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REVIEW ARTICLE

Stress Induced Type 2 Diabetes Mellitus among Industrial Workers – A Review

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ABSTRACT:
Objectives: To give a condensed summary of research findings on the health complications of industrial workers due to stress particularly on Type 2 Diabetes Mellitus (T2DM). **Method:** Abstracts of previous publications related to stress induced T2DM were collected from research database using T2DM, stress, trauma, life events and work stress as search items. **Results:** The outcomes of many previous studies have revealed that stress induced T2DM were found to be prevalent among industrial workers. The conclusions of many longitudinal studies have revealed that emotional stresses, anxiety, sleeping disorder, anger hostility are the factors that accelerate the development of T2DM. Conflicting results are also found regarding childhood neglect, life events and stress that accelerate the development of T2DM. Such stress induced T2DM will lead to many complications associated with T2DM. **Conclusion:** As of date as per WHO statistics 422 million people are living with DM and work related stress is said to play a part in this. Complications like CVD, vascular disease, nephritis, retinopathy and neuropathy are prevalent among Industrial workers due to work related stress. This review article highlights the outcome of many prospective studies done on the health implications of Industrial workers. More studies are required in this field to identify the mechanisms linking various forms of stress to T2DM.

KEYWORDS: Stress, T2DM, Glucose, Insulin, Depression.

INTRODUCTION:
Stress is an analogue between the situation and the Individual. It is the psychological and physical state that results when the resources of the individual are not enough to cope with the demands and the pressure of the situation.[1] Stress is felt when an individual faces a real or imagined challenge or threat to their well being. Feelings such as anxiety, nervousness, fearful, overwhelmed, being panic or stressed out is also often mentioned as stress. Invariably stress is the body's natural defence against real or expected danger which stimulates hormones preparing the system to evade or control it.[2] The body produces greater quantities of the chemicals Cortisol, adrenaline and noradrenaline.

Though our body is an intelligent operating system, it cannot differentiate between lives threatening external threat from imagined or perceived non-life threatening stressors. The body reacts the same way for both. The mechanism of stress is very complex [3]

Body tends to restore normal physiological functioning when some deviation is required. It is a process in which the body's internal environment is kept stable or constant, stressful work condition are perceived as aversive events that requires adaptive response to restore normal functioning[4] Hans Seyle 1956 who was considered as the "Father of Stress" describes it as people who do much to cope with challenges in everyday life or in other words he calls it as general adaptation syndrome.[5]

Types of stress:
The stress can be categorised into General stress, cumulative stress, Acute and Post traumatic stress depending on the level of stress and the amount of stressors.[6]

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1. Acute Stress: This type of stress is brief and is specific to the demands of one particular situation it may even be like performing a difficult challenge or a traumatic event. Overdoing on short term stress can lead to psychological distress which in turn can cause acute stress symptoms. This type of acute stress can easily be recognised and can be taken care of. It is manageable and treatable.
2. Episodic Acute stress: when an individual experiences acute stress over and over again it is referred to as episodic acute stress. The reactions of acute stress over arouse. The individuals who undergo this type of stress will continuously be under the clutches of acute stress. Episodic acute stress is a combination of real challenges and a tendency to operate mechanically. Some people are apprehend limitlessly about bad things that could happen, are frequently in a rush and impatient with too many demands on their time which can contribute to episodic acute stress.
3. Chronic stress: this is the third type of stress which involves ongoing demands, pressure and worries that seem to go on forever, with little hope of letting up. This chronic stress is very harmful as it affects an individual's health and happiness to a greater extent. This type of stress has a negative effect not only in health but also in relationship it puts an individual down causing greater harm in their life.[7]

Thus stress is an overall process by which the work environment may negatively impact the individual; it varies from person to person leading to various types of health issues. Hence managing stress is very important to maintain a healthy life[8]

Occupational Stress:

The workplace is a vital source of both demands and pressure causing stress. Stress is mainly an interaction between the situation and the individual. It is the psychological and physical state of mind that results in stress mainly when the resources of the individual are not sufficient to cope with the demands and pressure of that situation. This sort of stressful work environment may negatively affect the employees.[9]

The most stressful situation for an employee in a work place arise where the employee face heavy job demands but the same time he has a little control over their work thus an employee perceive the work environment as stressful when there is lack of fit. Thus stress is an overall process by which the work environment may negatively impact workers. The workplace stressors represent anything in the job or organisational environment that requires some response for the employee to adapt with it.[10] If not it may lead to severe strain which represents several ways of wrong adaptive of employees reacting to stressors in the work environment.

