# An analysis of work related stress factor in selected industries in Kerala, India

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*Abstract*— The management standards of Health and Safety executive (HSE-UK) were used to evaluate the work stress among Engineers, Supervisors and Workers in the public sector industries in Kerala, India. The studies were conducted in five industries out of which three are chemical and two are manufacturing The information were collected from engineers, supervisors, and workers in the above industries and the effect of stress variables namely demand, control, managers support, peer support, relationship, role, change were analyzed. The research reveals that work stress is more in manufacturing industries than chemical industries as far as personnel factor is concerned. A reverse trend is observed for relationship. It is observed that low level of control among supervisors and workers is the main cause of work stress. The EFA yielded two factor model. The CFA also yielded a two factor model namely personnel and relationship that fits the data very well.

*Keywords*— Health and Safety Executive, Management standards, Exploratory factor analysis, Confirmatory factor analysis.

## I.  INTRODUCTION

Work related stress is a current future health and safety issue. There are many definitions of stress. The national Institute of occupational safety and health (NIOSH) defines stress as "The harmful physical and emotional response that occur when the requirements of the job do not match the capabilities, resources, needs of the worker". Health and safety executive (HSE-UK) defines it as "The adverse reaction people have to excessive pressures or other type of demand placed upon them".

In a recent report the European union reports that more than 41 million EU workers are affected by work related stress and 600 million working days per year are lost across EU. In addition HSE Annual report reveals that about 13.4 million days are lost due to stress. It is estimated that the cost of work related stress costs UK economy £7 billion a year in sick pay, lost production, NHS costs etc, (Palmer et al.[35]).

Further more stressed workers are more likely to be unhealthy, poorly motivated for less productive and less safe at work and their organizations are less likely to succeed  in the market.

The research finds that the imbalance between efforts and rewards develop stress (The effort-reward imbalance model) and this often leads to complex health problems like coronary heart disease, (Bosma et al [8], Chandola et al [15]). It has been found that long working hours causes accident and injury (Kathryn and Harie [25], Cara Williams et al. [10]) which affects psychological health and physical health (Daraiseh et al [17]; Caruso et al.[12]; Dempsey et al [18]) and in turn affects job satisfaction (Karrna et al. [23]; Lie and Lambart[28]) of the employees. This results in job burn out, (Masslach et al.[31]), loss in productivity, staff turnover and absenteeism, (Leontaride and Ward [27], Karsh et al [24]). Work related stress can be caused by several factors such as work content, work organization and work environment, (Leontaride and Ward [27]; Caulfield et al.[13]).

An individual is well adopted to cope with short term exposure to pressure, which can be considered as positive, but has a greater difficulty in coping with prolonged exposures. The research work conducted at South Australia, (Caulfield et al.[13]) reveals that the work load pressures amounts 37% of the work related claims. The stress due to over work is even associated with increased alcohol consumption, smoking and affects families and home life.

Work related stress affects organizational morale and leads to problems like hyper tension (Mills et al. [33]), heart attacks and organizational problems like workplace violence.

Some of the theories concentrate on the stressors with in the work environment (eg: Demand –Support model, and effort-reward imbalance model, (Siegrist et al.[40]). It has been found that increased work hours have got positive association with job stress. Japanese government has implemented administrative guidance on over time which suggest that employees should not work more than 45 hours of over time per month, (Hoshuyama et al.[19]).

Generally workers with high strain job were more likely to report job stress. Approximately one of every three reported that low co-worker support and low support from the supervisors, (Shields [38]) are the sources of stress. Low co-worker support at the work place leads to intension to leave the job and it is further associated with high prevalence to

depression on the male and female workers. Chronic work stress seems to amplify the effects of psychiatric disorders, (Carollyn et al.[11]) and increased heart rate and increased blood pressure, (Tanja et al.[42]).

Many research reveals that job control increases increases employees opportunities to acquire needed resources and reduce frustration, (Jackson [20]). It has been found that better job control improves job satisfaction, (Noblet et al.[34]) and low job control often increases ambulatory blood pressure, (Cesana et al.[14]) and leads to coronary heart diseases, (Bosma et al.[8]).

