



RESEARCH ARTICLE

EFFECTIVENESS OF YOGA AS AN INTERVENTION IN MITIGATION OF OCCUPATIONAL STRESS AMONG SAFETY CRITICAL TRAIN OPERATION STAFF ON INDIAN RAILWAYS

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ABSTRACT:

Occupational stress among train operation staff is a matter of concern because its consequences are related with safety of the travelling passengers. Present paper discusses the two studies conducted by Psycho-Technical Directorate of Research, Designs and Standards Organization (RDSO), Ministry of Railways on train operation staffs of Indian Railways with an objective of probing effectiveness of Yoga in mitigation of work-related stress. First part of this study was conducted to understand the nature of job stress among the Drivers and the Assistant Station Masters, which revealed that Assistant Station Masters were more stressful and stress arising out of their assigned jobs was inversely related with their job satisfaction, performance rating and mental and physical health. Second part of the study aimed to study effectiveness of the intervention of Yoga techniques in reducing stress levels under able guidance of the expert practitioners. Pre and post Yoga results indicated positive impact of Yoga on physical, mental and cognitive health of the employees.

INTRODUCTION: Indian Railways is one of the largest transportation and logistics networks of the world and runs more than 12,000 passenger carrying trains carrying over 23 million passengers per day and more than 7,000 freight trains per day carrying over 3 million tonnes of freight every day over a network of 65,000 route kilometers. Its traffic density is third largest in the world and its safety record in terms of accidents per million train kilometers is around 0.20 and fatalities per billion Passenger km 0.147, both favorably comparable with that of advanced European Railways systems. Efficiency in round the clock operation of such a huge volume of traffic safely in an intricate system of Railways depends largely on the efficiency of train operation staff responsible for running these trains.

Stress among them becomes a matter of concern when strenuous working conditions, varying conditions of work and low levels of job satisfaction are perceived as threats and stressors by the employees. Across most of the organizational set ups workloads, working conditions and relationship at workplace become the main factors that lead to stress, which if not managed appropriately, can have detrimental effects on wellbeing of the employees and these serious consequences on physical and mental health may lead to adverse impact on organizational efficiency and productivity. It usually occurs when there is mismatch between the demands of a job and the resources and capabilities of an individual worker to meet the demands. The degree of stress an individual experiences generally depends upon his own appraisal of the demands of his work and this subjective appraisal gets affected by a variety of socioeconomic and psychological factors including personality attributes and many of them may not be directly related to the job. Prevalence of stress in working environment either due to work overload or due to some other reason adversely affects the abilities of employees to concentrate on

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the assigned job and make appropriate decisions and those who get stressed feel a lack of control over their circumstances and ignore safety procedures leading to unsafe working and accidents.

Since occupational stress is an integral part of organizational working and has negative impact on employees and organizations, it has extensively been studied in different organizations all over the world, but studied scarcely taking into consideration the safety critical train operation staff on Indian Railways. Management of work related stress in this particular group is of paramount importance because they remain directly involved in safe operation of trains and infringement of safety precautions lead to serious consequences involving loss of human lives. Although various strategies are undertaken to manage stress in an organizational set up, stress management at individual level is very important not only for maintaining good physical and mental health but also for establishing healthy interpersonal relations in the organization to nurture a good teamwork.

Among a range of strategies being adopted by organizations in managing occupational stress, the approach of inculcating benefits of strategies that could be imbibed by employees and adopted as a part of daily life activities in mitigating work-related stress may prove to be of great help. In this perspective Yoga, that originated in ancient India thousands of years ago and practiced since then, now all over the world, has proved very useful in keeping both physical and mental health in good fettle. This paper presents effectiveness of Yoga intervention as one of the most crucial strategies in reduction and prevention of stress.

Occupational Stress in Train Operation Staff:

Stress directly impacts the performance of train operations staff and thus it is essential to understand the causes of stress so that it could be alleviated to the extent possible. The job of train operation staff is strenuous in nature endowed with various stress inducing factors including long duty hours, irregularity of work, continuous monitoring, negative work-life relationship, uncongenial work environment with heavy noise, vibration, dust, excess heat, high voltage electricity etc. Literature

with regard to stress among train operations staffs is limited. Wang et al. (2012) suggested that highly educated drivers in the age group of 26 to 35 years feel greater pressure during work. The factors of occupational stress cause negative mood, but reward, self-esteem, social support and coping strategy are mood protective factors.