This stress related to responsibility associated with work, corporate culture or personality conflicts can lead to physical as well as emotional disorder and may lead to depression if unattended The effects of this occupational stress has an impact on the psychological and behavioural problems which may lead to anxiety, irritability, alcohol and drug use, makes to feel powerless and leads to low morale.[11]

If exposure to these sorts of stressors is prolonged then it may lead to chronic health problem including stroke and diabetes.[12] The workplace factors that have been found to be associated with stress and health risk can be categorised as common and individual factors, that is to do with the social and organisational context or to do with the context of work.[13]

Common Stress Factors:

The common occupational stress factors are long hours of work, work overload and work pressure, it also includes the effects of those personal lives having lack of control over work and lack of participation in decision making and poor social support and plays a role of contributing factor including interpersonal conflicts, organisational constrains and perceived control.

Individual Stress Factors:

Apart from these common factors Individual Factors also plays a important role in occupational stress like Work-family conflict, Merger and acquisition, Layoffs and Job insecurity and emotional labour. The amount of work an employee has to do in a given period of time. These factor forces the employees to confront negative emotions.

Unclear work or conflicting roles and boundaries are the major source of stress. Some more sources are the relationship at work and the organisational culture. The managing heads who behave critical, demanding and unsupportive or bullying create stress among employees, an organisational culture of unpaid overtime and must attendance causes stress. Whereas a positive social dimension of work and good team work reduces the stress, a culture of involving people in decision keeping them informed about the happenings of the organisation and providing the employees good amenities and recreation facility reduces stress.[14]

As far as the common factors are concerned an organisational change, consultation with employees, avoiding mergers, relocation, restructuring, downsizing, avoiding individual contracts and redundancies within the organisation will play major role in reducing the occupational stress.

For individual factors there should be an enormous change in the corporate level strategy. It is very important to identify characteristics associated with both healthy, low stress work and high levels of productivity. Recognition of employees for their good performance, opportunities for their career development and an organisational culture that value the individual worker and management actions that is consistent with organisation values.

Clinical Implications of stress:

Stress is mostly described as a state of disturbed homeostasis which includes somatic and mental adaptive reactions which is defined as "Stress response". There is strong support from clinical and preclinical data that exposure to stress plays a major role in the etiology of disorders related to depression which in turn leads to major depression. Certain growing evidences indicate the involvement of neurotransmitters and neuropeptides and also novel immune and inflammatory mediators has an intermediate link between stress exposure, depressive symptoms and Major depression.[15]

Even a short lived minor stress can have an impact like causing headache, stomach ache and increased heart beat. Sudden emotional stress principally anger can provoke heart attacks, arrhythmias besides sudden death. Chronic stress starts interfering with the ability to live a normal life for an extended period, the longer the stress lasts- the worse it is for both the mind and the body. Fatigue irritation, anxiety, depression leading to smoking and other bad habits to cope with stress, job strain, high demands coupled with low decision making latitude. These problems lead to coronary diseases and also affect the central nervous systems and endocrine systems. The release of stress hormones like adrenalin and Cortisol by the adrenal glands play a vital role in directing the hypothalamus to act on the stressors, if central nervous system fails to control the stressors it will lead to multiple diseases related to neurotransmitters.

The stress hormones can also affect the respiratory and cardiovascular system leading to stroke and heart attacks also it affects the digestive system, muscular system causing tense muscles it also interferes in sexuality and reproductive system. Chronic stress magnifies the symptoms of menopause in women, the stressors also badly affect the immune system, the stress hormones weakens the immune system and reduces the body's response to foreign invaders and becomes susceptible to many kinds of virus and bacteria's.[16]

Specific studies on clinical implications of stress have revealed the fact that under stress liver produces extra blood sugar to produce extra energy, but in chronic stress the body becomes incapable to cope up with the extra glucose surge thereby increasing the risk of developing Type 2 Diabetes mellitus.

