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Analyses on the physio-psychological state of the expeditioners in Antarctica

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Abstract This study is to investigate the physio-psychological state of 23 male expeditioners before their going to Antarctica, after during their staying for 3, 6, 9, 12 months at Antarctica and after their returning respectively. The results show that EEG β-wave frequency, β-wave index and neurasthenic symptoms increased obviously during their stay at Antarctica ($P<0.05$, $P<0.01$). Mean scores of SAS and SDS were higher than those before their going ($P<0.05$). Significant prolongation of decode-time was found in 3, 6 months after staying at Antarctica ($P<0.05$). These results suggested that Antarctic environment may induce the change of EEG and psychological state.
Key words Antarctica, EEG, SAS, SDS, Decode-time.

1 Introduction

The 8-th Chinese National Antarctic Research Expedition left Qingdao harbour on Nov. 30, 1991 and arrived at Zhongshan Station, the base for Chinese science studies in Antarctica on Jan. 7, 1992. They left Antarctica on Feb. 28, 1993 and arrived at Shanghai port on April 6, 1993. Zhongshan station (69°22′40″S, 76°22′40″E) is located in the northeastern part of Antarctica. It is covered with snow and ice all the year round. The weather changs now and then. The aim of this paper is to investigate the physio-psychological changes of the expeditioners during their residing in Antarctica.

2 Method

23 healthy male expeditioners (from 23 to 54 years of age) were under investigation. They were scientists and skilled workers. Investigative items include: (1) Records of meteorological conditions at Zhongshan Station. (2) Records on EEG (electroencephalogram) and EOG (electrooculogram) of the expeditioners. (3) Investigation of neurasthenic symptoms. (4) Analyses on SAS (self-rating anxious scale) and SDS (self-rating depressive scale). (5) Examination on the mental working capacity (mental arithmetic and decode capacity). Physio-psychological states of expeditioners were estimated befor leaving for Antarctica, by the end of 3, 6, 9, 12 months residing in Antarctica and after return.

3 Results

3.1 *Meteorological records at Zhongshan Station*

Results are shown in Table 1.

Table 1. The meteorological records at Zhongshan Station during 1992

	Temperature (℃)	Humidity (%)	Wind velocity (m/s)	Windy (day)	Snowy (day)	Sunshine (h)
Jan. ~Mar.	−2.3(7.8~−16.3)	59.7	6.4	38	32	668.2
Apr. ~June	−16.7(−3.2~−36.3)	59.7	6.4	31	44	77.6
July~Sep.	−18.8(−0.9~−39.6)	55.3	7.1	45	35	164.6
Oct. ~Dec.	−6.4(3.6~−28.3)	59.3	6.6	37	48	723.7

3.2 *Analyses on EEG of the expeditioners*

EEG and EOG records were conducted with NEC San ei, medical multitelemeter (Model 511). All data were analyzed by ANOVAs with subsequent Newma-Keuls test. There were no significant differences in the frequency, amplituds and index of α-wave band and slow wave band among various time of testing, but the frequency and index of β-wave band increased during their stay in Antarctica, which were significantly different in comparison with those before departure ($P<0.05$, $P<0.01$). The analyses of β-wave band are shown in Table 2. The increase of β-wave frequency and index indicated the EEG desynchronization process of cerebral cortex was relatively strengthened.

Table 2. Analyses of β-wave band

Test time	Frequency (c/s)	Amplitude(μv)		Index(%)	
		$\bar{X}\pm S$	$lg\bar{X}\pm lgS$	$\bar{X}\pm S$	$lg\bar{X}\pm lgS$
Before departure	18.82±2.48	6.62±5.30	0.70±0.35	18.65±16.30	1.04±0.54
Stay for 3 months	20.50±2.27*	7.30±3.78	0.80±0.26	36.04±26.03	1.40±0.45**
Stay for 6 months	20.35±2.33*	7.17±3.36	0.80±0.25	36.29±22.83	1.42±0.43**
Stay for 9 months	20.35±2.33*	8.37±4.74	0.86±0.21	37.30±24.14	1.44±0.39**
Stay for 12 months	20.62±1.52*	8.00±3.76	0.85±0.19	43.84±28.00	1.50±0.41**
After return	19.80±1.85	7.12±2.95	0.82±0.16	30.39±23.42	1.26±0.57**

Compared with that before leaving for the Antarctica, * $P<0.05$, * * $P<0.01$.

