Methods for Stress Assessment: A Review

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ABSTRACT
This review of the literature gives information about stress and its adverse effects on physical and mental health of an individual. Stress is ever-present universal feature of life. It causes many health problems like heart diseases, digestion problem, sleep problem and depression. Psychological scale like, Effort-Reward imbalance scale (ERI), Depression, Anxiety Stress Scale (DASS), Occupational Stress Index (OSI), Perceived Stress Sale (PSS) are used to infer stress in terms of behavioral change. Various physiological parameters that can be used to monitor stress are Heart Rate (HR), Galvanic Skin Response (GSR) and Electroencephalography (EEG). However, HR and GSR showed the 99.5% of stress detection accuracy. Moreover methods have also been indentified for the prevention of stress at workplace.

Keywords: Stress, Physiological Parameters, Heart Rate, Blood Pressure, Psychological Scale, GSR, HR, EEG, DASS, OSI, PSS, ERI, APA.

I. INTRODUCTION
American Psychological Association (APA), defined stress as “The non-specific reaction from the human body in order to any kind of requirement positioned on it” [1]. Stress response is considered as when there is the increasing activity in the sympathetic part of the autonomic nervous system. Stress is a widespread phenomenon which has been observed to raise undesirable health and reduces performance. Stress causes many health problems like heart diseases, digestion problem, sleep problem, depression etc [2]. Whenever, physiological signals changes under stress then there is variation in the efficiency of delivering energy (oxygen and glucose) to vital organs. The physiological signals, which increased efficiency, are: Heart Rate (HR) and Blood Pressure (BP), EEG signals, Respiratory system: Respiration rate and depth, GSR. Negative stress reduces work performance of an individual. Stress can be categorize into three types: Acute stress, Episodic acute stress and Chronic stress. Acute stress is the starting stage of stress. It arises from the commands and requirements of a particular situation. It is short-term stress body can recover quickly. Episodic acute stress is observed in those people who suffer from acute stress from long time. It occurs from time to time. Chronic stress is long period of stress people get used to it. It is harmful to people’s health. It comes when person never sees a way out from unpleasant problems [3].

Various symptoms are associated with stress mainly headache, high blood pressure, indigestion, fatigue, insomnia, shortness of breath, anxiety, irritability, anger, mood swing, hypersensitivity, depression, feeling of helplessness, hopelessness, loss of appetite, impatience, quickness to argue, increased smoking, poor job performance etc [4].

II. METHODS AND MATERIAL

1. Stress Measurement Methods
Stress can be measured and evaluated in terms of perceptual, behavioral and physical responses. Stress can be evaluated by psychological scale-based or physiological signals-based analysis.
1.1 Psychological Scale

Psychological scale is commonly used to infer stress in terms of behavioral changes. The self-administered questionnaire includes all the personal data of the individual and physiological parameters. A number of instruments available to measure stress.

Table 1, defined the various psychological scales that measured stress. “Effort-Reward Imbalance Scale (ERI)”. In effort-reward model considered that the negative thoughts take place when effort made by an individual higher than the reward the individual get. It is consisting of 23 items [5]. “Depression, Anxiety Stress Scale (DASS)”. It is consisting of 42 items. It used to measure depression, anxiety, stress among individual. DASS cannot measure suicidality [6]. “Occupational Stress Index (OSI)” measure stress that cause through the working condition of a worker. It is consisting of 46 items. It measures the following conditions under load, high demands, strictness, extrinsic time pressure, uncertainty [7]. “Perceived stress questionnaire” it targets stress due to perceive stresses. It measures the stressfulness of situations that cause stress [8].

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Scale</th>
<th>Measure</th>
<th>No of items</th>
<th>Reliability rate</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Effort-Reward imbalance scale (ERI)</td>
<td>Discrepancy of effort and reward, Psychological stressors</td>
<td>23</td>
<td>0.89</td>
<td>Siegrist (1996), Siegrist et al. (2004)</td>
</tr>
<tr>
<td>2</td>
<td>Depression Anxiety Stress Scale (DASS)</td>
<td>Depression (hopelessness, low self-esteem), anxiety (autonomic arousal, muscular-skeletal symptoms), stress (tension, negative Affects)</td>
<td>42 (21)</td>
<td>0.88</td>
<td>Fernandez Gomez</td>
</tr>
<tr>
<td>3</td>
<td>Occupational Stress Index (OSI)</td>
<td>Under load, high demands, strictness, extrinsic time pressure</td>
<td>46</td>
<td>0.935</td>
<td>Srivastava and Singh (1984)</td>
</tr>
</tbody>
</table>

1.2 Physiological measures of Stress

Stress affects physiological signals like pulse rate, blood rate, heart rate, ECG, Galvanic skin response, Skin temperature [9].

