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A study on the effects of selected yogic exercises on psychophysicological functioning and tolerance to aviation stresses on seven healthy and motivated subjects was carried out. After twenty four weeks of yogic training, a statistically significant reduction in heart rate, blood pressure and weight were noticed. There was significant rise in alpha index better performance as psychomotor tests and increased +G tolerance. The findings suggest a tendency for better thermoregulation, cardiovascular functions and a part to play in increasing resistance to motion sickness.

Yogic Exercises—Study of Psychophysiological Factors

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Introduction

Yoga is an ancient Indian Science which has been considered as a means to attain and maintain psychological equilibrium against a variety of stresses. In the field of aviation the individuals are constantly exposed to various stresses with severe physiological and psychological demands placed on them. It has been reported that static exercises may be more useful in enhancing tolerance to aviation stresses as compared to endurance training. It is intended to select, rationalise and standardise certain yogic exercises, keeping in view the psychophysiological stresses to which an aviator is exposed. It is aimed to find out the role played by these yogic exercises in bringing about any psychophysiologic changes to the benefit of the individual towards better adjustment to aviation stresses.

Material and Methods

Seven healthy well motivated volunteers in the age group of 32-43 years (mean age 36.4 yrs) were taken for this study. Before starting the study, their general and systemic examination was carried out. Their base line parameters were recorded before commencement of yoga training. All these parameters were recorded in the morning before starting the days routine. The various parameters studied included the following :—

(a) Pulse, BP and weight

(b) ECG—12 leads

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(c) EEG—16 channels

(d) +I G tolerance

(e) 70° head up tilt (HUT) studies to assess orthostatic tolerance.

(f) Cold pressor test to assess overall cardiovascular reflex activity.

(g) Bicycle Ergometer—sub-maximal exercise on which oxygen consumption, ventilation and cardiovascular parameters have been recorded. Load given was 75 Watts for 8 mts.

(h) Exposure to heat stress (Oxford Index 38.7°C) 20 min Values reported on changes for Mean Skin Temperature (MST), Oral Temperature (OT), Mean Body Temperature (MBT), heart rate.

(i) Stressanlyser—performance on this test involves tracking and psychomotor coordination in general.

(j) Simple & choice reaction time tests.

(k) Flight oriented psychomotor test (FOPT)—Performance of this test involves comprehension, short term memory and gross psychomotor coordination.

(l) Flight Stressor Task—this involves vigilance task which simulates partially a flight emergency.

(m) Critical Flicker Fusion Frequency—This is an index of the subject's psychophysiological state.

The subjects were assessed on the above mentioned psychophysiological parameters which were recorded at approximately the same time of the day after six months of yogic training exercise.

The volunteers were subjected to the following asanas, five times a week, for a duration of one hour each time.

(a) Sithilikarans Vyama

(b) Suryanamaskar

(c) Standing posture :

(i) Ardhakati Chakrasana

(ii) Parsva Konasana

(iii) Ardha Chakrasana

(iv) Pada hastasana

(v) Parivatta trikonasana

(d) Uddiyana Bandha

(e) Sitting posture :

(i) Sasankasana

(ii) Ustrasana

(iii) Paschimatanasana

(iv) Padmasana

(v) Ardha Natsyendrasans

(f) Supine posture :

(i) Vipartikarani

(ii) Sarvangasana

(iii) Matsyasana

(iv) Halasana

(v) Chakrasana

(g) Prone posture :

(i) Bhujangasana

(ii) Salabhasana

(ii) Dhunurasana

(iv) Savasana

(v) Pranayama

Results and discussion

The results on various psychophysiological parameters (pre and post yoga) are given in tables I to IX. Tables are attached as an appendix.

Discussion

Yogic exercises improve the psychophysiological functioning of the body as they bring about equilibrium between autonomic responses. It is possible even to condition the higher nervous regions and through these functions of some of the internal organs which cannot be influenced volitionally.