3.3 *Analyses on neurasthenic symptoms of the expeditioners*

The neurasthenic symptoms mainly include dizziness, insomnia, fatigue, hyposthenia, hypomnesia and hypoprosexia. The scores of symptom are given in Table 3. The scores at the end of 6, 9, 12 months residing in Antarctica, as compared with those before departure, were increased significantly ($P<0.05$).

Table 3. Scores of neurasthenic symptoms ($\bar{X}\pm S$)

Test time	Dizziness	Insomnia	Fatigue	Hyposthenia	Hypomnesia	Hypoprosexia
Before departure	1.21±0.42	1.21±0.42	1.17±0.49	1.17±0.49	1.21±0.59	1.34±0.57
Stay for 3 months	1.08±0.28	1.43±0.57	1.43±0.58	1.34±0.64	1.43±0.72	1.65±0.57*
Stay for 6 months	1.26±0.54	1.73±0.68**	1.86±0.69**	1.39±0.58	1.56±0.66	1.73±0.68*
Stay for 9 months	1.43±0.58*	1.56±0.66*	1.73±0.75**	1.56±0.66*	1.78±0.67**	1.73±0.75*
Stay for 12 months	1.43±0.50*	1.73±0.68**	1.73±0.54**	1.47±0.59	1.82±0.71**	1.82±0.65*
After return	1.55±0.68*	1.43±0.48	2.00±0.64**	1.60±0.75*	1.99±0.72**	1.88±0.61*

Compared with that before leaving for the Antarctica, * $P<0.05$, * * $P<0.01$.

3.4 *Analyses on SAS and SDS of the expeditioners*

Scores of SAS (self-rating anxious scale) and SDS (self-rating depressive scale) of each expeditioners during their stay in Antarctica were higher than those before leaving for Antarctica. The increase at the end of 6 months residing in Antarctica was significant (Table 4).

Table 4. Analyses of SAS, SDS and the decode capacity ($\bar{X}\pm S$)

Test time	Anxiety (points)	Depression (points)	Decode-CRT (s)
Before departure	26.60±5.22	30.43±6.97	12.49±7.80
Stay for 3 months	27.95±5.04	32.82±7.54	15.38±10.70*
Stay for 6 months	30.30±6.67*	37.04±12.76*	14.20±5.53*
Stay for 9 months	29.13±4.71	33.69±9.62	13.52±6.61
Stay for 12 months	29.56±6.97	35.08±9.28	11.71±4.73
After return	31.32±7.62*	32.31±9.21	9.79±3.16*

Compared with that before leaving for the Antarctica, * $P<0.05$.

3.5 *Analyses on the mental working capacity of the expeditioners*

Measurements of the mental working capacity were conducted by using pocket computer (SHARP, PC-1500A). The correct reaction time (CRT) in the test of mental arithmetic capacity of each investigator was not different at varies time of experiment, but the decode CRT was prolonged ($P<0.05$) by the end of the third and sixth month while staying in Antarctica (Table 4).

4 Conclusion

The results show that under the environment in Antarctica, the physio-psychological state of the explorers may be altered. The frequency and index of β-wave, the score of neurasthenic symptoms and the scores of SAS and SDS increased relatively during their stay in Antarctica. The decode capacity decreased in the initial stage (Yu and Zhang, 1991). These changes of central nervous system were consistent in nature. The results indicate that the Antarctic working and living environment could affact the human

brain functions (Defayolle, 1985; McCormick, 1985; Leonard, 1989; Beatty, 1989). The EEG desynchronization process of cerebral cortex was relatively strengthened.

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