Different train drivers may have different occupational stress status and may exhibit different mood status, e.g. high speed train drivers the worst and other trains drivers the best. Effort-reward imbalance, psychological needs, work responsibilities, job roles, work conflict and physical environment have been found to be important factors of occupational stress and social support has been an important stress mitigating factor for the train drivers (Zhou, Gu, Wu, & Yu, 2014 a & b). Environmental factors, collision with people and animals resulting in their injury or death are other important issues which train drivers are concerned about (Mazloumi, Kazemi, Saraji, Hosseini & Barideh, 2014). Train accidents and observing suicides also cause stress among train drivers and increase likelihood of developing post-traumatic stress disorder. Other task related factors including working in different time schedule makes the drivers work during unusual hours, resulting into stress among them.

It gets compounded by disturbance in their circadian rhythms causing sleep related problems, building up of fatigue and decrement of alertness and other cognitive attributes that may have detrimental effects on safe operation of trains (Psycho-Technical Directorate Study Report No. PT- 38, 2014). Work-life imbalance becomes another source of stress among the train operation staff, as they do not have control over the time of their duties, resulting in erratic working hours. Work schedule of this nature interferes with their personal lives and leisure activities which is the most important factor of their social life. Effort to maintain work efficiency during long working hours itself induces stress. Moreover, after completion of prolonged and continuous task, perceived stress increased (Warm, Parasuraman & Matthews, 2008). The jobs of train operation staffs are cognitively loaded and are resource demanding, thus depletion of resources is another cause of fatigue and stress. Understanding the nature of stress in

employees is not only quintessential for reducing stress and errors in train operations, it also helps in suggesting design of less stressful system that could minimize mental workload and stress.

Correlates of Occupational Stress: When an individual experiences difficulties in coping with stress, he is likely to exhibit changes in mood, behavior and physical appearance. The common physical characteristics include muscle tension, headache, stomachache, trouble sleeping, trouble eating, and lack of energy, whereas emotional changes include nervousness, anxiety, loss of enthusiasm about enjoyable things, anger, hostility, shyness, withdrawal, helplessness and hopelessness.

Behavioral changes may include poor eating habits and excessive weight gain or loss over a short period of time. Despite extensive research literature with respect to relationship between workplace factors, stress, and job satisfaction (e.g. Burke, 1988; Leong, Furnham, Cary, & Cooper, 1996; Sullivan & Bhagat, 1992) the application of research findings to a particular workplace is not always straightforward. The same workplace factors may not be consistently related to stress in all the workplaces and the relationship between stress and job satisfaction can differ depending on the group being investigated (Rees, 1995; Young & Cooper, 1995). However, studies suggest that Role Overload and Role Ambiguity create more job stress and less job satisfaction among workers (Cooper & Marshall, 1976). Highly satisfied workers are better performers and possess good physical and mental health than the dissatisfied workers (Rahman & Sen, 1987). Chao, Jou, Liao, & Kuo (2015) reported that work stress had a positive effect on both turnover intention and job performance but a negative effect on satisfaction. Rose (2003) reported that long working hours reduce employee's urge for performing better and increase the stress level.

Nabirye (2010) found significant negative relationships between occupational stress and job performance and between occupational stress and job satisfaction among nursing professionals. Interpersonal aspects of job performance (sensitivity, warmth, consideration, tolerance) and cognitive/ motivational aspects (concentration,

composure, perseverance, adaptability) were also found to be correlated significantly with self-reported perceptions of stressful events and subjective stress (Motowidlo, Packard & Manning, 1986). However, Watson & Pennebaker (1989) suggest that self-report measures of stress and health contain a significant negative affectivity component and correlations between such measures are likely to overestimate the true association between stress and health.

Yoga as an Intervention Technique to Reduce Stress: Experience of stress is a response to various physical, occupational and emotional stimuli, if these stimuli go beyond manageable limits, they become stressors. At workplace these psychological stressors stem from a variety of possible causes, undermine work performance and have severe health impacts. Continued exposure to stress leads to physical and mental symptoms including anxiety, depression and psychological ailments. Yoga, having its origin in ancient India, is one of the oldest techniques of practicing certain activities in a systematic and well defined manner that have been effective in mitigating physical and mental stress since time immemorial.

Its application as therapeutic intervention takes advantage of various psycho-physiological benefits for amelioration of physical, mental and spiritual state of an individual. It includes eight multidimensional aspects of *Yama* (universal ethics), *Niyama* (individual ethics), *Asana* (physical postures), *Pranayam* (breathing exercise), *Pratyahar* (control of the senses), *Dharana* (concentration), *Dhyana* (meditation) and *Samadhi* (bliss). The postures increases physical flexibility, coordination and strength, and breathing practice and meditation calm the mind, develop greater awareness and diminish anxiety, resulting in higher quality of life.