Our study has shown significant fall in heart rate, systolic and diastolic BP (Table 1). Similar trends have been reported by Selvamurthy et. al. Datey et. al and Lakshmikanta et. al. Yoga has been utilised for the management of hypertension. Datey has suggested that yogic exercises influence the hypothalamus which maintains homeostasis via autonomic nervous system by reducing sympathetic activity. One of the subjects in this study had shown significant reduction in body weight after six months of yoga training (Table II). This could be attributed to certain degree of isometric muscular exercise. Udapa et al have observed correction of body weight in their study.

On bicycle ergometer, with submaximal exercise improved cardiovascular efficiency was noted after 24 weeks of yoga training. There was reduction in VO_2. max. ventilation, heart rate and blood pressure (Table VI).

On cold pressor test the post yoga recording after twenty four weeks showed lesser rise in heart rate and blood pressure as compared to pre training readings (Table - VIII). However tilttable test did not reveal any significant change (Table IX). Exposure to heat stress in the IAM hot cockpit showed trends of reduction of heat induced physiological strain after 24 weeks of yoga training (Table VII). These attribute to a better adjustment of the thermoregulatory mechanism. Bhatnagar et al and Selvamurthy[3] et al have also reported improvement in thermoregulation efficiency due to yogic training.

In our study subjects have shown significant increase in $+G_z$ tolerance (Table V). Epperson[4] in his study has reported that weight lifting exercise (upper extremity strengthening) has shown to improve $+G_z$ tolerance on volunteer centrifuge acceleration panel members. Added to this upper extremity development, exercise would seem appropriate to enhance support of neck which must rotate side to side during high G combat. At present there is no evidence that aerobic or endurance training enhances $+G_z$ tolerance. There is the possibility that this running or jogging type exercise which mainly increase lower extremity muscle mass, could lead to greater amount of venous pooling in lower extremetes which may lead to decreased $+G_z$ tolerance. In our study subjects have shown increase in $+G_z$ tolerance possibly on account of plenty of upper extremity and isometric pattern of yogic exercises involved in the yoga profile.

Two subjects developed symptoms of motion sickness in human centrifuge in pre yoga phase but no such symptoms were observed after six months of yoga training. This may be on account of vestibular habituation accorded by various yogic exercises. There is some evidence that gymnastic exercises which stimulate the vestibular apparatus e.g. tumbling and rolling on a mat or by means of a sophisticated gymnastic equipment (Dobie) reduce susceptibility to motion sickness. There is evidence to suggest, that ground vestibular exercises have a part to play in helping individual to achieve a state of habituation to motion and in maintaining that state (Popov).[7] Apart from vestibular habituation, optimisation of arousal might have contributed towards reduction of susceptibility to motion sickness.

Alpha state is one in which the brain is in awake and yet relaxed and peaceful state. Increase in alpha index observed in the present study may represent an enhanced and yet restful awake state following yogic exercises (Table II). The yogic exercises help the individual to condition their brain in such a way that the quick restoration of alpha state takes place following any departure from such restful, awake periods. The relaxation attendent to the alpha state could have had its beneficial effects in alleviating the normal daily stresses. This is evident to some extent from the enhanced sense of well being reported by the subjects.

Significant improvement was not noticed on performance on various psychomotor tests like stressanalyser, flight stressor task, flight oriented psychomotor test, reaction time test and CFF (Table II & IV). All the yogic postures involve the constant attention, concentration, alertness with

Table I

Physiological Parameters

	PRE YOGA MEAN±SD	POST YOGA MEAN ±SD	MEAN DIFF	SIG
HR/mt	68.1 ±8.8	63.1±7.0	-5.6	P<0.05
SYST BP mm Hg	135.7±8.5	125.1±6.7	-10.6	P<0.001
DIAST BP mm Hg	79.7±7.5	76.9±6.4	-2.8	P<0.05

Table II

Physiological Parameters

	PRE YOGA MEAN±SD	POST YOGA MEAN±SD	MEAN DIFF	SIG
Weight Kgs.	67.2±4.6	64.5±3.1	−2.7	P< 0.001
Alpha Index	40.7±7.5	52.9±8.9	+12.2	P<0.001

Table III

Phychological Tests

	PRE YOGA Mean ± SD	POST YOGA Mean ± SD	Mean diff.	Sig
Simple Reaction time in milli Sec.	293 ± 55	254 ± 31	− 39	P < 0.05
Choice Reaction time in milli Sec	396 ± 99	363 ± 99	− 33	P < 0.05
FOPT TRT in Sec	7.3 ± 1.3	6.7 ± 1.1	− 0.6	N.S.

