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EFFECT OF YOGA ON ACCLIMATISATION AND ATTRITION OF MANPOWER DUE TO HIGH ALTITUDE ILLNESS IN HIGH ALTITUDE AREA

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ABSTRACT Personnel working at high altitude face peculiar health problems because of harsh unfriendly environment. These occur with increase in the altitude because of decrease in atmospheric pressure resulting in decreased availability of oxygen. This condition is called **hypobaric hypoxia**. The significance is amplified further because of the fact that human efficiency also reduces considerably at higher altitudes. Thus, when an organization loses trained manpower on account of de-induction due to high altitude illness, there is a considerable impact on the organizational functioning. **Yoga** is our ancient Indian cult and way of life which is claimed to endow perfect physical and mental health to its practitioner. Yogic exercises have been shown to improve physiological and biochemical status in high altitude. [1]. There are however no studies available wherein the effect of yoga on attrition of manpower due to high altitude illness during acclimatization has been assessed. The objectives of the present study is to study the effect of Yoga on inductees during acclimatization and its impact on attrition of manpower.

KEYWORDS : High altitude area, high altitude illness, acclimatization, attrition, yoga

Yoga is our ancient Indian cult and way of life which is claimed to endow perfect physical and mental health to its practitioner. A 3000 year old tradition, Yoga is recognized as a form of mind-body medicine that integrates an individual's physical, mental and spiritual components to improve aspects of health, particularly stress related illnesses. Evidence shows that stress contributes to the etiology of heart disease, cancer, and stroke as well as other chronic conditions and diseases. The scientific study of yoga has increased substantially in recent years and many clinical trials have assessed its therapeutic effects and benefits.[2] Yoga induces long-term changes in respiratory function and control. Caucasian subjects practicing yoga maintain a satisfactory oxygen transport at high altitude, with minimal increase in ventilation and with reduced hematological changes, resembling Himalayan natives. It is seen that respiratory adaptations induced by the practice of yoga may represent an efficient strategy to cope with altitude-induced hypoxia.[3] The effects of Yoga (Pranayama) on lung function and lactate kinetics in sedentary adults at intermediate altitude has also been demonstrated.[4]

Personnel working at high altitude face peculiar health problems because of the harsh unfriendly environment. These occur with increase in the altitude because of decrease in atmospheric pressure resulting in decreased availability of oxygen. This condition is called **hypobaric hypoxia**. The environmental factors at higher altitudes that accentuate illness/ affect efficiency are –

(a) Severe cold with high wind velocity
(b) Low humidity
(c) Increased ultraviolet and solar radiation
(d) Difficult terrain
(e) Severe cold with high wind velocity
(f) Low humidity
(g) Increased ultraviolet and solar radiation
(h) Difficult terrain

Health hazards in high altitude (HA): The health hazards encountered at high altitude (HA) that cause attrition of manpower are –

(a) AMS
(b) High Altitude Pulmonary Oedema (HAPO) - potentially fatal
(c) High Altitude Cerebral Oedema (HACO) - potentially fatal
(d) Pulmonary Arterial Hypertension of HA
(e) Thrombotic Episodes -

The incidence of thrombotic episodes is directly related to the altitude and so is more common at extreme altitude. These episode include thrombophlebitis pulmonary thromboembolism and cerebrovascular accidents due to cerebral thrombosis. The basis for these include the polycythaemia which increases blood viscosity and the hypercoagulable state at HA. This hypercoagulable state is due to raised levels of factor X and XII as well as an increased platelet count. This is further aggravated by the dehydration due to increased water loss through the increased ventilation and by the enforced inactivity during extreme cold.

Thrombotic episodes have been implicated in the genesis of HAPO, HACO and pulmonary arterial hypertension of HA. Pulmonary embolisms are more common at extreme altitude and the presentation is similar to that of HAPO however, HAPO is relatively less common at extreme altitudes as mentioned earlier.

The management of these conditions include administration of oxygen and evacuation to the nearest hospital/field ambulance where definitive therapy can be initiated. Imbibing of fluids liberality is advocate, particularly at extreme altitudes, to help prevent these episodes.