The psychological job demand (in terms of quantity of work, mental requirements and time constraints), job control and social support at the work place represent perceived job stress, (Bacquer et al.[3]). Some researchers considers the job control as one of the psychosocial factors and found strong correlation with body pain and head aches, (Aaras et al.[1]).

Research reveals that physical exertion and job insecurity leads to work stress. It is also found that cumulative sleep debt due to shift work, (Kageyama et al. [21]) and work place climate, (Mc Manus et al.[30]) has found strong correlation with work stress.

Apart from time pressures, interruptions, disturbance at work, job responsibility, role conflict, ambiguity and lack of training (http://www.surreyergonomics.org) are found to be important predictors of job stress.

On 3rd November 2004 HSE-UK launched new management standards to help employers and employees to analyze and evaluate work related stress. HSE has identified six key areas, (Mackay et al. [29]; Cousins et al. [16]); that can cause work related stress. They are demands, control, support, relationship, role and change.

## II. SUBJECTS AND METHODS

The main purpose of this investigation is to analyse and evaluate work related stress by using new stress management standards of HSE-UK, in the absence of well defined measures for the evaluation of work stress in India. The questionnaire for the above evaluation consists of 35 items and seven subscales (demand, control, managers support, peer support, relationship, role and change). The questions were likert type with five fixed alternatives.

A multistage sampling technique was adopted to identify the industry and subjects. At the first stage, three companies were selected from the chemical sector which constitutes 20% of the large scale public sector chemical industries in Kerala. Similarly two large scale manufacturing industries were also selected in the same way. The selection was done by simple random sampling. Accordingly the following chemical industries namely The Travancore Cochin Chemicals Ltd (TCC), The Kerala Minerals and Metals Ltd (KMML), The Travancore Cements Ltd (TCL) and two manufacturing industries namely Transformers and Electricals Kerala Ltd (TELK), Steel and Industrial Forgings Ltd (SIFL) located in the South Indian state of Kerala were selected for the study.

In the second stage the sample size of the participants were finalised, which constitutes 40% of the population from each categories using stratified proportional sampling. The resulted sample consists of Engineers (75 numbers), Supervisors (110 numbers) and Workers (675 numbers). Participants of this study consists of both male and female employees of age between 25 to 55; however, majority of the employees were males. All the employees are permanent and working in shifts on rotation and each shift consists of 8 hour duration per day. Number of women participants are about 20% of the male participants in manufacturing industries and only 10% of the male participants in chemical industries. All the industries are large scale type and located in different districts of Kerala. In short, both chemical and manufacturing industries are identical in all aspects influencing the stress except in the case of working environment, which is harsher in chemical industries than manufacturing industries, in the sense the employees are more exposed to harmful working environment.

A printed questionnaire was administrated to the participants after an oral introduction about the aim of the investigation and they were assured that their answers would be strictly anonymous. The filled up questionnaires are then carefully edited for completeness, consistency and accuracy etc. After final editing the number of questionnaires in each categories used for the analysis is presented in the table 1. The overall response rate was 96.5% (Table – 1).

*Table - 1:* List of respondents – industry wise

| Designation | Chemical Industries | | | Manufacturing Industries | | Total |
|---|---|---|---|---|---|---|
| | TCC | KMML | TCL | TELK | SIFL | |
| Engineers | 18 | 24 | 6 | 12 | 7 | 67 |
| Supervisors | 26 | 41 | 10 | 19 | 10 | 106 |
| Workers | 120 | 192 | 117 | 120 | 108 | 657 |

On the basis of the data so collected, analysis is performed using statistical techniques. The main tools used are normal test, one way ANOVA, correlation analysis and factor analysis. The effect of different variables on HSE management standards in the above industries are studied. A cross comparative study of the above factors in intra

industries and inter industries were also done to study work related stress and further designation wise analysis were also conducted. Structural equation modeling was made based on exploratory factor analysis and confirmatory factor analysis.

## III. RESULTS

### 3.1 Correlation Matrix

The correlation between the variables is given in the correlation matrix. It is noted that no significant correlation exists between the variables. Hence these variables can be considered as independent variables for the purpose of research. Refer Table-2.

