



Original Article

Physical and mental health at high altitude of individuals doing yogic practices

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ABSTRACT

Objectives: There is an increase trend in the past few years, in the number of people traveling to high altitude for recreational activities such as pilgrims, mountaineering, and climbing and for occupational purposes such as defense and mining which have resulted in increasing in hypoxia conditions and anxiety-related medical problems at high altitude. As it is known that mental stress affects brain and heart functions, a recent research performed on Sudarshan Kriya Yoga (SKY) further validated the effectiveness of SKY on participants (practicing SKY) as compared to control after quantifying mental stress. To study the physiological effect of SKY advance breathing technique when immediately ascends to high altitude, we wanted to study the level of stress and mental well-being of lowlanders at high altitude.

Materials and Methods: It is an interventional study performed at high altitudes, with lowlanders as participants where their biochemical and psychological parameters are being assessed.

Results: The result for biochemical parameter cholesterol, triglycerides, low-density lipoproteins (LDLs), high-density lipoproteins (HDLs), very low-density lipoproteins, LDL-HDL ratio, and cholesterol-HDL ratio showed a significant decrease in the pre- and post-analyses values with $P \leq 0.001$. Acute mountain sickness (AMS), Warwick-Edinburgh Mental Well-being Scale, and State and Trait Anxiety Inventory (STAI) also show a decreasing trend with significant result in AMS, mental well-being, and non-significant in STAI p value is $P = 0.016$, $P = 0.055$, and $P = 0.125$, respectively.

Conclusion: We observed positive outcome both in for biochemical and stress-related parameters with SKY advance program practitioners who have rapidly ascend to high altitude.

Keywords: Mind-body therapies, Physiological stress, Mental health, Altitude sickness

INTRODUCTION

As there has been a constant increase in the number of people traveling to high altitude for recreational activities such as pilgrims, mountaineering, and climbing and for occupational purposes such as defense and mining which results in increasing in hypoxia conditions and anxiety-related medical problem at high altitude.^[1] Sudden ascend of lowlander to high altitude change the mood, behavior, and disability of cognitive functioning of an individual can lead to accidents.^[2,3] The research also proves that when lowlanders move to high altitude mental instability increases, leading to increase in depression, anxiety also revealing high level of lipid profile having higher level of cholesterol, triglycerides, and low-density lipoprotein (LDL).^[4-8] Studies also demonstrate at lipid profile and stress, have strong correlation individuals with high stress levels, and have

higher cholesterol, triglycerides, and LDL.^[9,10] It has been recognized that there is a change in the psychological mood, behavior, personality, cognitive functioning, and sleeping pattern as ascend to high altitude.^[11,12] There have been several studies performed on hypoxia condition but few performed on mental instability at high altitude over the past decade but the real cause is still unknown. Another study conducted using cognitive screening test on adapted lowlanders staying at high altitudes since more than 1 year, indicated the increase in percentage of the prevalence rate of mild cognitive impairment, decline in working memory, and imbalance in mind-body coordination.^[13]

Meditation, *yogic*, and other mind-body techniques (MBTs) are fast drawing attention as preventive and affordable non-pharmacological interventions. However, the adequate investigations have not been carried yet on the mechanisms

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by which these techniques bring relief. These approaches include re-emerging breathing exercises such as *Pranayama*, *Yogasanas*, and *Sudarshan Kriya Yoga (SKY)* which ensures aiding immunity. As it is known that mental stress affects brain and heart functions, a recent research on SKY further validated the effectiveness of SKY on participants (practicing SKY) as compared to control after quantifying mental stress. Results suggested that SKY is a good alternative of medication for stress management as it helps in the improvement of human stress tolerance and enhancement of the cognitive performance in case of participants.^[14] The study carried out by Kjellgren *et al.* involved 103 Swedish individuals, 55 in *Sudarshan Kriya (SKY)* and *Pranayama (P)* group, and 48 individuals in the control group. Control group simply relaxed, while SKY and P group was involved in Yoga. At the end of 6 weeks, participants in SKY and P were found to have lower degree of anxiety, depression, and stress as compared to control.^[15,16] In this pilot study, we wanted to observe the physiological effect of SKY advance program when lowlanders ascend to high altitude, we also wanted to analysis stress level and mental well-being in lowlanders when immediate ascend to high altitude.