Any form of stress will induce transient hyperglycemia even in non diabetic individuals even though it may resolve by itself, it must be differentiated from other forms of illness related to DM. Stress induced elevation in plasma Glucose (PG) may vary among individuals and occasional monitoring of PG when an individual is not under attach of stress will help in the diagnosis of DM. Human body always responds to take action whether the stress is due to physical or psychological. This is called "fight or flight" response which increases the levels of several stress related hormones like epinephrine, growth hormone (GH) and glucocorticoids. These stress related hormones will increase PG levels leading to more insulin output. Industrial workers are prone to different types of stress related disorders and many studies have predicted various health issues, the most important among being the development of T2DM [17]

Uncontrolled DM induce many pathophysiological changes followed by secondary effects such as Insulin resistance (IR), metabolic disturbances and release of free radicals which damages several organs. Hence proper management of DM is essential to prevent new onset complications and they may get accelerated if stress also plays a part. Kidney, Liver, and Cardiac are the three organs which are mostly affected. [18]

Work stress and the Risk of T2DM:

Many previous studies have shown that T2DM patients double their risks for co-morbidity and mortality compared to healthy controls. A significant number of patients suffer from higher grade of diabetic specific emotional stress. A study based on depression analysis showed that 24% of patients had subclinical form of depression and 42% did not show any kind of stress disorder. Diabetic specific emotional problems are most common in T2DM patients. The problem area in diabetes questionnaire (PAID) score was 39 compared to patients with subclinical or no depression. PAID score analysis in different groups have shown 14% in non depressed diabetic, 42% in subclinical and 49% in depressive diabetic patients. Hence diabetes related depression is prevalent among T2DM patients and this is mostly found in male T2DM patients.[19]

A Prospective study on industrial workers in Japan revealed that Impaired Fasting Glucose (IFG) and Impaired Glucose Tolerance (IGT) were found to be prevalent. A follow up study for 3 years have shown some major factors such as night duty Hazard Ratio (HR), increase in FPG and ALT and all these declined

during recovery phase. Hence night duty stress induced psychological disturbances are the two major factors for the development of T2DM[20]

A study done in Japan among electrical company workers revealed that the incidence of T2DM was found to be significantly higher in those who worked more than 50 hours per month compared to those who worked 25 or less hours per month and the findings were still higher among workers who handle machines. Those who have worked more than 50 hours per month had 3.7 times risk of developing T2DM compared to those who worked around 24 hours per month at 2.4 times risk. Hence longer working time and new technologies are considered as factors for T2DM in Japan[21]

In a cohort study on British workers, analysis of psychological stress using job strain and iso- strain revealed that iso- strain was associated with two fold higher risk for T2DM in the age adjusted analysis for women but not in men. After adjustment for health behaviour and obesity and other T2DM risk factors decreased to 20% risk. A 15 year follow up study showed that psychological work stress was found to be an unconventional predictor of T2DM among women [22]. Middle aged men working among low occupational class in Sweden showed psychological stress as independent predictor of T2DM. After adjustment for age, Body mass Index (BMI), hypertension, smoking, physical inactivity, men with unskilled and semi skilled manual workers showed a significant higher risks for diabetes than higher officials. Adjustments for self reported psychological stress did not improve the outcome and it was concluded that low occupational workers showed a greater risk for T2DM, independent of conventional and psychological risk factors[23]

Another population based cohort study done in Sweden for a period of 8-10 years showed that work stress factors such as demands, decision latitude, job strain, shift work, overtime work and sense of coherence revealed that T2DM was found in a majority of men than women (111vs 60). This observation was arrived at after adjusting for age , education, BMI, physical activity, smoking, family history of DM along with their psychological stress. This study inferred that women with low decision latitude showed association to T2DM and it was influenced by combined high job demand and its associated stress. Men with high work demand and high strain showed decrease as the risk for T2DM. The outcome of this study concluded that work stress and shift work may contribute to the development of T2DM in women, but in Men the risk was reduced by high work demands, high stress and an active job, however the outcome of this study showed some controversy in its conclusions[24]