*Table – 2 :* Correlation between the variables

| Variables | Demand | Control | Managers support | Peer support | Relationship | Role | Change |
|---|---|---|---|---|---|---|---|
| Demand | 1.000 | .427 | .237 | .255 | .326 | .211 | .252 |
| Control | .427 | 1.000 | .285 | .236 | .304 | .127 | .274 |
| Managers support | .237 | .285 | 1.000 | .415 | .425 | .302 | .479 |
| Peer support | .255 | .236 | .415 | 1.000 | .386 | .280 | .360 |
| Relationship | .326 | .304 | .425 | .386 | 1.000 | .440 | .492 |
| Role | .211 | .127 | .302 | .280 | .440 | 1.000 | .415 |
| Change | .252 | .274 | .479 | .360 | .492 | .415 | 1.000 |

### 3.2 Exploratory factor analysis

In the first stage, an, Exploratory Factor Analysis (EFA) was conducted to identify a viable factor structure. The factor loadings are shown in the Table-3 after vari max rotation. The factor loadings for the variables, demand and control is found to be positive and factor loading for the variables, managers support, peer support, relationship, role, change are found to be negative. Therefore it is suggested to have a two factor structure with demand and control as personnel stress factor (stress-P) and others as relationship stress factors (stress-R)

*Table –3:* The Factor loadings for EFA

| Variables | Factor-1 | Factor-2 |
|---|---|---|
| Demand | .457 | .195 |
| Control | .415 | .003 |
| Managers support | -.104 | -.355 |
| Peer support | -.016 | -.087 |
| Relationship | -.084 | - .013 |
| Role | -.342 | - .389 |
| Change | - .310 | - .025 |

### 3.3 Structural equation modeling of work stress

Confirmatory factor analysis (CFA) was conducted by Analysis of Moment of Structures AMOS Version 7 Arbuckle [2]. CFA was carried out for both single factor and two factor model.

CFA is a structural equation modeling technique, (Barbara M. Byrne [4]; Boollen [7]) which determines the goodness of fit between hypothized model and the sample data. The following goodness of fit indices are used to assess the degree of fit between the model and sample, $\chi^2$, Tuker Lewis Index (TLI :>.90 acceptable: >.95 excellent, (Tucker et al.[43]); the Comparative Fit Index (CFI: >.90 acceptable, >.95 excellent; (Bentler and Bonnet [5]; Bentler [6]) Root Mean Square Error of Approximation (RMSEA; <.08 acceptable, <.05 excellent, Brown et al [9]). CFA allows several advantages over other analytical techniques in that it allows the specification of casual relationships between observed variables and latent constructs while simultaneously accounting for item level measurement error. (Barbara M Byrne [4]).

The results of the analysis are given in Table 4 and it is found that CFA provides modest support for the two factor model, which is in agreement with the inference based on EFA.