(f) High Altitude Induced Systemic Hypertension (HAISH).
At high altitudes, enhanced sympathetic activity and other physiological changes may lead to a transient rise in blood pressure of both systolic and diastolic levels that rarely reaches dangerously high levels. However, during the acclimatization phase in most of the cases this rise in systolic and diastolic blood pressure comes back to within normal limits. In some cases the systolic and diastolic blood pressure continue to remain high and require de-induction to lower heights.

High Altitude Induced Systemic Hypertension (HAISH) is encountered frequently but needs to be established as a significant clinical entity in the morbid conditions of High Altitude Illnesses. It has been observed that HAISH is one of the major causes for attrition / de-induction of persons who are undergoing acclimatization or even those fully acclimatized thereby causing an extra morbidity in high altitude.

(g) Cold Injuries - Once a person has acclimatized to altitude, cold injuries are generally the greatest threat. Frequent winds cause extremely low temperatures due to wind-chill factor. Moreover, performing duties in snow bound areas and poor judgment due to hypoxia induced psychological effects can result in poor decision making and higher incidence of cold injuries.

(h) Injuries caused by Sunlight. The potential for solar radiation injuries is significant at high altitudes due to increased ultraviolet (UV) radiation (resulting from thinner atmosphere), and reflection of

light from snow and rock surfaces. Solar radiation injuries can be severe and occur with much shorter exposure at high altitude. Injuries include sun burn and snow blindness.

(I) Terrain Injuries - Soldiers, villagers, mountaineers and tourists are at increased risk to injuries, accidents, falls, lightning, avalanches etc due to harsh terrain, frequent poor visibility due to clouds, poor judgment etc at high altitude.

(j) Carbon Monoxide (CO) Poisoning is a frequent hazard and is caused by the inefficient fuel combustion resulting from the low oxygen content of air and higher usage of stoves, combustion heaters i.e. bukharies in enclosed, poorly ventilated spaces.

(k) Other Problems at HA
- Chronic Mountain Sickness
- High Altitude Retinopathy

Impact of Attrition of manpower in an organization in high altitude:
The effects of high altitude adversities are of considerable importance since the attrition will interfere with the working efficiency of an organization because of various altitude related ailments. The significance is amplified further because of the fact that human efficiency also reduces considerably at higher altitudes. The objectives of the present study is to study the effect of Yoga on inductees on acclimatization and its impact on attrition of manpower due to high altitude illness.

Acclimatisation Schedule: Acclimatisation is carried out in 3 successive stages depending on the height where the individual is ultimately going to stay and perform duties -

(a) **First stage of acclimatization:** This is applicable to individuals posted between height 2700m to 3600m. The acclimatization period will be 6 days as under -

(i) First and Second day: Rest, except for short walks in the unit lines only, not involving any climbs.
(ii) Third and Fourth day: Walk at slow pace for 1.5 to 3 km. avoid steep climbs.
(iii) Fifth and Sixth day: Walk up to 5 km and climb upto 300 mtrs at a slow pace.
(b) Second Stage of Acclimatization: (Above 3600m and up to 4500m) This is carried out for 4 days as under -
(i) First and Second days: Slow walk for distance for 1.5 to 3 km, avoid steep climbs.
(ii) Third day: Slow walk and climb up to 300m.
(iii) Fourth day: Climb 300m without equipment.

(c) Third Stage of Acclimatization: (Above 4500m) This also lasts for 4 days and is on the same lines as second stage of acclimatization.

Re-entry into high altitude: Fully acclimatized individuals who have left high altitude area require acclimatization again on re-entering to high altitude, if they are away for more than 10 days. Individuals, who are away for more than 4 weeks, require complete acclimatization as state in the para 2 (a) above. Those who have been away from more then 10 days, but less than 4 weeks, have acclimatization for 4 days at each stage as under -

(a) First and Second day: Rest, except short walk.
(b) Third day: Walk at slow pace for 1 to 2 km. Avoid steep climb.
(c) Fourth day: Walk for 1 to 2 km, climb up to 300m.