Different studies have revealed that practice of *Asana*, *Pranayam*, *Dharana* and *Dhyana* have positive effects on various physiological mechanisms that regulate psycho-physiological changes in the human body. Yoga has been found to decrease the level of stress hormones – cortisol (West, Otte, Geher, Johnson & Mohr, 2004; Michalsen et al., 2005) and epinephrine (Selvamurthy et al., 1998), blood glucose (Khatri, Mathur, Gahlot, Jain & Agrawal, 2007), heart rate and systolic and diastolic

blood pressure (Damodaran et al., 2002). Studies also suggest that it reverses negative impact of stress on the immune system by increasing the levels of Immunoglobulin A (Stuck, Meyer, Rigotti, Bauer & Sack 2003). These studies and many others support the belief that Yoga improves physical and mental health by regulating Hypothalamic-Pituitary-Adrenal axis and Sympathetic Nervous System (Ross & Thomas, 2010). Studies have also revealed that Yoga has been equal and sometimes superior to aerobic exercises including walking, jogging, bicycling, stretching etc. in healthy and ailing persons (Ross & Thomas, 2010). In one of the study it has been found that Yoga group performed significantly better than the Exercise group on the levels of fatigue and on several measures of quality of life including pain and social functioning (Oken et al., 2006).

It has been effective in relieving symptoms of depression (Krishnamurthy & Telles, 2007), anxiety (Smith et al., 2007), obsessive compulsive disorder (Shannahoff-Khalsa et al., 1999) and schizophrenia (Duraiswamy et al., 2007). It has been beneficial in reducing anxiety and stress (Malathi & Damodaran, 1999; Shankarapillai, Nair & George, 2012) and proved to be an effective intervention measure to improve physical wellbeing besides coping stress (Waelde & Thompson, 2004). Further, Michalsen et al. (2005) found significant improvement on measures of stress and psychological outcomes through participation in three month intensive yoga program in women suffering from mental distress.

Cowen and Adams (2004) reported that practicing Yoga *asana* improves physical fitness and perceptual benefits. Yoga improves stress, anxiety and health as compared to other relaxation techniques (Smith, Hancock, Eckert & Mortimer, 2006) and enhances wellbeing, mood, attention, mental focus and stress tolerance (Brown & Gerbarg, 2005). Hegde et al. (2011) suggested that it can be used as an effective therapy in reducing damaging effects of oxidative stress in the cells of human beings. Yoga is convenient and practical approach of improving work performance by relieving tension and job stress (Gura, 2002) as it limits stress related problems and its regular practice have substantial healthy benefits (Kiecolt-Glaser et

al., 2010). All these studies and many more indicate that stress management program based on the techniques of Yoga is helpful in reducing stress besides improving physical and mental wellbeing.

Present Paper: The present paper reports the findings of two studies (Study Report Nos. PT-8 of 1999 and PT-15 of 2001) conducted by Psycho-Technical Directorate of Research, Designs and Standard Organisation and also in collaboration with Swami Vivekananda Yoga Research Foundation (SVYRF), Bangalore and Himalayan Institute of Hospital Trust (HIHT), Dehradun. First part (Study I) focuses on psychological approach of assessing occupational stress among train operation staff and its various correlates, while in the second part (Study II) the effect of Yoga intervention was examined on various physiological and psychological measures among locomotive drivers.

Study I: The aim of Study 1 was to understand the nature and correlates of stress among two groups of train operation staff - the Drivers and the Assistant Station Masters (ASMs). It was hypothesized that both the groups will differ significantly from each other with respect to the level of stress, job performance, satisfaction, performance rating and physical and mental health. Second hypothesis was formed with an assumption that variables such as job performance, job satisfaction, physical and mental health these variables would be correlated with occupational stress and thus this interrelationship was studied.

METHOD: Sample: The study was conducted on a group of 387 safety critical train operation staff comprising of 182 Drivers and 205 ASMs. Their age varied from 23 to 58 years with mean age of 42.64 years (SD \pm 8.45).

Tools used: Occupation Stress Index (OSI) developed by Srivastava and Singh (1984) with split half reliability of .935.

Satisfaction – Dissatisfaction Scale developed by Pestonjee (1973) with reliability .99 (split half).

Somatic Health Complaints (SHC) Scale developed

by the Psycho-Technical Directorate of RDSO and comprising of 25 items intended to measure physical problems experienced by employees in the last 12 months.

Mental Health Inventory developed by the Psycho-Technical Directorate of RDSO, which comprised of 35 items measuring various components like positive self-evaluation, perception of reality, integration of personality, autonomy, group oriented attitude and environmental mastery.