Table IV

Psychological Tests

	PRE YOGA Mean ± SD	POST YOGA Mean ± SD	Mean Diff	Sig
NRC Stressanalyser TRT in Sec	191 ± 17	164 ± 15	— 27	$P < 0.01$
FST Average TRT in milli sec	26.25 ± 9.96	19.48 ± 7.48	— 6.77	$P < 0.01$
CFF Flicker rate/sec	36.3 ± 2.4	37.3 ± 1.7	1.0	$P < 0.05$

Table V

Reactions to + Gz

	PRE YOGA Mean ± SD	POST YOGA Mean ± SD	Mean diff	Sig
+ Gz Tolerance	3.62 ± 0.94	4.10 ± 80	0.48	$P < 0.05$
Incidence of Motion sickness in subjects	2/5	0/5	—	—

Table VI

Bicycle Ergometer

Sub maximal Exercise 75 Watts — 8 min

	PRE YOGA Mean ± SD	POST YOGA Mean ± SD	Mean diff	Sig
VO_2 (1)	1.22 ± 0.31	1.07 ± 0.31	— 0.15	NS
VE (L)	32.0 ± 4.8	28.3 ± 2.6	— 2.6	NS
HR (min)-1)	121.3 ± 12	115.7 ± 1.9	— 2.6	NS
Syst BP mm Hg	155.7 ± 8.3	149.7 ±12.8	— 6.0	NS
Diast BP mm Hg	85.8 ± 3.8	80.8 ± 7.2	— 5.0	NS

Table VII

Physiological Responses to Heat Stress

	PRE YOGA Mean ± SD	POST YOGA Mean ± SD	Mean diff	Sig
△MST°C	3.3 ± 0.2	3.4 ± 0.7	0.1	NS
△OT°C	0.9 ± 0.6	0.5 ± 0.3	0.4	NS
△BT°C	2.16 ± 0.44	1.56 ± 0.30	0.6	NS
△HR beats/min	2.4 ± 2.2	23.7 ± 9.7	— 0.3	NS

Table VIII

Cold Pressor Test

	PRE YOGA Mean ± SD	POST YOGA Mean ± SD	Mean diff	Sig
△HR/min	13.1 ± 10.1	6.5 ± 4.5	— 6.6	NS
△Syst BP	21.4 ± 5.2	18.7 ± 5.4	— 2.7	NS
△Diast BP	17.9 ± 2.8	18.4 ± 7.5	0.5	NS

Table IX

70° Hut Test

	Pre Yoga Mean ± SD	Post Yoga Mean ± SD	Mean diff	Sig
△ HR/mt	12.4 + 5.1	11.0 + 4.2	— 1.4	NS
△ Syst BP mm Hg	—3.6 ± 2.8	—1.2 ± 4.3	2.3	NS
△ Diast BP mm Hg	10.7 + 2.8	7.7 + 4.1	— 3.0	NS

simultaneous relaxation and precision in psychomotor coordination to pursuit of achieving an appropriate posture. These inherent factors in yogic exercises appear to have contributed to the better performance. Other factors like increases in alpha index, better hemispheric coherence and the concommitant sense of well being could have contributed to the increased performance efficiency after six months of yoga training.

Conclusion

The study suggests that yogic exercises influence the psychophysiological functions in a beneficial way. Yogic exercises appear to improve the mental and physical functioning of the body, bring about a balanced equilibrium between autonomic responses and conditioning of the higher nervous region possibly hypothalamo limbic region. However further studies on a large sample may throw more light on these aspects.

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