
A Treatise on Some Selected Statistical Stress Management Models (SMMs)

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ABSTRACT

In the past decades, the majority of studies to date have focused on different conditions that may lead to stress and the effects such conditions had without harmonising the statistical models together as an improvement in the development of new stress models for managing stress related problems. This paper tried to describe stress from different perspectives, reviewed collection of detailed literatures on stress models and carefully presents and tabulates the enlisted models to guide any researcher working in related field to pick from the pools of models listed.

Keywords: Stress, Types, Psychological, Models, X-ray, Logistic regression

AIMS Research Journal Reference Format:

Ogoke, U.P & Nduka E.C. (2022): A Treatise on Some Selected Statistical Stress Management Models (SMMs). *Advances in Multidisciplinary and Scientific Research*. Vol. 8. No. 3, Pp 39–46. www.isteams.net/aimsjournal.
[dx.doi.org/10.22624/AIMS/V8N3P3](https://doi.org/10.22624/AIMS/V8N3P3)

1. INTRODUCTION: AN OVERVIEW OF STRESS

Stress is a physical, mental or emotional factor that causes bodily or mental tension which could be external (environmental, psychological or social) or internal (illness, medical procedure (Medterms). These health challenges can in turn have adverse consequences on their work output, households and the entire society. Stress may trigger other ailments such as hypertension, cancer, bipolar disorder etc, and has been associated with developmental anomaly in infancy for the pregnant ones (Anja et al(2003), Ogoke et als (2015)). Selye (1985) define stress from a physiological and psychological viewpoint as the body's response against any general demand laden onto it. Cuceoglu (1999) reflected stress to be both physiological and psychological and acknowledged stress as an individual's fight beyond own physical and psychological boundaries because of uncomfortable conditions approaching from the environment. Job stress is viewed as an individual's reactions when he interacts with work environment which poses threat morally, emotionally and physically that could be mediated by psychological factors or individual difference.(Jamal, 2005; Szilagy & Wallace, 1987). Larry Trivieri (healthy world.com) classified stress factors into four types or categories: physical stress, psychological stress, psychosocial stress, and psycho spiritual stress. Prolonged stress can result in suppressed immune function, increased susceptibility to infectious and immune-related diseases and cancer. Emotional stress can also result in hormonal imbalances (adrenal,pituitary, thyroid,etc) that further interfere with healthy immune functioning.

Many stimuli trigger stress in humans and the role of self-management in reducing work stress caused by role ambiguity, role conflict, time pressure and work overload (Imran, et al (2021). In the context of organizations, occupational stress” is also acknowledged as job stress and/or Work Stress”. They are often used interchangeably in organizational settings, but its connotation refers to the similar thing (Abu AlRub, 2004; Harrison, 1978; Larson, 2004). Work stress is the stress received while working and there are many stressors that contribute into this conditions, role conflict, role ambiguity, time pressure and work overload are few of them. Role Conflict is when individuals simultaneously perform multiple roles, and they conflict with each other. Role Ambiguity refers to the inadequate information in relation to limits of authority, responsibility, rules and policies of the organization and performance evaluation methods required by the individuals to complete their roles in an organization (Ammar, 2006). Time pressure is the pressure that is created in relation to any task needed to be completed while work overload is the degree of stress felt by employee due to the believe that they having difficulty adjusting to the amount of work assigned to them refer to Work Overload (Idris, 2011).

2. SOME SELECTED STATISTICAL STRESS MODELS

Much attention has not been paid on the list of mathematical models dealing with stress management for any researcher working in related field to pick from the pools of models. Danka et al (2000) constructed a mathematical model of stress reaction based on the assumption of the feedback mechanism between the HPA axis and the memory system using the above-defined individual variables. Their work connects psychological and biological aspects of stress reaction, integrates a wide range of results from diverse research fields (physiology, psychology, psychiatry, etc.) into a consistent feedback mechanism between the HPA axis and the memory system in stress reaction. Two variables— σ and τ —are extracted as the main carriers of individual differences, representing two basic personality traits, neuroticism and openness which relate memory system to stress axis. The model has two important implications (predictions). Yonghee and Sangmun (2010) considered the limitations of the currently available questionnaires as analytical tools by focussing on these four steps.

The first step is the creation of an integrated job stress questionnaire (IJSQ) that incorporates physical, psychosocial, and environmental factors. The second step combines data mining (DM) with response surface methodology (RSM), to deal with specific situations by creating a new methodology called Response Surface Data Mining (RSDM). The third step follows the RSDM with detailed statistical relationships between the risk factors and the response of interest. The fourth and final step is a case study using the IJSQ and RSDM. The case study demonstrates that the proposed RSDM can effectively find significant physical, psychosocial, and environmental risk factors by reducing the dimensionality. In addition, the process provides detailed statistical inference. A mathematical model consisting of six compartments, Susceptible-Exposed-Quarantine-Infectious-Hospitalized-Recovered (*SEQIHR*) was developed, aimed at showing the impact of stress on the transmission of COVID-19 disease. From the model formulated, the positivity, bounded region, existence, uniqueness of the solution, the model existence of free and endemic equilibrium points, and local and global stability were theoretically proved. The basic reproduction number (R_0) was derived by using the next-generation matrix method, which shows that, when $R_0 < 1$, the disease-free equilibrium is globally asymptotically stable whereas when $R_0 > 1$ the endemic equilibrium is globally asymptotically stable. Moreover, the Partial Rank Correlation Coefficient (PRCC) method was used to study the correlation between model parameters and R_0 .