Working women with passive or tensed working situation who has minimal emotional support are prone to developing T2DM. No improvement was observed in such women after adjusting for BMI, Civil status, educational levels, tendencies for interactions between work stress and low emotional support. Work stress and low emotional support may increase to the risk of T2DM in women, but not in men. Hence psychological stress becomes a potential risk factor for T2DM[25]. In a study the multivariate adjusted relative risk of IFG decreased with an increase in hours in overtime work a day, but did not attain significance longer work time was found to be a negative risk factor for the development of IFG or T2DM in Japanese workers. Hence long working hours and high job strain does not affect male office workers and they are in lower risk of developing T2DM[26]

The three factors that induce burn out among industrial workers are emotional, exhaustion, physical, fatigue and cognitive weakness. Remarkably consistent burnout symptoms were observed irrespective of change in place of work and employment status. However logistic regression analysis indicated that burnout was associated with a 1.84 fold increased risk for T2DM even after adjusting for DM related risk factors. Hence chronic burnout might be a risk factor for the onset of T2DM.[27] Although available evidence strongly suggest that depression and T2DM are associated but the direction of association remains unclear. People with established DM may have depression, but it may also be a risk factor for onset of T2DM and it has been proved by a Medline data compilation. The pooled risk was 1.26 and 1.37 respectively for the fixed and random effects. Depressed adults have a 37% risk for developing T2DM. Since certain pathophysiological mechanisms not clear, randomized control studies are required to test the effectiveness of prevention and treatment of depression in order to reduce the incidence of T2DM.[28] Although studies have proved that Stress induces T2DM, a growing body of evidences are available linking the prevalence of T2DM with visceral adiposity, but whether the relationship between stress and depression is mediated by visceral adiposity is not clear. Interestingly in a study the number of stressful events were found to be positively associated with the prevalence of undetected T2DM and this association remained significant even after adjustments were made for family, history of DM, alcohol intake, physical activity and low level of schooling. Further the number of stressful events weakly and positively associated with waist- to hip ratio (WHR) adding this WHR to logistic regression analysis, stress related T2DM was marginally reduced. These findings indicate that chronic psychological stress is indeed associated with undetected T2DM and with visceral adiposity. However

among white middle aged population visceral adiposity does not seem to be the main link between stress and diabetes[29]

Meta analytic study has revealed that an association exists between adverse psychological factors and risk with DM, but data are lacking on the quantification of the relationship between them. Adverse psychological factors are significantly related poor diabetes control but not with incident DM. More sensitive analysis studies showed that low social support were robustly associated with poor diabetic control than stressful events or stress prone personality or coping with life. However, etiological effect of adverse psychological factors remains elusive. Large population based cohort studies are required to prove this association further[30]

A study done in South India has revealed that high socioeconomic status was associated with T2DM compared to low socioeconomic status and it was found to be significantly higher in high socioeconomic group with pre existing co morbidities compared with persons with no stress, the person with job stress, working stress or family stress is at increased risk of developing T2DM [31] In a white hall II cohort study, psychological stress predicts incident T2DM if the association differs between population at high or low risk of T2DM. Participants with normoglycemia and those with prediabetes were combined with a low risk score and psychological stress did not predict T2DM. Among participants with prediabetes and a high risk score 40.9% with psychological stress developed diabetes compared to 28.5% without distress who did not develop diabetes. Hence Psychological distress had a correlation with an accelerated progression to develop T2DM in population with advanced prediabetes[32]

A study done in Augsburg has revealed that both men and women with job stress showed increased rise of subsequent T2DM. Men and Women with who experience high job strain are found to be at higher risk of developing T2DM independently of traditional risk factors. It is important to take preventive strategies to combat the globally increasing T2DM epidemic due to adverse effect of high job strain in workplace environment[33]