Performance Rating Scale developed by Pestonjee and Singh, (1978) with reliability .92 (Split half)

RESULTS: Means and SDs were computed for all the variables of both the categories of staff. To see the significance of difference of Mean, *t* test was computed on each scale among the groups. The findings are presented in Table 1 and 2 and the Means are graphically displayed in Figure 1 and 2. Correlation was computed to see the relationship among variables.

Occupational Stress Index (OSI): Analysis of Mean suggested that OSI for ASMs (*M* = 113.10) was significantly higher than Drivers (*M* = 106.29; *t* =3.94, *p* < .001). In order to make a micro analysis of the existence of differences among the two categories of staff, Means and SDs of scores on various stressors (composite variables of stress) were computed and significance of differences were tested, through '*t*' test. Values of Mean along with *t* test are given in Table 1.

Table 1 Mean and t-test on dimensions of Occupational Stress Index of the two groups

SN	Variable	Mean		t-test Driver Vs ASMs
		Driver	ASMs	
1	Role overload	20.32	21.85	-3.31*
2	Role ambiguity	11.15	11.09	0.17
3	Role conflict	14.15	14.61	-1.27
4	Unreasonable group pressure	3.65	3.76	-1.04
5	Person	4.18	4.36	-1.78
6	Under participation	6.09	6.59	-2.33*
7	Poor peer relation	9.50	11.20	3.73*
8	Intrinsic impoverishment	10.76	12.13	-4.20*
9	Low status	7.62	8.54	-3.34*
10	Strenuous working condition	11.43	12.82	-4.41*
11	Unprofitability	7.03	7.11	-0.41
12	Total OSI score	106.29	113.10	-3.94*

Note. **p*<.05

The above table highlights various factors - ASMs scored higher on Role Overload (RO), Role Conflict

(RC), Unreasonable Group Pressure (UGP), Person (PER), Under Participation (UNP), Poor Peer Relation (PPR), Intrinsic Impoverishment (II), Low Status (LS), Strenuous Working Conditions (SWC) and Unprofitability (UP) than the Means of scores for Drivers, resulting in significantly higher mean of OSI for ASMs than the Drivers. The differences of Mean between ASMs and Drivers on RO, UNP, PPR, II, LS and SWC were significant. Table - 1 also depicts that the Drivers scored higher on Role Ambiguity (RA) than ASMs, though, the difference between Means of the two groups was not significant.

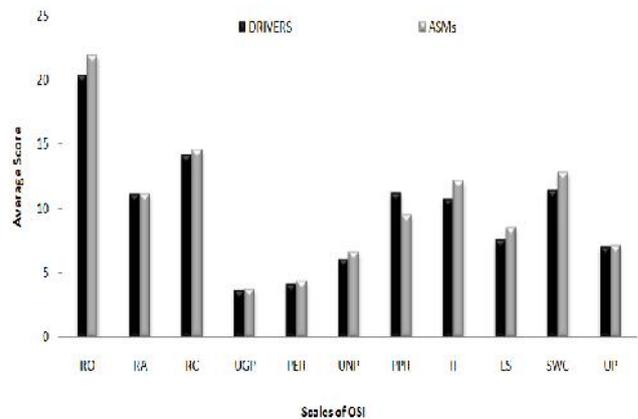


Figure 1 Average score on components of OSI of Drivers and ASMs

Job Satisfaction, Performance Ratings, Total Mental Health and Somatic Health Complaints:

Table 2 shows that Drivers scored significantly higher than ASMs on job satisfaction measures, suggesting that ASMs are less satisfied than the Drivers. Further, Drivers and ASMs scored approximately equal on performance rating though the difference between the Means of ASMs and Drivers was not found significant (*t* = -0.54, *p* = .587). Performance was rated by their supervisors. These two categories of employees are rated as per their concerned duties.

Organisational expectations from employees of the two categories are strict adherence to prescribed procedures for performing their role. This may be attributable to lack of orientation towards rating by raters who might have been affected by halo effects. With respect to Total Mental Health, Table 2 shows that Drivers scored slightly higher Mean than the ASMs, but this difference was not significant. Further, ASMs scored significantly higher Mean on SHC than the Drivers (*t* =5.50, *p* <.001) and this

difference may be attributed to less physical work in the job of ASMs than that of the Drivers.