Numerically, the *SEQIHR* model was solved by using the Rung-Kutta fourth-order method, while the least squares method was used for parameter identifiability. Furthermore, graphical presentation revealed that when the mental health of an individual is good, the body immunity becomes strong and hence minimizes the infection. Conclusively, the control parameters have a significant impact in reducing the transmission of COVID-19 (Paul, et al 2022). Wong et al 2014 applied Fireman's job stress to Integrate work/non-work conflict with Job Demand-Control-Support model by administering Questionnaire survey for data collection. Work/leisure conflict (WLC) and work/family conflict (WFC) mediate partially the relationship between job demand and job control, job support and job stress.

The relationship between family support and job stress is fully mediated by WLC and WFC. WFC and WLC are integrated into Job Demand-Control-Support model in current research to narrow the gap of job stress theory. Chauvin et al (2014) worked on the Assessment of job stress factors in a context of organizational change by designing a questionnaire and online surveys to measure psychological demands, decision latitude, supervisor support, co-worker support, and organizational difficulties by applying a stepwise regression method and a confirmatory factor analysis. A Confirmatory Factor Analyses indicated a poor fit of the five-factor model based on 30 items but an acceptable to good fit of a reduced five-factor model based on 26 items. A stepwise regression showed that the organizational difficulties dimension was the second most important predictor of psychological stress. Takashi et al (2015) validated previous observations on the association between job stress and workers' mental health, by removing the effects of unobserved time-invariant confounders using data from three to four waves of an occupational Japanese cohort survey, focusing on 31,382 observations of 9741 individuals who participated in at least two consecutive waves. They estimated mean-centered fixed effects models to explain psychological distress in terms of the Kessler 6 (K6) scores (range: 0–24) by eight job stress indicators related to the job demands-control, effort-reward imbalance, and organizational injustice models.

Mean-centered fixed effects models reduced the magnitude of the association between jobs stress and K6 scores to 44.8–54.2% of those observed from pooled ordinary least squares. Alternatively specified models showed the robustness of the results and they concluded that the validity of major job stress models, which link job stress and workers' mental health, was robust, although unobserved time-invariant confounders led to an overestimation of the association. Krishna et al 2015 measured and modelled Job Stress of Electric Overhead Traveling crane Operators using Classification and Regression Tree (CART) and Analysis of Variance. The job stress and the operators were measured on different scales through the administration of questionnaire. Their findings include: the five subscales can be used to measure job stress; employee empowerment was the most significant factor followed by the role overload; workplace characteristics contributed more towards job stress than operator's characteristics; and of the workplace characteristics, crane height was the major contributor. They concluded that issues related to crane height and cabin feature can be fixed by providing engineering or fool proof solutions than relying on interventions related to the demographic factors.

Natasha et al (2017) analysed effect of personal and work stress on burnout, job satisfaction and general health of hospital nurses in South Africa using hierarchical multiple linear regression. Findings revealed that personal stress is a better predictor of burnout and general health than job satisfaction, which is better predicted by work stress. Kadry et al (2018) adopted both descriptive and inferential statistics to detect the causes that lead to stress and could worsen the mental and physical activity of the body by collecting data from health sciences post grad students who work and study using a survey that was administered by smart phone applications. The results show that stress is caused by lacking time to exercise, lack of socializing and sleeping disturbance while overworking and un-motivation are not correlated to stress. Regarding stress outcomes they observed that, over eating and loss of self-control are not associated with stress. Most people prefer listening to music when they are stressed, and that if stress is caused by work-overload the solution is to decrease working hours.