***Table -4:*** Goodness of fit indices

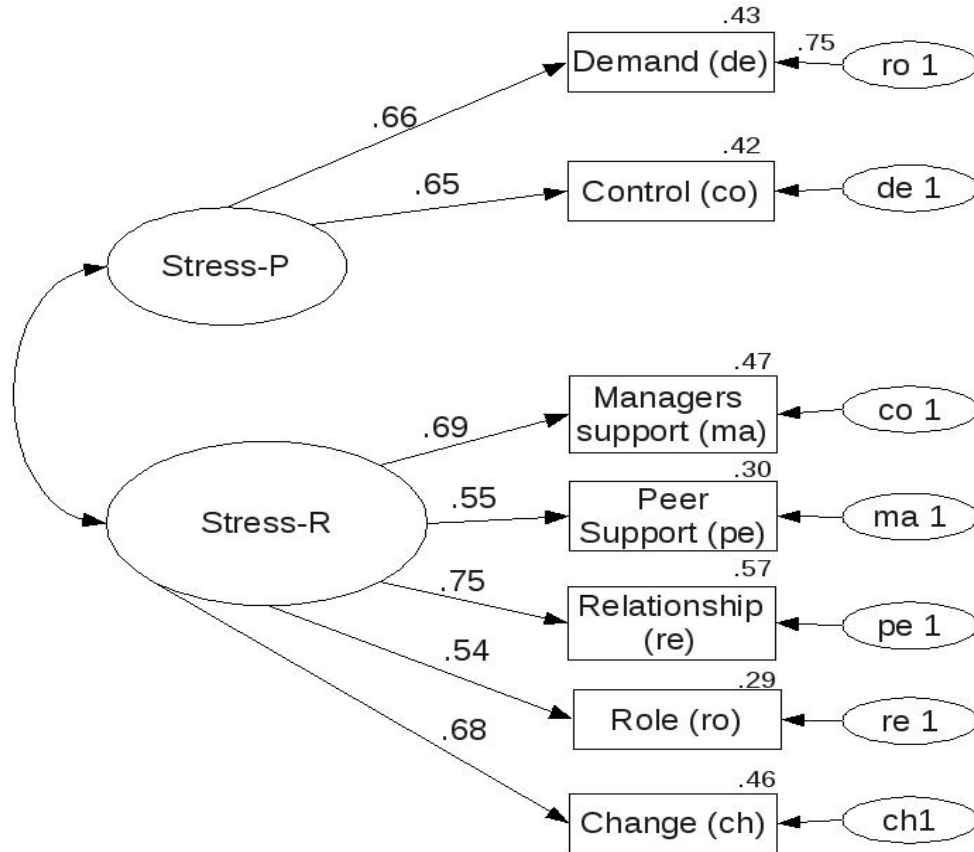| Model | df | $\chi^2$ | NFI | TLI | CFI | RMSEA |
|---|---|---|---|---|---|---|
| One factor model | 13 | 129.424 | .906 | .861 | .914 | .104 |
| Two factor model | 13 | 47.207 | .966 | .959 | .975 | .056 |



Figure – 2 Two factor structural modeling of work related stress

## IV. DISCUSSION

The main aim of the study is to evaluate the work related stress in selected industries (chemical and manufacturing) in Kerala, India by using new HSE management standards. Interestingly it is found that the factors responsible for work stress is prominent in all companies, irrespective of nature/type of industry

While examining the correlation between the variables we could see a weak correlation between demand and control and between control and support. This result was expected one, and many earlier research studies, (Karasek & Theorell [22], Mcelenahan et al [32]) justify our results and suggest that jobs with high demand, low control and low support are stressful. Authoritarian managers, unfair treatment by managers and superiors, perceived discrimination by managers, harassment on the basis of race, sex, bullying, intimidation, victimization etc result in poor work relationship, (Cara Williams et al [10], Cousins et al [16]). The present study shows significant correlation between managers support and relationship and many similar studies, (Leontaridi and Ward[27], Karrna et al [23], Pisarki et al [36]) support and justify our findings. Further significant correlation was found between change and relationship in this study. The organisational changes like technological changes, work place changes, unable to consult over changes with superiors, unable to adjust with the changes etc are stress rising factors, (Cousins et al [16]). The stress due to these factors can be minimized by improving the relationship. The works of many earlier researchers, (Shigemi et al [37], Launis and Pihlaja [26]) justify our findings. Moderate level of correlation are obtained between change with relationship and change with managers support. For any organization to exist successfully there should be significant correlation between these parameters, (Leontaride et al [27]).

Number of experimental and longitudinal studies has strengthened the view that control is an important casual determinant of job stress, (Shields [38], Smith et al [41]).Both single factor and two factor standardized structural equation models are given in Figure-1 and Figure-2 respectively. EFA and CFA suggest that a two factor model as it provides best fit to the given sample data.

The limitations of this study are to be kept in mind, when assessing the results. This study is limited only to public sector industries in Kerala, India, where majority of blue collar employees are males. Therefore it would be inappropriate to draw conclusions about male and female workers based on this result.

The conclusion is drawn based on the date obtained by means of self reported measures. Comparative study is not carried out because of the lack of literature or study of HSE management standards in the context of Indian Public Sector industries.

## V.  CONCLUSION

It is found that the HSE management standards can be effectively used for the analysis of work stress in the public sector industries in Kerala, India. It is seen that there is work stress among employees working in industries. The two factor model suggested through CFA yields better fit than single factor model.

