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Benefaction of Biological Stress on Diabetes

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ABSTRACT

Whether originating from physical or mental factors, stress has been demonstrated to provoke alterations in blood sugar levels, presenting a predicament for individuals living with diabetes. Stress tends to elevate the levels of counter-regulatory hormones, particularly cortisol, adrenaline, or noradrenaline. Furthermore, diabetes itself constitutes a significant source of stress.

To investigate the impact of stress on diabetes, a study was conducted with 200 participants diagnosed with Type-I and Type-II diabetes. These individuals were divided into two distinct groups based on their stress levels. A battery of tests and questionnaires was administered to both groups to assess their respective stress levels.

The data collected underwent rigorous statistical analysis, which revealed that individuals diagnosed with diabetes displayed a mean stress score of 18, with a corresponding mean deviation of 12.59. This study provides compelling evidence that people living with diabetes experience significantly higher levels of stress compared to their non-diabetic counterparts.

Keywords: Diabetes, Type-I and Type-II diabetes, biological stress

INTRODUCTION

Stress is one of the main obstacles to effective glucose control. Diabetes is a chronic metabolic disease characterized by elevated blood glucose levels and over time can lead to damage to the heart, blood process that can put a lot of stress on your daily life. Stress affects T2DM both directly and indirectly by affecting other risk factors for diabetes. (Mishra D.N.2022)

Based on nine prospective epidemiological studies, depression increases the risk for type 2 diabetes by 37%. (Knol. M et.al,2006)

Depression as a risk factor for diabetes, representing 6,916 incident cases. In that meta-analytic review, the risk for incident diabetes was 60% higher in depressed participants, compared to non-depressed controls. (Mezuk B et.al,2008)

Emotional stress can increase the risk for the development of type 2 diabetes through different pathways. Emotional stress was found to be associated with unhealthy lifestyle behaviors, i.e., inadequate eating behaviors in terms of quality and quantity of food, low exercise levels, smoking and alcohol abuse. (Bonnet F et.al,2005)

Depression is the most commonly researched psychological factor in the Diabetes mellitus field. Results from meta-analysis and prospective cohort studies indicate that depression is associated with an increased risk of Diabetes. (Rotella et.al, 2013)

Negative stressful experiences in the first 2 years of life may increase the risk of developing type 1 Diabetes in children. (Thernlund GM, et.al,1995)

Other factors, such as high family chaos and behavioral problems, were also implicated. Other research has also supported the hypothesis that stressful experiences can lead to increased risk for developing type 1 or type 2 diabetes. (Kisch ES ,1985)

Depression and diabetes-related distress can occur together and can have serious implications for the management of diabetes, because those affected may feel unable or unmotivated to carry out self-care behaviors such as blood glucose testing or healthy eating. A different group of researchers in the United States has identified both diabetes-related stress and other stressors as important in predicting self-care behavior. (Albright TL, et.al ,2001)

Most research on external stressors has focused on how measures of work-related stress can increase one's risk of developing T2DM. meta-analytic evidence indicate that job strain which is defined as a high job demands coupled with low control at work is associated with an increased risk of T2DM. (Nyberg ST et.al, 2014)

People with depression are more likely to be sedentary and eat diets that are rich in saturated fats and refined sugars while avoiding fruit and vegetables, which may contribute to the increased risk of developing type 2 diabetes. (Mc Martin SE et.al, 2013)

The prevalence rates of depression could be up to three-times higher in patients with type 1 diabetes and twice as high in people with type 2 diabetes compared with the general population worldwide. (Roy T and Lloyd CE, 2012)

MINERALS AND METHODS

For the purpose of this study, two distinct groups, namely the diabetic and non-diabetic cohorts, were meticulously chosen as representative samples. The diabetic group was comprised of individuals who had been undergoing treatment for diabetes over a span of five years, encompassing a total of 200 participants, where 100 were classified as Type-I diabetics and the remaining 100 as Type-II diabetics. Furthermore, the non-diabetic cohort, comprising 200 healthy individuals, was carefully divided into two subgroups based on age. Group I encompassed individuals above the age of 30. Therefore, the overall sample size consisted of 400 subjects, with 200 representing diabetics and 200 representing non-diabetics from the city of Kanpur. In order to gather comprehensive data for this investigation, information was collected from both governmental and private clinics within Kanpur.