1.2.1 Heart rate variability (HRV)

HRV refers to the difference between consecutive heartbeats. HRV is determined and continuously modulated by complex interactions between the sympathetic and parasympathetic system in order to properly respond to the demands of our body. These changes in heart rhythm constitute the concept of heart rate variability (HRV). It has been used as an indication of stress and mental effort in adults and is a useful indicator in the high-stress environment. HRV decreases during the period of high stress [10].

1.2.2 Respiration Rate

Respiration rate corresponds to the number of breathes takes per minute. The most common measures of respiration are Rate of respiration (Resp Rate) and depth of breath (RespAmp). Respiration rate is increases while Emotional arousal increases, during rest and relaxation respiration rate is decreases. Negative emotions cause irregularity in the respiration pattern. Respiration is closely linked to cardiac function; irregularity in breath can affect cardiac measures. The normal respiration rate for an adult at rest is 12 to 20 breaths per minute. [11].

1.2.3 Galvanic skin response (GSR)

Galvanic Skin Response (GSR), also known as Electrodermal activity (EDA), is a indicator of skin conductance. When an individual is aroused or excited, the skin resistance varies with the state of sweat glands (eccrine glands) in the skin. Sympathetic nervous system controlled the Sweat glands. The moisture levels in the skin fluctuates the mean value of skin conductance level and this change in conductance can indirectly relate to mental activity. GSR is nonintrusive easily capture physiological signal that used for evaluation of effective
state of user, mainly for stress and arousal level. EDA changes with respect to changes in stress levels [12].

1.2.4 Electroencephalography (EEG)

EEG is a method to detect the abnormalities related to the electric activity of brain. EEG signal recorded from the brain by placing the non-invasive electrode on the scalp. EEG signals recorded from different lobes i.e. Prefrontal pole (FP), Central(c), Parietal (P), Occipital (O) and Temporal (T) lobes provided the good observational data of variability in mental state. It shows the good co-relation with the mental health [13].

In Table 2, Some previous works for stress detection based on multiple physiological signals are summarized. Various physiological signals like Heart Rate (HR), Galvanic Skin Response (GSR), Electrocardiograms (ECG), Blood pressure (BP), Skin Temperature (ST) were investigated by different researchers to evaluate the stress. Through HR and GSR signals showed higher accuracy rate 99.5% for stress assessment.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Authors</th>
<th>Physiological signal</th>
<th>Stimuli</th>
<th>No. of person</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Healey at al(2004)</td>
<td>ECG,EMG,RR,GSR</td>
<td>Driving task</td>
<td>24</td>
<td>97%</td>
</tr>
<tr>
<td>2</td>
<td>Kovic and Croft(2005)</td>
<td>ECG,EMG,GSR</td>
<td>Fuzzy state</td>
<td>8</td>
<td>76%</td>
</tr>
<tr>
<td>3</td>
<td>Wagner et.al(2005)</td>
<td>GSR,EMG,RR,ECG</td>
<td>Audio task</td>
<td>1</td>
<td>79.5-96.6%</td>
</tr>
<tr>
<td>4</td>
<td>Sharawi et.al (2006)</td>
<td>ST,GSR</td>
<td>Driving task</td>
<td>35</td>
<td>60-78%</td>
</tr>
<tr>
<td>5</td>
<td>Guan yuan(2009)</td>
<td>ECG,EMG,GSR</td>
<td>Audio task</td>
<td>1</td>
<td>75-85%</td>
</tr>
<tr>
<td>6</td>
<td>Sierra(2011)</td>
<td>HR, GSR</td>
<td>Fuzzy logic</td>
<td>80 Female</td>
<td>99.5%</td>
</tr>
</tbody>
</table>

2. Steps for the Prevention of stress at workplace

The following steps can be used to prevent the stress at work station [18].

- Clearly specify worker’s responsibilities and job.
- Provide workers opportunities in order to take part in activities and decisions which affects their work.
- Legal guideline, global and national wide directives and sociable support.
- Enhancing employment organizing and stability.
- Reduction associated with work time and proper arrangement of working groups.
- Organizing place of work based on ergonomic office criteria.
- Working together within graphic displays models.
- Organize team discussion between supervisor, work associate and employees.
- Design formal online survey regarding collecting stressful work problems.
- Determine employee’s awareness regarding work issues and stress.
- Analyze data to recognize stressful work conditions [18].

III. CONCLUSION

This review summarizes the literature on stress and various psychological scale-based, physiological signal-based approaches for the measurement of stress. Various psychological scale like Effort-Reward Imbalance Scale (ERI), Depression, Anxiety and Stress scale (DASS) and Occupational Stress Index (OSI) are used for stress assessment and physiological signals including: Heart rate, GSR, EEG and EMG were discussed. Among these physiological signals HR and GSR are the most
prominent signals which provided the precise and accurate information on the physiological situation of individual. Moreover this review provides the various stress prevention methods for workers to deal with workplace stress.

IV. REFERENCES