Table 2 Mean score on Job satisfaction, mental health, Somatic health and Job performance rating scale and t-test

SN	Variable	Mean		t-value
		Drivers	ASMS	
1	Job Satisfaction	21.97	17.10	5.85*
2	Job Performance rating	49.13	49.51	-0.54
3	Somatic Health Component	34.86	40.94	-5.50*
4	Total Mental Health	112.02	111.82	0.16

Note. * $p < .01$

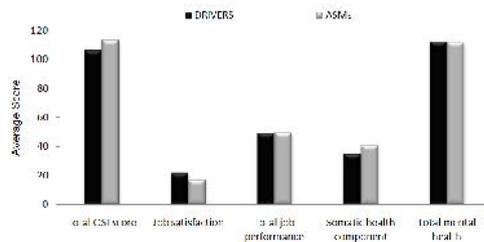


Figure 2 Scores on different scale of two groups of employee

Relationship of OSI with Job Satisfaction, Somatic Health Complaints, Total Mental Health and Performance Rating:

Correlational analysis suggested that Total Mental Health was related with OSI negatively and significantly ($p < .001$). It was also related negatively and significantly ($p < .001$) with seven components of OSI. The relationship of Somatic Health Component with Satisfaction, as expected, was negative and was significant ($p < .001$). Somatic Health Complaint was negatively related with Total Performance Rating but not significantly. As expected, Total Mental Health related positively with Job Satisfaction ($p < .001$).

Total Mental Health related with Total Performance Rating positively and significantly ($p < 0.001$). Further, Job Satisfaction was found negatively related and significantly with 11 components of OSI. Results of this study reveal that ASMs have the highest overall occupational stress than the Drivers because of overload, conflict, group pressure, under participation poor peer relations, intrinsic improvement, low status and strenuous working conditions. However, these groups of employees attributed Role Overload as a major source of Occupational Stress followed by Role Conflict and Strenuous Working Condition. ASMs had more physical complaints than the Drivers. The Drivers were more satisfied than the ASMs and reported slightly better perceived mental health than the ASMs.

Study II: The aim of Study II was to study the effectiveness of Yoga in reducing stress level and its related symptoms among train operation staff and for this a ten day Stress Management Programme was arranged at SVYRF, Bangalore for the drivers of Southern and South Central Railways and HIHT, Dehradun for the drivers of Northern and North Eastern Railways – many of them involved in train accidents on Indian Railways and all having high stress score on OSI. The aim of this programme was to explore whether Yoga practice would bring any change in physiological relaxation that could help the drivers to carry out monotonous task without influence of stress and attentional breakdown.

A three days stress management programme was organised at HIHT in which 10 accident involved drivers of Indian Railways were given training to feel their stress level through an internal cleansing routine, proper diet, breath and stretching exercises, walking therapy, personal counselling by physicians, relaxation practices and self-monitoring. Stress profile of each driver was made which suggested that majority of them showed mild increase in muscle tension and Electrodermalgraph (EDG) and had poor breathing pattern and a few of them had anxiety and mild hypertension. After a gap of 7 months, eight of ten drivers were sent again to HIHT for assessment of the effectiveness of the techniques taught in the stress management programme and their stress profile was compared with the earlier one. All the eight drivers showed improvement in physiological mechanisms related with stress assessed through heart rate, blood pressure, respiration rate, body temperature, electromyography, electrodermalgraph etc. Feedback from the drivers suggested that they felt more relaxed, energetic and alert after doing these exercises. The results were as under:

- 1) Electromayograph: Three drivers showed improvement and for others it was more.
- 2) Electrodermalgraph: All the eight drivers showed improvement.
- 3) Temperature: Most of the drivers had normal temperature.
- 4) Heart Rate: All the drivers showed normal Heart Rate, four drivers had high Heart Rate earlier.

- 5) Blood Pressure: Six drivers showed normal BP, one driver had mild high but better than before and one had mild increase.
- 6) Respiration: All of them showed improvement in respiration.
- 7) Stress check list: Their habits improved, one driver showed less smoking and was less irritable and happier.

This course helped the drivers in solving their individual problems like adjusting the body clock to suit night driving and anxiety of different nature through *Pranayam*. Performance rating of these drivers by their supervisors indicated positive changes in their behaviour and attitude. Drivers also reported in their feedback that they feel more relaxed, energetic and alert after practicing the exercises. The results showed positive trend but full effect was not there as the drivers were not very regular in doing the exercises. Though the duration of intervention programme was only 3 days - very short for realising full benefit, the outcomes were quite promising. Since this preliminary study was intended to have a feel of the effect of Yoga on stress management, a more detailed study of the stress management programme was organized at SVYRF, Bangalore, the details of which are given below:

METHOD: Sample: 27 drivers scoring high on OSI were sent to attend the course, out of which 12 were involved in causing accidents on Indian Railways. All of them stayed in the *ashram*, followed norms of the *ashram* and remained busy in various activities from 5:00 hrs. in the morning to 22:00 hrs. in the night.