MATERIALS AND METHODS

We enrolled 29 men and women who have travelled to Kailash Mansarovar an altitude of more than 6600 m (20,000 ft) above the sea level in flight, as per the defined inclusion and exclusion criteria. The participants were enrolled by the art of living (AOL) who have been SKY practitioners, who have completed SKY basic program, and who have enrolled themselves for the Advanced Meditation Program carried out in Kailash Mansarovar, Tibet. All the participants were recruited at the high altitude only. The advance SKY protocol is for 4 days started at 5.00 am till late evening 8.00 pm and vegetarian diet (Satvik food) was served. Satvik food is high on “*prana*” which includes fresh fruits, vegetables, and cooked food which are consumed within 8 h.^[17,18] This study was approved by the Ethics Committee of Swami Vivekananda Yoga Anushandhan Samsthan (SVYASA) University, Bengaluru, India RES/IEC-SVYASA/165/2020 and Sri Sri Institute of Advanced Research (SSIAR), Bengaluru, India (vide SSIAR/IEC/05). Healthy participants (male and female) in the age group of 20–65 years who had prior SKY meditation experience and completed SKY basic program were enrolled in the study. Anyone with any comorbidities were excluded from the study. The written informed consent and air mode of transportation were considered mandatory for inclusion. However, subjects with comorbidities including major surgery, diabetes, hypertension, cardiovascular disease, chronic liver, and kidney disease traveled by road to high altitude were excluded from the study.

Intervention

The 4-day protocol has *asana's* (Suryanamaskar along with a set of other supine, sitting, and standing *asana* called

padmasadhana), *pranayama (Nadi Shodhan/Anulom-Vilom, Kapalabhaati, Brahmari Pranayama* followed by *Ujjayi, Bhastrika*, and SKY), and guided meditations, also including silence, nature walk, and had spiritual music prayer meetings which was followed under the strict supervision of authorized teachers by AOL.^[19-21]

Assessment

Biochemical Assessment: Biochemical assessment of cholesterol, triglycerides, high-density lipoproteins (HDLs), LDL, and very low-density lipoproteins (VLDLs) carried out by a certified diagnostic laboratory using standard diagnostic test for lipid profile. The blood was collected by a phlebotomist and facs tubes used for efficient transport to a standard diagnostic laboratory.

Psychological assessment

State anxiety measured using a subscale of State and Trait Anxiety Inventory (STAI) developed by Spielberger *et al.* (1983). The test analysis of four levels of anxiety from 1 to 4 where 1 being “not at all” to 4 being “very much” with total score ranging from 20 to 80. There are 20 questions divided into two parts; 10 questions to analysis the presence of anxiety and other 10 questions measure the absence of anxiety.^[22]

The Warwick-Edinburgh Mental Well-being Scale (WEMWBS): WEMWBS is used to assess the mental well-being (positive mental health) of the participants. It is a scale of 14 positively worded items, with five response categories, from “none of the time” being “1” to “all the time” being “5” score ranging from 14 to 70. These questions cover feeling and functioning aspects of mental well-being of a participant.^[23]

Analysis

Participants were analyzed at 2 time points at the time when they reached the high altitude and on the end of the 4th day of the camp. All participants were enrolled at high altitude. Analysis was performed on SPSS 21 software. The most commonly reported statistical method paired sample *t*-test was carried to do the analysis; which was summarized as mean \pm standard deviation. The results were presented as 95% confidence intervals. The significance level was established at $P < 0.05$.

RESULTS

There were total of 29 participants into the study, they all are SKY practitioners for at least 1 year with average age 43 ± 8.73 .

	Pre mean \pm SD
N	29
Age	43 \pm 8.73
Sex ratio	m=12 (41.38%), f=17 (58.62%)

Table 1: Mean and standard deviations at 2 time points before and after the intervention.