In the current research endeavor, a meticulous and systematic approach was employed to ensure the selection of a representative sample, known as the systematic purposive sampling technique. Once the sample was finalized, personal contact was established with the participants, during which the significance and utility of the study were thoroughly explained. Additionally, a considerable amount of time was devoted to fostering an atmosphere of open conversation and establishing rapport. Subsequently, a series of tests and questionnaires were administered to the participants. Among them, the Social Readjustment Rating Questionnaire (SRRQ) developed by Holmes and Rahe in 1967, comprising a comprehensive set of 43 items, was individually administered to each subject. Each item in the questionnaire was assigned a specific numerical value corresponding to its perceived level of stressfulness. By summing up the scores for all items, an overall indication of the individual's stress level could be derived.

Scores showing level of stress on diabetics and non-diabetics

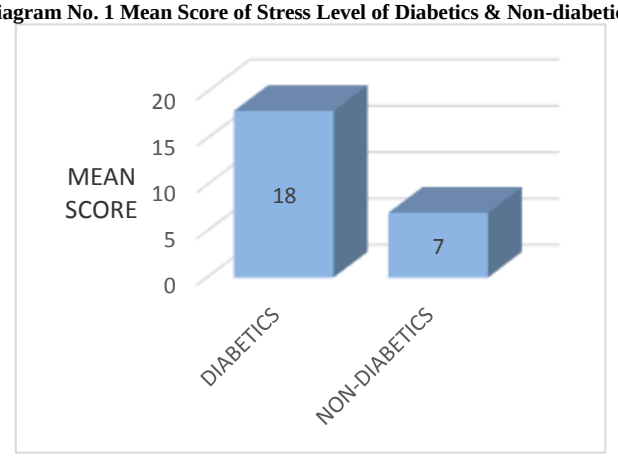
Diabetics Vs Non-Diabetics

Table-1

Persons	Sample Size	Mean	S.D.	S. E_D	df	t
Diabetics	200	18	12.59	1.84	398	11.58*
Non-diabetics	200	07	5.02			

***Significant at 0.1 level**

Diagram No. 1 Mean Score of Stress Level of Diabetics & Non-diabetics



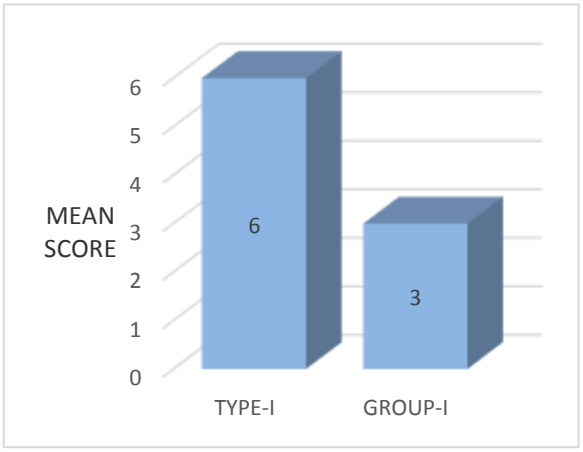
Type-I Vs Group I

Table-2

Persons	Sample Size	Mean	S.D.	$S.E_D$	df	t
Type-I Diabetics	100	06	1.58	0.33	198	9.09*
Group-I Non-Diabetics	100	03	2.80			

***Significant at 0.1 level**

Diagram No.2 Mean Score of Stress Level of Type-I & Group-I



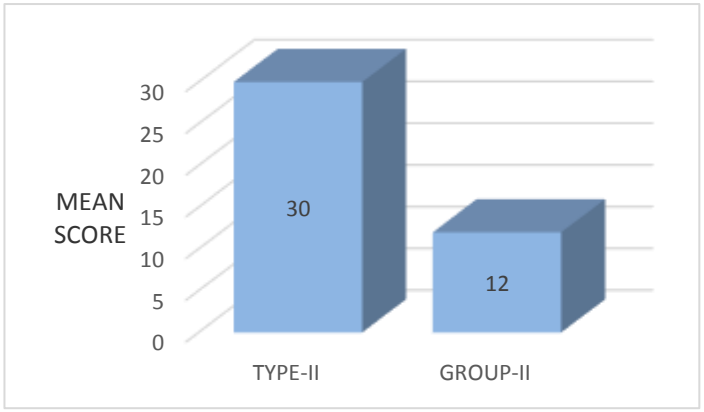
Type-II Vs Group II

Table-3

Persons	Sample Size	Mean	S.D.	$S.E_D$	df	t
Type-II Diabetics	100	30	4.11	0.45	198	40*
Group-II Non-Diabetics	100	12	2.12			