Design of the study: Pre and post experimental design was used. Physiological, behavioural and perceived performance measures were computed prior to and after six months of stress management programme based on Yoga as an intervention. Yoga based relaxation techniques included Cyclic Meditation, Instant Relaxation, Quick Relaxation and Deep Relaxation Techniques were introduced as intervention to reduce the stress level of the drivers.

The drivers were subjected to different activities including *Deep Breathing/Pranayama*, exercise of

hand, eye, neck and joints, *Ardh Kati Chakrasana*, *Ardh Chakrasana*, *Tadasana*, *Padahastasan*, *Trikonasna*, *Vajrasana*, *Sasankasana*, *Aradha Matsyendrasana*, *Makarasana*, *Bhujangasana*, *Nadi shodhan*, *Salabhasana*, *Dhyan*, relaxation in *Shawasan* besides lectures on Yoga, stress, holistic living etc. so that they could understand and take full benefits of Yoga. They were also imparted training on some *kriyas* (set of well-defined activities) such as *Trataka*, *Dhauti*, *Kapala Bhati*. The drivers also attended morning and evening *bhajans* (prayers) and meditation. Duration of all these activities ranged from 15 minutes to 60 minutes depending upon the activities performed. The drivers who had specific health problems were persuaded to learn special techniques of *asanas*.

Assessment and Tools: Heart Rate and Heart Rate Variability (HRV): The Electrocardiogram (ECG) was recorded using standard bipolar limb I configuration and an AC amplifier with 1.5 Hz high pass filter and 75 Hz low pass filter setting. ECG was digitized using a 12 bit analog-to-digital convertor (ADC) at a sampling rate of 500 Hz and stored on the hard disk of a PC/AT 486 system COMPTECH for analysis. The R waves detected to obtain a point event series of successive R-R intervals, from which the beat to beat rate series was computed. The recorded data were visually inspected off-line and only noise free data were included for analysis.

The mean values were removed from the heart rate series to obtain the HRV series. The HRV power spectrum was obtained using Fast Fourier Transform (FFT) analysis. The energy in HRV series of the following specific frequency bands was studied - very low frequency component (0.0-0.05 Hz), low frequency component (0.05-0.15Hz) and high frequency component (0.15-0.50 Hz). The low frequency (LF) and high frequency (HF) values were expressed as normalized units.

1. Breath rate: was recorded using a nasal thermistor connected to a 4-channal polygraph Recorder.
2. Skin resistance: using Ag/AgCl plate electrodes with electrode gel, placed in contact with the volar surfaces of the distal phalanges of the index and middle fingers of the left hand. A low-level DC preamplifier was used and constant current of

- 10 A was passed between the electrodes.
3. Alpha EEG: in the Electroencephalography (EEG) was recorded using Ag/AgCl disk electrodes placed at the occipital (O1 and O2) positions of the international 10-20 system of electrode placement.
4. Scaled General Health Questionnaire (GHQ): This questionnaire had 4 parts with 7 questions in each part. Part A dealt with somatic symptoms, part B with symptoms of anxiety and insomnia, part C with questions related to social dysfunction and part D with symptoms of severe depression (Goldberg & Hillier, 1979).
5. Test of monotony: This test was conducted for 20 minutes and it involved asking the subject to continuously enter the letters from three rows of a computer keyboard, non-stop so that the amount of mental attention was present. Subjects were asked to use the index finger for the first row, middle finger for the second row, ring finger for the third row.

RESULT: Subjective experience and physiological measures were obtained before and after intervention programme which suggested that subjective rating of health based on the GHQ were significantly better after Yoga ($t = 4.23, p < .001$), suggesting that drivers rated health related problem more in pre intervention (11.2) as compared to after intervention session (6.4), thus showing an improvement in general health (75% reduction). In Heart Rate variability HF/LF ratio significantly decreased suggesting reduced parasympathetic tone (51.9% reduction). Other variables like heart Rate