## VI.  ACKNOWLEDGEMENT

## REFERENCES

[1].  Aaras A, Horgen G, Bjorset H H, Ola Ro, Walsoe H. 2001. Masculosketal, visual and psychosocial stress  in VDU operators before and after multidisciplinary ergonomic interventions; A 6 Year prospective study-Part II. *Applied Ergonomics,*  32, pp 559-571.
[2].  Arbuckle J L .2006. AMOS 7.0 update to the Amos users guide, Chicago, IL, small waters co-operation.
[3].  Bacquer D D, Pelfrene E. Clays E, Mark R, Moreau M, deSmet P, Kornitzer M and De Backer G . 2005. Perceived job stress and incidence of coronary events;  A  3 year follow up the belgian job stress project cohort. *American Journal of Epidemiology*, 16(5), pp 431-441.
[4].  Barbara M Byrne . 2001. Structural equation modeling with AMOS EQS and LISREL comparative approaches to testing for the factorial validity of a measuring instrument. *International Journal of testing*, 1(1), pp 55-86.
[5].  Bentler PM & Bonnet DG .1980. Significance tests and  goodness of fit in the analysis of covariance structures    *Psychological bulletin*, 88, pp 588-606.
[6].  Bentler PM .1990. Comparative  Fit indexes in structural models. *Psychogical bulletin,* 107, 238-246.
[7].  Boollen KA .2002. Latent  variables in Psychology and social sciences, Annual Review of Psychology, 53, pp 605-634.
[8].  Bosma H, Peter R, Siegrist J, Marmot M .1998. Two alternate job stress models and risk of coronary heart disease. American Journal of public health 88(1), pp 68-74.
[9].  Brown M W and Cudeck R .1998. Alternative ways of assessing model fit In K A Bollen and J S Lang (Edn), Testing structural equation models, pp 136-162.
[10].  Cara Williams .2003. Sources of work place stress- Perspectives - statistics Canada – catalogue no. 75 -001-XIE  pp 5-12.
[11].  Carollyn S. Lin D E, Koochoorn M, Goldner E .2007. Association  of chronic work stress. Psychiatric disorders  and chronic physical conditions with disability among workers. *Psychiatric Services*, 58(5), pp 652-658.
[12].  Caruso C C, Hitchcock E M, Dick R M, Russo J M, Schimit J M .2004. Over time and extended  work shifts, recent findings on illness, injuries and health and behaviors. Centre for disease control and prevention. *National Institute of occupational safety and health* pp 1-49.
[13].  Caul Field N, Chang D, Dollard M F and Shang  C E I .2004. A review of occupational stress interventions  in Australia. *International Journal of stres*s *managemen*t, 11(2), pp 149-166.
[14].  Cesana G, Sega R, Ferrario M Chiodini P, Corrao G Mancia G .2003. Job Strain and blood pressure in employed men and women; A Pooled analysis of four northern italian population samples. *Psychosomatic medicine*, 65, pp 558-563.
[15].  Chandola T, Britton A, Brunner E, Heming W H, Mallic M, Meerakumari, Badrick E, Kivimaki M and Marmot M, .2008. Work stress and coronary heart disease .European Heart Journal Advance access, pp 1-9.
[16].  Cousins R, Clarke S D, Kelly C, Kelly P J and McCaig R H, Mackay C J .2004. Management standards and work related stress in UK; practical development. *Work & Stress* 18(2), pp 113-136.
[17].  Daraiseh N, Genaidy A M, Karwowshi W, Davis L S, Stambough J, Huston R L .2003., Maskulosketal outcomes in multiple body regions and work effects among nurses: the effects of stressful and stimulating working conditions. *Ergonomics*, 46, pp 1178-1199.
[18].  Dempsey P G, Filiaggi A J .2006., Cross-sectional investigation of task demands and maskulosketal discomfort among restaurant wait staff. *Ergonomics*, 49(1), pp 23-26.
[19].  Hoshuyama T. 2003. Over work and health effects current status and future approach regarding Karoshi Sangyo Eiseigaku Zasshi 45:187-193.45, pp 187-193.
[20].  Jackson S E .1989. Does job control control job stress*? Job  control and workers health* Chapter 2,    John weily and sons Ltd, pp 25-53.
[21].  Kageyama T, Nishikido N, Kobayashi T and Kawagoe M .2001. Estimated sleep debt and work stress in Japanese white collar workers. *Psychiatry and clinical Neurosciences*, 55, pp 217-219.
[22].  Karasek R Theorall T .1990. Healthy work,  stress, productivity and the reconstruction of working life, USA Basic Books 1990.
[23].  Karrna M, Polluste K, Lepnurm R and Theloff M .2004 The progress of reforms, job satisfaction  in a typical hospital in Estonia . *International Journal for quality in healthcare*, 16(3), pp 253-261.
[24].  Karsh B, Booske B C, Sainfort F .2006. Job and  organizational   determinants of nursing home employee commitment, Job satisfaction   and intent to turn over. *Ergonomics*, 48 (10),  pp 1260-1281.
[25].  Kathryn and Harie P B .1998. Health reports, Statistics Canada volume 3 – catalogue pp 82-83.
[26].  Launis K, Pihlaja J .2007., Changes in production concepts emphasize problems in work-related well being. *Safety science*: 45, pp 603-619.
[27].  Leontaride RM and Ward ME .2002. Work related stress quitting intensions and absenteeism *IZA discussion paper No 493* Bonn. Germany; pp 1-23.