Activity on day 3 to 6 after arrival has been defined as Do's and Don'ts.

The following activities are not be permitted from day 3 to 6 in the acclimatization schedule:-
- No strenuous work.
- No lifting of weights.
- No extreme physical exertion

Strict medical monitoring is done and those who did not achieve the minimum physiological parameters as below were de-inducted to lower heights by referrals to hospital as per protocol, so as to prevent morbidities. The minimum physiological parameters to be achieved during acclimatization at various altitudes is as under –

(a) Physiological parameters –
(I) At 10000 ft :-
- Spo2 >92 % at room air
- RR rate < 24/min
- BP < 140/90

(ii) At 15000 ft :-
- Spo2 > 88-90 % at room air at rest
- RR rate < 24/min at rest
- BP < 140/90
- Normal ECG

It has been observed that HAISH is one of the major causes for attrition / de- induction of persons who are undergoing acclimatization or even those fully acclimatized thereby causing an extra morbidity in high altitude. High Altitude Induced Systemic Hypertension (HAISH) is encountered frequently but needs to be established as a significant clinical entity in the morbid conditions of High Altitude Illnesses.

Yoga is our ancient Indian cult and way of life which is claimed to endow perfect physical and mental health to its practitioner. The studies suggest that yogic exercises have significant impact on physiological and biochemical parameters in high altitude.

The present study introduces yogic practices by trained instructors in the acclimatization schedule and analyzes the data of attrition due to morbidity and mortality in high altitude.

Methodology
All the inductees were inducted to high altitude in East Sikkim through the JNM axis and Zuluk axis where first stage acclimatization was carried out. Before starting this protocol of introducing yoga during acclimatization, a group of yoga teachers were sent to Patanjali, Dehradun who were specially trained for yogic asanas which help in high altitude i.e. pranayama, anulom-vilom, kapalbhati, bhasrika, other breathing and stress relieving asanas. These trained yoga instructors were employed to train the inductees during the 06 days of first stage of acclimatization in the form of asanas and pranayama daily for 30 minutes each morning and evening. The subjects continued to perform these yogic exercise regularly besides following the routine of acclimatization at first stage.

The protocol was implemented for 03 months and the inductees were closely monitored. A person who was initially normotensive but showed consistently high systolic or diastolic pressure for 6 days of stage 1 of acclimatization, was put through two more days initially i.e. total 08 days and then further two more days of acclimatization at the same height i.e. total 10 days. Yogic exercises like Pranayam, Kapalbhati, other breathing and stress relieving exercises along with restricted salt diet was continued for all those in this extension period and record of medical examination maintained. However, at the end of total 10 days acclimatization at stage 1 any inductee, if found to remain hypertensive or not meeting the criteria, were finally de-inducted to the hospital at lower altitude i.e. Gangtok.

At lower altitudes, if the patient remained normotensive without any active medical treatment and found normal on bio-chemical parameters, he/she was re-inducted to the high altitude area through the same regimen of acclimatization. However, if the patient again developed hypertension on re-induction, they were

diagnosed as high altitude induced systemic hypertension (HAISH). In the routine the personnel who had achieved normal physiological parameters at the end of 06 days were inducted to second stage with advice to continue the yogic exercises as in the first stage. The personnel who did not show signs of any high altitude illness but did not achieve normal physiological parameters were detained at first stage for 02 days first as **Extension I** and then 02 extra days if still not fit at first stage as **Extension II,** instead of de-inducting them to lower altitude. They were made to continue yogic exercises twice daily for 30 minutes and physiological parameters closely monitored. Those personnel who had signs and symptoms of any high altitude illness were however referred to hospital for treatment as per protocol.

Results

The physiological parameters of **4427** inductees at **first stage** were monitored at 17 Mile Stone Transit camp, JNM axis and at Zuluk Transit camp and is as per the **Table 1**.