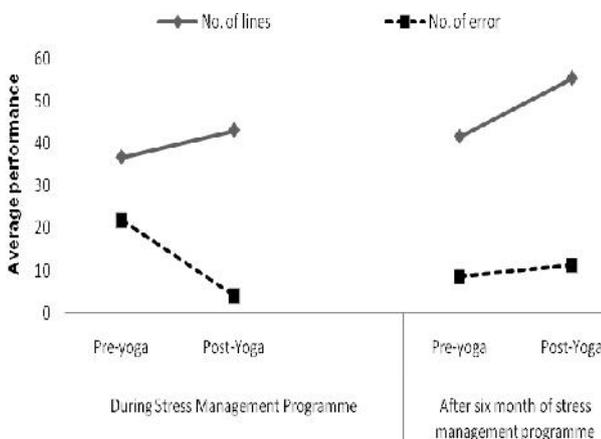


Figure 3 Performance on monotonous task during and after six month of stress management programme as a function of Yoga session

and respiratory rate did not show any group significant difference, which could be due to individual differences. All the drivers had different levels of base line health and some of them had health problems like hypertension, back and joint pain, knee pain, asthma, diabetes, constipation and piles. They were subjected to different special techniques having different effect on their body.

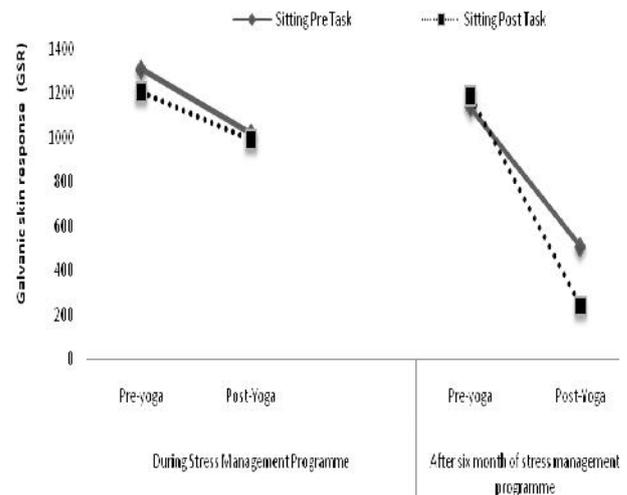


Figure 4 GSR during and after six month of stress management programme as a function of Yoga session

Further, 10 drivers were subjected to extensive assessment in which physiological measures were taken as a function of task session settings, findings of which is shown in Table 3, which suggest that speed of repetitive movements based on the number of lines of characters entered using a computer key board and accuracy in this task were all significantly better after Yoga (see Figure 3). This also suggested improved motor ability (19.3% increase) as number of lines (mean accuracy) increased from 36.7 to 43.1 and error reduced from 21.9 to 4. There was no significant difference between Pre and Post Yoga measurement on Heart Rate, Respiration, Alpha EEG and Galvanic Skin Response (GSR) though some drivers showed improvement (reduced respiration rate and heart rate) after yoga as expected.

After six months the drivers who had attended stress management programme were sent again for follow up assessment. Due to some operational and personal reasons only sixteen drivers could report. Their follow up assessment suggested significant decrease in HF/LF ratio ($t = 4.317, p < .001$). This suggested a shift in the automatic balance (an increase in sympathetic tone, i.e., LF component and/or a

decrease in the parasympathetic tone i.e., HF component) indicating improvement in alertness. Heart rate also showed significant decrement from before (77.6) to after (65.1) six months ($t = 5.21, p < .001$). Respiration rate reduced from 19.1 to 17.6 cycles per min though it was not significant. Scores on scaled GHQ significantly decreased after 6 months by 49.4% ($t = 4.75, p < .001$) suggesting improvement in overall physical and mental health.

The drivers subjected to intensive assessment were also called after six months to see the difference. Out of 10 drivers who were given the monotonous task only five could report after six months. Significant increase in the number of lines entered or mean accuracy (increase from 41.6 to 55.4) was noticed. Total number of errors increased though this was not significant. No significant change in heart Rate was noticed though it was lower from pre yoga measurement. Respiration rate before the monotonous task was lower by 4 cycle ($p < .05$) in post task sitting. GSR was significantly lower after 6 months in pre task sitting which suggested decline in stress as shown in Figure 4. The Alpha in EEG increased significantly after 6 months before the task ($p < .05$).

Performance rating by supervisors on different abilities like cognitive, affective, motor and communication skill increased significantly after yoga intervention. Similarly, feedback from the drivers also revealed enhanced subjective experience with respect to their mental, physical and cognitive

health, despite the fact that 50 % drivers practiced yoga regularly, while the remaining 50 % practiced only when they are at home.

DISCUSSION: Study-I aimed to explore the nature and correlates of stress among highly strained safety critical train operation staff of Indian Railways. The findings of this study revealed that ASMs feel more stressed as compared to the drivers. There are larger differences in education level, their surroundings and amenities at various stations where they work, which impact their stress levels. Result of this study has indicated that among different OSI factors Role Overload was the most important cause of stress in both the groups followed by Strenuous Working Conditions. As compared to ASMs Job Satisfaction was higher in drivers and Somatic Health Complaints were also more in them.