Another study done in Augsburg revealed that loneliness was associated with an increased risk of T2DM in men but not in women. After adjustment for inducing T2DM factors, those living alone showed a risk of 1.69 in men and 0,85 in women. Inclusion of education and depressed mood in women did not improve the score. Hence living alone is an independent predictor of T2DM in men but not in women under general population[34] People working in the lower employment grades had a higher incidence of diabetes than those in higher employment grade and the odds ratio (OR) for men was 2.9 and for women 1.7. Hence an inverse relationship may exist between social positions and incidence of diabetes and it may base on health behaviour and other risk factors. These findings infer that effort reward imbalance may be specifically associated with coronary heart disease combined with T2DM[35]

A study done in Indonesia in a community hospital to determine the relationship of T2DM to related factors such as duration of T2DM, treatment, glycemic control and the presence of complications associated with quality of Life (QL) revealed that the presence of two or more complications were associated with worsened QL. Hence treatment regimen, level of glycemic control and the presence of complications are only associated with the QL[36]

Many prospective studies have firmly established an association between work related stress and the development of T2DM. However meta analysis based on seven prospective studies did not find any significant association between work related risk and risk of T2DM. An association between work related stress and the risk for T2DM was observed in between while meta analysis for all population did not confirm direct association between work related stress and risk for T2DM. Sub group analysis revealed that job strain was a risk factor for T2DM in women[37]

A study involving job stress and diabetes revealed that T2DM was prevalent in 2.6% in males and 2.1% in females and an inverse relationship exists between job control and diabetes in both males and females and a positive association between job stress and diabetes. Sensitive analysis also confirmed the above observed associations. Taking into account of all biological variables the results obtained support the association between job stress either in a combination of high psychological job demands and low job control as well as lack of job control alone and the prevalence of diabetes[38]

In a population based follow up studies of ten years in Norway, the initial diagnosis of T2DM has not revealed any association with depression on both sexes. Individuals reporting with symptoms of depression and anxiety at baseline had an increased risk of onset of T2DM and did not predict any underlying factors to mediate the association. This study has concluded that depression and anxiety symptoms emerges as important risk factors for onset of T2DM and is independent of established risk factors of T2DM[39]

Stress induced hyperglycemia may occur in critically ill patients who have normal glucose tolerance. In an Australian study, the incidence of T2DM assessed critically ill patients was 4.8% and the risk of diabetes in patients with stress induced hyperglycemia was double that of those without stress. Hence stress induced hyperglycemia may identify patients at subsequent risk of incident diabetes[40]. A significant association was found between psychological distress and T2DM among high risk scores compared to these with low risk scores. Hence psychological distress is an independent risk factor for T2DM and was found to be in high risk population[41]

Stress related factors are a cause of T2DM independent of behavioural factors. T2DM prevention will be more effective if psychological stress response was recognised and controlled and interventional programs are initiated to control them. More longitudinal studies are required in this field.[42] In a prospective study meta analysis did not show any statistically significant association between any individual aspect of work- related psychological stress or job strain and risk of T2DM[43]

Although work related psychological stress and T2DM have been extensively investigated, the association between life long work stress and T2DM in later life remains unclear. In a six year follow up study high job strain was associated with T2DM occurrence amongst the 60 year old women but not in men. A more pronounced risk of T2DM was associated with high job stress in combination with heavy household chores load in women aged 60 years at baseline[44].

CONCLUSION:

The number of research done on work stress induced diabetes in India is very few, but many studies have been done in developed countries. Majority of the studies have predicted adverse psychologically combined work related stress as causative factors for the development of T2DM. Conflicting conclusions are still emerging from many cohort studies on this topic but majority of studies predict stress related depression as the main cause for the risk of T2DM. Few studies have shown opposite conclusions. Adverse psychological factors were in support of risk for T2DM. Working women are more prone to stress induced T2DM as they are burdened with additional household works. The other factors that contribute for T2DM risks are living alone, work burn out, poor socioeconomic status, high strain and active job. Pathophysiological mechanism underlying the above observations remain unclear warranting further research in this area. Large scale studies should explore the psychological and behaviour mechanisms associated between work stress and T2DM.

CONFLICT OF INTEREST:

None.

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