Table 1 - Effect of Yoga and extension on Acclimatization

	No of individuals participated	Unfit for induction	Cumulative Attrition	Fit for induction	Cumulative No of individuals fit
Initial 6 days of acclimatization training	4427 (100%)	247+160*	160 (3.77%)	4120 (90.94%)	4120 (90.94%)
Eight days of acclimatization training	247 (9.06%)	60+16*	176(3.97%)	171 (3.88%)	4191 (94.66%)
Ten days of acclimatization training	60 (1.36%)	12*	188(4.24%)	48(1.08%)	4239 (95.75%)
Final Remarks	4427(100%)		188(4.24%)	4239(95.75%)	4239(95.75%)
* No of individuals were de inducted from high altitude at this stage of study due to high altitude related illnesses					

A total of 4427 individuals were inducted to high altitude during study period. After six days of training for acclimatization to high altitude, a total of 4120 (90.94%) individuals were found to be physically fit for induction into high altitude based on assessment of their physiological parameters. A total of 307 (9.06%) of individuals were found to be unfit for induction. Out of 307 individuals, 60 (3.77%) individuals were de inducted from high altitude due to high related illnesses. For balance 247 individuals, acclimatization was extended to 8 days i.e. Extension I and Extension II at first stage.

A total of 247 individuals underwent acclimatization for 8 days (6 + 2). After eight days of training, 171 out of 247 individuals were found to be physically fit for induction and 76 individuals were found to be unfit for further induction. Cumulative no of individuals fit for induction into high altitude at this stage was 4191 (94.66%). Out of 76 unfit individuals, 16 individuals were de inducted from high altitude due to high altitude related illnesses. Cumulative attrition of manpower due to high altitude related illnesses at this stage of study was 176 (3.97%).

Acclimatization was further extended to two more days (6 + 2 + 2) for those who were found physically unfit during 08 days of acclimatization.

A total of 60 individuals (3.04 %) underwent acclimatization for 10 days. After ten days of training, 48 out of 60 individuals were found to be physically fit for induction and cumulative no of individuals fit for induction into high altitude was 4239 (95.75%) and total no of individuals unfit for induction was 188 (4.24%). All the individuals de-inducted during acclimatization were found to be unfit because of high altitude induced systemic hypertension.

On extension of acclimatization, there was gradual gain of manpower to the organization and attrition rate of manpower gradually reduced in each stage. The rate of reduction in attrition rate with each stage of acclimatization was statistically highly significant ($p<0.01$).

Recommendation

Practice of yogic exercise (asanas and pranayama) in inductees facilitate better acclimatization and help to prevent HAISH which attributed to major attrition of manpower. These exercises may be easily practiced in the available living place where there may be even lack of space due to terrain constraints at high altitudes.

In view of these, it is recommended that yogic exercise may be continued at high altitude at all stages.

Conclusion

Yogic exercise (asanas and pranayama) in inductees facilitate better acclimatization and help to prevent altitude illness such as HAISH, AMS and HAPO etc. These exercises may be easily practiced in the living place which lack space and mobility due to terrain constraints at high altitudes.

Total fitness of inductees increased from 90.94%% to 95.75%. The fitness of inductees can therefore be increased by approximately 5% by inclusion of yogic exercises and extension of duration of acclimatization by 4 days in high altitude area thereby reducing attrition of manpower in an organization from 12.83% to 4.24%. The reduction in attrition rate is statistically highly significant ($p<0.01$).

REFERENCES

1. Himashree, Gidugu & Mohan, Latika & Singh, Yogesh. (2016). Yoga Practice Improves Physiological and Biochemical Status at High Altitudes: A Prospective Case-control Study. Alternative therapies in health and medicine. 22. 53-59.
2. Woodyard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. Int J Yoga. 2011;4(2):49-54.
3. Bernardi, L, Passino, C, Spadacini, G et al. Reduced hypoxic ventilatory response with preserved blood oxygenation in yoga trainees and Himalayan Buddhist monks at altitude: evidence of a different adaptive strategy. Eur J Appl Physiology. (2007) 99: 511.
4. Fernando Benavides-Pinzón, William & Luis Torres, José. (2017). Effects of yoga (Pranayama) on lung function and lactate kinetics in sedentary adults at intermediate altitude. Revista de la Facultad de Medicina. 65. 467-472.