Nigus et. al (2019) assessed the prevalence of perceived stress and associated factors among pregnant women in Bale zone hospitals, Southeast Ethiopia. Logistic regression was applied to identify factors associated with perceived stress and statistical significance was considered at p -value < 0.05 . Their study concluded that the prevalence of perceived stress among pregnant women was relatively low and that health care providers should give due attention to the screening of stress in the first trimester to reduce the likelihood of pregnancy-specific stress. Sarah et.al. (2010) sought to identify factors associated with high antenatal psychosocial stress and describe the course of psychosocial stress during pregnancy. They performed a cross-sectional analysis of data from an ongoing registry. They made use of multiple logistic regression to identify factors associated with high stress as measured by the Prenatal Psychosocial Profile stress scale. Imran et al,(2022) adopted stratified random technique to draw sample size from the 3 targeted population,

A structural equation modeling, path analysis and bootstrapping were used to find the Path Coefficients, R-Square, P-Value, T-Statistics, model significance of the variables under study. Danka, et al (2000) constructed a mathematical model of stress reaction based on the feedback mechanism between HPA axis and memory system using the defined individual variables. Other methods employed include questionnaire as analytical tools. Tang, et al (2019) used the logistic regression model to investigate the prevalence and influencing of maternal stress, anxiety and depression in early pregnancy and provided scientific basis for reducing prenatal mental disorders in China. Results showed prevalence of prenatal stress, anxiety and depression in early pregnancy were 91.86%, 15.04% and 5.19% respectively. The risk factors include housewife/unemployment, level of social support, lack of exercise, active smoking, prim-parity and level of family care. Akinsulore et. al (2021) used logistic regression, chi-squared test and T- test to study pregnancy-related anxiety symptoms (PRASs) and their associated factors amongst pregnant women. The results show that, the prevalence of PRAS and major maternal worries were 43.5% and 55.7% respectively. In summary, they concluded that high level of PRAS and major maternal worries were common amongst antenatal clinic attendees of a tertiary teaching hospital in Nigeria.

3. SUMMARY TABLE OF SOME SELECTED MATHEMATICAL STRESS MODELS USED IN DIFFERENT RESEARCH

| S/No | Author | Topic | Model used | Publisher/Link |
|------|----------------------------|---|--|--|
| 1 | Danka et al(2000) | A Mathematical Model of Stress Reaction: Individual Differences in Threshold and Duration | Differential Equation | Doi:10.3758/BF03332017 |
| 2 | Sarah et al(2010) | Psychosocial stress during pregnancy | Multiple Logistic Regression | Pub Med Central |
| 3 | Yonghee and Sangmun (2010) | Job Stress Evaluation using Response Surface Mining | Response Surface Data Mining (RSDM) | https://doi.org/10.1016/j.ergon.2010.03.003 |
| 4 | Wong et al(2014) | Fireman's job stress: Integrating work/non-work conflict with Job Demand-Control-Support model. | Structured Equation Modeling | Elsevier |
| 5 | Chauvin et al (2014) | Assessment of job stress factors in a context of organizational change. | Factor Analysis and Step-wise Regression | doi: 10.1016j.era.2014.09.005 |
| 6 | Takashi et al (2015) | Do time-invariant confounders explain away the association between job stress and workers' mental health? | Mean-centered fixed effects models | Science Direct |
| 7 | Krishna et al(2015) | Measurement and Modelling of Job Stress of Electric Overhead Traveling Crane Operators | Questionnaire, Analysis of Variance(ANOVA), Classification and Regression Tree(CART) | Elsevier; Science Direct |
| 8 | Natasha et al(2017) | Effect of personal and work stress on burnout, job satisfaction and general health of hospital nurses in South Africa | Hierarchical Multiple linear regression | Health SA Gesondheid http://ees.elsevier.com/hsag/default.asp |

| S/No | Author | Topic | Model used | Publisher/Link |
|------|-------------------------|--|--|---|
| 9 | Engidaw et al (2019) | Perceived stress and its associated factors among pregnant women in Bale zone Hospitals, Southeast Ethiopia: a cross-sectional study | Logistic regression | BMC Res. Notes; https://doi.org/10.1186/s13104-019-4383-0 |
| 10 | Arnau-Soler et al(2019) | A validation of the diathesis-stress model for depression in Generation Scotland | Diathesis-stress model, Mixed linear model | Translational Psychiatry; https://doi.org/10.1038/s41398-018-0356-7 |
| 11 | Tang et al(2019) | Influencing factors for Prenatal Stress, Anxiety and Depression in Early Pregnancy among women in Chongqing, China. | Logistic regression | PUBMED |
| 12 | Nigus et al (2019) | Perceived stress and its associated Factors among pregnant women in Bale zone Hospitals, Southeast Ethiopia:a cross-sectional study. | Logistic Regression | Biomed Central |
| 13 | Akinsulore et al(2021) | Pregnancy related anxiety symptoms and associated factors amongst pregnant women attending a tertiary hospital in south-west Nigeria | Logistic Regression | Pub Med Central https://doi.org/10.4102/sajpsy.chiatry.v27i0.1616 |
| 14 | Paul et al (2022) | Mathematical Approach to Investigate Stress due to Control Measures to Curb COVID-19 | Susceptible-Exposed-Quarantine-Infectious-Hospitalized-Recovered (SEQIHR) Model, Rung-Kutta fourth-order method and Least Squares Method | doi:10.1155/2022/7772263 |

4. CONCLUSION

Generally, regression type model has been applied to stress during pregnancy, job stress evaluation, pre-natal stress while structured models were applied in others.

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