[28]. Lie J and Lambart VA .2008. Work place stressors, coping demographics and job satisfaction in Chinese intensive care nurses British association of critical care nurses. *Nursing in critical care* 13(1), pp 12-24.

[29]. Mackay C J, Cousins R, Kelly P J, Lee S and McCaig R H .2004. Management standards and work related stress in UK policy background and science. *Work & Stress,* 18(2) pp 91-112.

[30]. Mc Manus I C, Keeling A and Paice E .2004. Stress, burn out and doctors attitude to work are determined by personality and learning style; A twelve year longitudinal study of UK medical graduates. *BMC medicine*, pp 2-29.

[31]. Masslach C, Wilmer .B. Schaufeli, Leiter M P .2001. Job burn out. *Annual Review Psychology* 52, pp 397-422.

[32]. Mcclenahan C A, Giles M L, Mallett J .2007. The importance of context specticity in work stress research: A test of the demand – control – support model in academics, W*ork & stress*, 21(1), pp 85-95

[33]. Mills P J, Davidson K W, Furag N H .2004. Work stress and hyper tension: A call from research to intervention. *Annals of behavior medicine*, 28 (1), pp 1-36.

[34]. Noblet A, Cooper C, Williams J M and Rudd A .2005. Well being; Job satisfaction and commitment among Australian community health workers: The Relation ship with Working Conditions. *Australian Journal of Primary Health*, 13(3), pp 40-48.

[35]. Palmer S, Cooper C and Thomas K .2004. A model of work stress. Counseling at work winter http:// www.hse.gov.uk.

[36]. Pisarki A, Lawrence S A, Bohle P, Brook C .2008. Organizational influences on the work life conflict and health of shift workers. *Applied Ergonomics*, 39(5), pp 580-588.

[37]. Shegemi J, Mino Y, Tsuda T, Babazono A, Aoyama M .1997. The relationship between job stress and mental health at work, Industrial health, 35, pp 29-35.

[38]. Shields M .2006. Stress and depression in the employed population –*Statistics Canada- health reports* 17(4) pp 11-29.

[39]. Shimizu Y, Makino S, Takata T .1997. Employee status during the past decade (1982-1992) Based on a nation wide survey conducted by the ministry of labour in Japan. *Industrial Health*, 35, pp 441-451.

[40]. Siegrist J, Starke D, Chandola T, Godwin I, Marmot M, Weid hammer I and Peter R .2004. Measurement of Effort Reward Imbalance at Work; European Comparisons. Social Science and Medicine, 58 (8), pp 1483-1499.

[41]. Smith L, Jeppesen H J, Boggild H .2007. Internal locus of control and choice in health service shift workers. Ergonomics, 1050(9), pp 1485-1502.

[42]. Tanja G M, Vrijkotte, Lorenze J P vanDoorman and DeGeus E J C .2000. Effect of work stress on ambulatory blood pressure, heart rate and heart rate variability. *Hypertension,* 35, pp 880-886.

[43]. Tucker LR & Lewis C .1973. A reliability coefficient for maximum likely hood factor analysis. Psychometrica, 38, pp 1-10.