***Significant at 0.1 level**

Diagram No.3 Mean Score of Stress Level of Type-II & Group-II



Inference

Based on the data presented in table-1, it can be observed that the mean stress score for individuals diagnosed with diabetes is 18, with a corresponding standard deviation of 12.59. Conversely, the mean stress score for non-diabetic individuals is 07, accompanied by a standard deviation of 5.02. Furthermore, the standard error of the difference (SED) is calculated to be .95, while the t-value obtained is 11.58. Notably, there exists a noteworthy disparity of 11 points between the mean stress scores of diabetics and non-diabetics. This discrepancy indicates a higher level of stress among individuals with diabetes in comparison to their non-diabetic counterparts, a distinction that has been found to be statistically significant at the .01 level.

Table-2 presents a comprehensive comparison of stress levels between individuals diagnosed with Type-I Diabetes (aged below 30) and the Non-diabetic Group-I (below 30 years of age). The mean stress level for Type-I Diabetics is calculated to be 6, with a standard deviation of 1.58, while for the Non-diabetic Group-I, the mean stress level is 3, with a standard deviation of 2.80. The standard error of the difference (SED) is determined to be 0.33, and the calculated t-value is 9.09, both of which hold significant statistical significance at the 0.01 level. The outcomes obtained from Table-2 further corroborate that individuals with Type-1 Diabetes experience higher levels of stress compared to the Non-diabetic Group-I, despite both groups sharing the same age range. Based on these findings, it can be concluded that Diabetes exacerbates stress levels.

According to the findings presented in Table-3, the average stress score for individuals with type-2 diabetes was recorded at 30, whereas the non-diabetic participants in group-2 exhibited a mean score of 12. The corresponding standard deviations for these groups were calculated to be 4.11 and 2.12, respectively. Furthermore, the standard error of the difference (SED) was determined to be 0.45, while the calculated t-value amounted to 4, indicating a highly significant result at the 0.01 level.

Upon analysis, it is evident that the findings presented in table-3 substantiate the results obtained from table-1 and table-2. In this regard, it is noteworthy that the average stress score among Type-II diabetics is notably higher, with a significant difference of 18 when compared to the non-diabetic population. This discrepancy of 18 between Type-II diabetics and Non-Diabetics Group-II serves as additional confirmation, reinforcing the established association between diabetes and stress. The data unequivocally demonstrates that stress tends to be more prevalent among individuals with diabetes in comparison to those without the condition.

The examination of the results presented in Table 1, Table 2, and Table 3 unequivocally suggests a notable disparity in stress levels between individuals with diabetes and those without. Specifically, the findings indicate that stress is significantly more prevalent among individuals diagnosed with diabetes compared to those who are non-diabetic. Remarkably, the combined mean stress score for individuals with Type-I and Type-II diabetes amounts to 30. This compelling evidence supports the notion that individuals with Type-II diabetes experience higher levels of stress when compared to both Type-I diabetics and non-diabetic individuals.

Upon careful analysis of the findings presented in Table 1, Table 2, and Table 3, it becomes evident that a significant disparity exists in the stress levels experienced by individuals categorized as Diabetics and Non-Diabetics. Remarkably, the data reveals a higher prevalence of stress among the Diabetic group when compared to the Non-Diabetic counterpart.

Upon analyzing the aforementioned data, it becomes evident that the findings undeniably support my initial hypothesis, effectively affirming the notion that the prevalence of stress is markedly higher

among individuals afflicted with diabetes when juxtaposed with their non-diabetic counterparts. Furthermore, a parallel observation can be made, suggesting that the level of stress experienced among individuals diagnosed with maturity-onset diabetes surpasses that witnessed in those with juvenile diabetes. Remarkably, stress has been incontrovertibly established as significantly associated with both mental and physical well-being.