These findings support the first hypothesis that the two groups differ significantly from each other on different measures. However, on Mental Health and Job Performance rating measures both drivers and ASMs showed same trend of scores. Stress was found negatively related with Job Satisfaction, Performance Rating and Physical as well as Mental Health. The second hypothesis gets corroborated with these findings and also with different earlier studies and researches (Chao, Jou, Liao, & Kuo, 2015; Nabirye, 2010; Rahman & Sen, 1987; Watson & Pennebaker, 1989), which suggest that with increase in the stress level there is decrease in job satisfaction, job performance rating and physical as well as mental health.

In Study II an attempt was made to study the effectiveness of yoga as an intervention to reduce stress among the drivers initially in HIHT, Dehradun and then elaborately in SVYRF, Bangalore. The aim of stress management programme was to make an individual aware of and witness one's reaction to stress, detect early warning signals and learn to apply effective practical tools to remove physical and emotional stress that may have prevented him from experiencing an inner sense of relaxation, peace and joy.

Yoga had healthy impact in creating mental calmness and alertness by reducing stress, enhancing Alfa-waves/ sensory-motor rhythm in brain leading to normalisation of brain function. Findings of this

Table 3 Intensive assessment of Drivers as a function of pre and post yoga session

SN Parameters	Time period	During stress management programme		After six month of stress management programme			
		Mean	t value	Mean	t value		
		Pre-Yoga	Post-Yoga	Pre-Yoga	Post-Yoga		
Performance on monotonous task							
1.	No. of lines	36.7	43.1	2.33*	41.6	55.4	4.615*
	No. of error	21.9	4.0	1.23*	08.6	11.2	1.039
Heart Rate (HR)							
2.	Pre Task	75.6	78.2	.70	80.5	71.6	1.811
	Post Task	76.1	80.3	.98	79.9	71.3	2.02
Respiration Rate							
3.	Pre Task	20.7	19.8	.79	19.9	15.9	2.866*
	Post Task	20.6	18.2	1.67	19.4	16.5	2.462
Skin Resistance (GSR)							
4.	Pre Task	1307.7	1018.7	1.24	1134.9	508.1	2.533
	Post Task	1206.8	992.6	.93	1188.4	241.8	3.489*
Alpha							
5.	Pre Task	525.6	331.4	1.58	441.8	1228.2	2.983*
	Post Task	653.8	295.8	1.92	655.6	838.6	0.383

Note. * $p < .05$

study also confirmed the above notion and divulged that the drivers showed improvement in various physiological indices that were relevant for reducing stress and enhancing performance. In addition to physiological responses, subjective rating by the drivers themselves showed improved physical and mental health. Performance rating by supervisors also substantiated the effective impact of yoga in improving various cognitive abilities which was the result of regular practice of yoga. Thus, findings of present study support various researches which showed improvement in physical and psychological health and reduction of stress as result of yoga relaxation programme (Cowen & Adams, 2004; Malathi & Damodaran, 1999; Michalsen et al., 2005; Shankarapillai et al., 2012; Smith et al., 2006; Walde & Thompson, 2004).

CONCLUSION: The impact of occupational stress on the quality of life of employees and their performance is a matter of serious concern, which needs to be addressed well on Indian Railways entrusted with the responsibility of offering transportation services to the nation round the clock. Continuance of work-related stress in the population of safety critical staff may lead to development of fatigue, decrement in attentional capacity and poor ability to concentrate on their assigned task besides impairment of cognitive attributes - all leading to deviation from the compliance of safety rules, unsafe working and ultimately accidents. In this perspective it is imperative for the organisation to enhance the level of awareness among the safety critical staff about the practice of Yoga, so that they could remain physically and mentally fit and healthy and could work safely and efficiently for achieving the organisational objectives. The present study has substantially revealed that practice of yoga including asanas, deep breathing techniques and relaxation activities as a part of daily life activity is of immense help in the well-being of safety critical train operation staff. This should be adopted as an important strategy in maintaining performance at an efficient level.

The train operation staff should go through a few minutes of yoga exercise before reporting for duty and after reaching home or the running room on completion of their duty. Periodic health checkups for assessment of their mental and physical state at

regular intervals and need based specific intervention shall improve physiological and psychological health of the employees, shall boosts up subjective attitude towards work and life and prove beneficial not only for them but also for the organization they serve.

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