5: Trait anxiety inventory scores in two groups

Group	TAI score TAI	Without TAI	Mild TAI	Moderate TAI	Severe
AMS (96)	46.74 ± 4.46†	1	24	39	32
Healthy control without AMS (93)	38.71 ± 5.62 38.71 ± 5.62	55 55	19 19	16 16	3 3

Post hoc chi-square = 86.27; df = 3; $p = 0.000$. TAI: trait anxiety inventory
†ANOVA: F = 118.62; df = 1, 187; $p = 0.000$; AMS: Acute mountain sickness

Effects of personality traits on acute motion sickness

Personality traits test (Table 6) showed that, the neuroticism score and extraversion score in the AMS group were 12.01 ± 3.27 and 15.29 ± 2.33, respectively, which were significantly higher than healthy controls (6.11 ± 2.34 and 11.86 ± 2.69, respectively). There was no significant difference of psychoticism or life score between the two groups.

DISCUSSION

Acute mountain sickness is an acute responsive disease to high altitude due to insufficient acclimation and hypobaric hypoxia (16–19) and there is risk for development of HAPE and HACE if not treated effectively (20). In addition to the disorder of fluid homeostasis as one pathogenesis of AMS (21), recent studies have proposed that AMS was correlated with the activation of the sym-

Table 6: Eysenck personality traits in two groups

Groups	Neuroticism	Psychoticism	Extroversion	Lie
AMS (96)	12.01 ± 3.27†	4.53 ± 2.59	15.29 ± 2.33†	5.38 ± 1.68
Healthy controls without AMS (93)	6.11 ± 2.34†	4.26 ± 2.54	11.86 ± 2.69†	5.47 ± 1.45
Statistics (ANOVA, for all degrees of freedom 1, 187)	F = 201.14, $p = 0.000$	F = 0.495, NS	F=161.99, $p = 0.000$	F = -0.147, NS

AMS: Acute mountain sickness; †Bonferroni *post hoc* test: AMS and healthy controls differed at the level lower than 0.05.

pathetic nervous system which could be driven to large extent by the mood states, such as anxiety and stress. Anxiety/stress may provoke the functional disturbance of the central nervous system and result in disorders of important organs (22). Furthermore, some studies took notice of the overlap between the symptoms of AMS and the symptoms of severe anxiety (23). For example, Missoum *et al* found that more anxious people were more sensitive to the somatic symptom of hypoxia while patients with AMS were more anxious (24). Consistent with this proposal and previous studies, the present study using a self-assessment questionnaire indicated that the prevalence of anxiety at baseline in the AMS group was significantly higher than the non-AMS group, suggesting that subjects with anxiety are more prone to the development of AMS after entering high altitude without sufficient acclimation.

The Spielberger STAI is one of the most widely known self-report scales to measure anxiety and has been used extensively in the past decades as a research and clinical instrument (25). The STAI consists of two scales, one assessing the general tendency to be anxious as a personality trait (STAI-trait) and one measuring the degree of anxiety at a particular moment as a situation-dependent state (STAI-state). Both scales are useful in evaluating research results, with state scores differing between an intervention and control group and trait scores representing a subject's higher disposition to anxiety (25). Although the two scales are intended to measure two distinct dimensions of anxiety, there is overlap and a significant correlation between scales has been reported (26, 27). In fact, we observed a significant correlation ($r = 0.421$; $p < 0.001$) between our state and trait scores. This indicates that, the stressed state anxiety in the mountain environment is associated with the trait anxiety of the individual. The individuals both with state anxiety and trait anxiety in the mountain environment are susceptible to AMS, which should be particularly clinically managed.

Neuroticism was convincingly related to anxiety and depression, which is in keeping with the generally accepted idea that this personality trait makes individuals prone to exhibit psychopathological symptoms (28, 29).

We also found that higher levels of neuroticism were associated with increase likelihood of self-referral to AMS patients with anxiety, supporting the proposed association between neuroticism and AMS patients with anxiety. This indicates that, neuroticism is also one of the risk factors for AMS. When individuals with neuroticism go to Tibet area, there should be attempts to prevent AMS.

We found that higher levels of extraversion were associated with increased likelihood of self-referring to AMS patients with anxiety. It has been noticed that extraverted people are active, assertive and energetic, whereas individuals low in extraversion are quiet, reserved and shy (30). The tendency of extraverted individuals to be active and energetic might suggest a higher disposition to be involved in physical activities through the life span. This, in turn, might make them more prone to suffer from hypoxic injuries under intense physical training conditions, such as the ones in the present study. This indicates that, extraversion is also one of the risk factors for AMS. When the individuals with extraversion go to the Tibet area, activities should be reduced to prevent AMS.

In conclusion, the present study indicated that anxiety can facilitate the development of AMS. Considering the positive association between trait anxiety, neuroticism, extraversion and AMS, systemic health training and finding the people with high trait anxiety, neuroticism and extraversion is helpful to deal with this stress and decrease the risk of development of AMS.

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