Parameter	n	Mean±SD	Mean±SD	95% Confidence interval of the difference	t	P-value
Cholesterol (mg/dl)	29	252.31±46.56	198.38±53.46	35.33–72.53	5.94	<0.001*
Triglycerides (mg/dl)	28	159.82±45.61	124.68±46.85	18.6–51.69	4.36	<0.001*
Low-density lipoproteins (mg/dl)	24	169.76±38.39	118.89±40.53	33.5–68.24	6.06	<0.001*
High-density lipoproteins (mg/dl)	28	38.07±5.15	39.61±5.28	–3.51	–1.8	0.083
Very low-density lipoproteins (mg/dl)	28	31.96±9.12	24.94±9.37	3.72–10.34	4.36	<0.001*
Low-density lipoproteins/high-density lipoprotein (ratio)	24	4.36±1.53	3.02±1.13	0.76–1.92	4.78	<0.001*
Cholesterol/high-density lipoproteins (ratio)	28	6.84±1.69	5.2±1.72	1.06–2.22	5.84	<0.001*
AMS	6	5.67±3.33	1.67±1.63	1.11–6.89	3.55	0.016
STAI	6	41±10.06	30.33±5.16	–29.76	1.84	0.125
WEMWBS	8	56.13±5.22	62.25±9.18	–12.59	–2.3	0.055

*AMS: Acute mountain sickness, STAI: State and Trait Anxiety Inventory, WEMWBS: Warwick-Edinburgh Mental Well-being Scale

The result shown in Table 1 for biochemical parameter cholesterol, triglycerides, LDLs, HDLs, VLDLs, LDL-HDL ratio, and cholesterol-HDL ratio showed a significant decrease in the pre- and post-analyses values with $P \leq 0.001$ except HDL is increased bit with non-significant effect where $P = 0.083$ which is non-significant. Acute mountain sickness (AMS), STAI, and WEMWBS, the questioner by the participants, were not filled properly so only six and eight participants, respectively, could be considered in this pilot batch. Result related to psychological assessment including AMS, WEMWBS, and STAI shows a positive decreasing trend with significant result in AMS, mental well-being, and non-significant in STAI but positive decreasing trend with p value is $P = 0.016$, $p=0.055$, and $P = 0.125$, respectively. The STAI is non-significant as the sample size is small.

DISCUSSION

The previous studies reveal that when lowlander ascends to high altitude, there is an increase in the lipid profile parameters such as cholesterol, triglycerides, and HDL.^[6-8] Studies also indicating that yogic practices performed at high altitude facilitates improvement in health as compared to other exercise forms and has positive effect on biochemical parameters.^[20,24] After yogic breathing, similar results are being reflected in our study, all the lipid profile parameters are showing that a significant decline except HDL is increased with non-significant effect. Percentage of AMS is higher in the lowlanders accompanied with high-altitude individuals as per previous studies.^[25] Yogic practices such as asana and

pranayama help in better acclimatization with prevention of high-altitude disease such as AMS, sleep disorders, and SpO₂ have already been proven,^[24,26-29] there is a significant decrease in the AMS score of lowlanders $5.67 \pm 3.33 - 1.67 \pm 1.63$ in our study justifying to the previous results that yogic practices helping in acclimatization and disease management at high altitude. In the prior studies, it has been observed that with altitude, there is a change in mood followed by depression, which makes the person irritable and quarrelsome with no pre-training^[30] whereas when the participants are motivated and trained for long duration mission at high altitude then performance of individual is high, mood swing is less.^[31] The study carried out in 2007 also reports anxiety-related illness in lowlanders without any previous history of the same at low altitude and mental well-being also gets disturbed when ascends to high altitude.^[32,33] In emergency situation like war when army and other official need to ascend to high altitude without any preparation in those circumstances and emergency situation if army practices, mind-body practices such as SKY will show positive result and help in better and faster acclimatization. The same has been shown in our study where the participants are not prepared for high altitude and they are showing better state of anxiety and mental well-being as anxiety parameter show a decline and mental well-being shows an improvement as they have been SKY meditations practitioners. The previous studies prove that SKY breathing technique and other MBTs help manage stress and increase the happiness index in the individuals.^[34,35]

Strength and limitations

The strength in our study is we have taken participants at very high altitude for 4 days and then observed the changes. The limitation is that it is pilot data, the sample size is small, and limitation of getting samples at Kailash Mansarovar, we could not have a control group.

CONCLUSION

We have observed positive results in SKY advance program practitioners who have immediate ascend to high altitude. As this is pilot data and sample size is small so further research is needed to define the epidemiology of anxiety-related disorders and lipid profile at high altitude, to quantify the contributions of various etiologic factors, and to identify safe and effective treatments.

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Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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