In a groundbreaking study conducted by Marcovecchio in 2012, an in-depth analysis was carried out to examine the profound impacts of both chronic and acute stress on the regulation of diabetes. The study unequivocally revealed that stress emerges as a significant and primary factor contributing to the lack of control over diabetes. Furthermore, in subsequent research conducted by Harris et al. in 2017, a compelling correlation between stress and the heightened risk of developing Type-II diabetes in women was elucidated. These findings not only highlight the detrimental influence of stress on the onset of diabetes but also underscore the crucial role that stress plays in the development of this condition.

Importantly, the outcomes derived from this research resonate harmoniously with numerous other investigations that have meticulously examined the profound impact of emotionally distressing encounters on an individual's overall health status.

Stressful experiences, given their significance as etiological factors in the pathophysiology of chronic disabling conditions, warrant considerable attention. Numerous studies highlight the cumulative impact of multiple stressful life events. The exploration of physiological and environmental stressors in individuals with diabetes has a longstanding history. Initial reports proposed that Type-I diabetes onset could potentially be triggered by psychological stress in individuals with physiological vulnerability. Psychological stress can disrupt the activity of the sympathetic nervous and adrenomedullary systems, elevate levels of plasma cortisol, potentially enhance the secretion of glucagon and growth hormone, and influence immune functions. Within this framework, a theoretically relevant set of biological pathways exists that could potentially mediate the relationship between psychological stressors and the onset of diabetes. Surwit and Feinglos observed mounting experimental evidence indicating altered activity of the sympathetic nervous system in Type-II diabetes. This discovery suggests the presence of a disrupted homeostatic mechanism that could contribute to excessive energy storage by decreasing sympathetic activity while simultaneously preventing weight gain by decreasing parasympathetic activity. Diabetics often exhibit higher levels of stress, potentially due to the causal neuroendocrine activities linked to the onset of hyperglycemia and/or hyperinsulinemia. (Williams et al., 2013).

Extensive research has been conducted to investigate the profound role of psychological stress in the regulation of metabolic control among patients diagnosed with Type-I (Juvenile diabetes). This expansive body of research suggests that the presence of family conflicts has the potential to elicit emotional responses within a specific subset of diabetic children, thereby directly triggering recurrent Ketoacidosis, irrespective of their adherence to treatment regimens. Notably, preliminary studies conducted on both animal and human models of diabetes have presented intriguing indications that psychosocial stress might contribute to the onset of both Type-I and Type-II diabetes.

When examining the impact of stress on metabolic control in Type-I diabetics through laboratory research, the results have proven to be somewhat inconsistent when applied to random samples. However, the adoption of a research model derived from cardiovascular disease has proven to be a valuable approach in identifying and classifying diabetics who may be particularly susceptible to the direct

psychological effects on metabolic regulation. It is evident that psychosocial stress can exert direct psychosomatic effects on the neuroendocrine regulatory mechanisms that govern metabolic control. Furthermore, it is apparent that stress can influence patients' compliance behaviors, leading to challenges in achieving optimal metabolic control. At the very least, stress may significantly impact glycemic control by influencing patient behaviors. These findings were underscored by the research conducted by Novak et al. in 2013.

CONCLUSION

Based on the aforementioned results, it has been unequivocally established that individuals diagnosed with diabetes experience significantly higher levels of stress when compared to their non-diabetic counterparts. Moreover, among individuals with diabetes, those with maturity-onset diabetes exhibit greater stress levels than those with juvenile-onset diabetes. Diabetic individuals face an array of challenges, encompassing financial difficulties, the loss of a spouse or relative, employment concerns, retirement worries, and marital issues, among others. The implications of this study's findings hold practical value for doctors, as well as for individuals with diabetes and their family members. In terms of guidance, it would prove advantageous for doctors to maintain comprehensive profiles documenting the mental well-being of each diabetic patient, in order to effectively address and alleviate their psychological tension. It is crucial to acknowledge that mental well-being plays a pivotal role in the overall management of diabetes.

Declaration by Authors

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