

IMPACT OF STRESS ON TYPE 2 DIABETES MELLITUS MANAGEMENT

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SUMMARY

Background: Type 2 diabetes mellitus (T2DM) is one among the major health and socioeconomic problems worldwide. It is, however, not a somatic illness for which just symptomatic treatment will suffice. Stress is an important factor in not only causing diabetes onset or exacerbation, but also in hampering proper treatment by interfering with the treatment adherence of patients. Hence, it becomes important for physicians to acquaint themselves with the effects of stress on T2DM in order to ensure proper treatment of the latter.

Objective: Documentation of effect of stress on the management of T2DM.

Subjects and methods: The research was a cross-sectional study on the patients attending Sri Muthukumaran Medical College, Hospital and Research Institute, Mangadu. A total of 400 people, who were pre-established diabetic patients of the hospital of age greater than 30 years, were chosen for the study. The stress levels of the patients were assessed with the Perceived Stress Scale (PSS) and treatment adherence using a questionnaire prepared exclusively for the study. Based on the data, a statistical relationship was framed between the degree of control (treatment adherence) and the stress levels of the patients.

Results:

- The FBS levels were a direct reflection of the stress levels ($P < 0.05$).
- Stress had a major impact on treatment adherence among the diabetic subjects: Increased levels of stress decreased the adherence ($P < 0.001$).
- The glycaemic index (HbA_{1C} level) was found to be linked to both treatment adherence and stress. Increased adherence kept it at bay ($P < 0.05$) while stress proved abysmal to glycaemic control.

Conclusion: T2DM is the result of an interplay between various factors; environmental, psychiatric and somatic. Hence, a holistic treatment approach is required, one that involves stress management, education and mental health awareness along with pharmacological treatment, to fully control the disease.

Key words: type 2 diabetes mellitus – stress - perceived stress scale - treatment adherence - glycaemic index - glycaemic control - non-adherence

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a well prevalent condition worldwide. Various modalities of treatment for diabetes have been developed over the past years, many of them successful in keeping the disease at bay. It is however, important to note that the treatment which has been prescribed is being followed, and if not, why. It is also essential that in any disease, a holistic treatment aspect is chosen or else, the disease is never fully treated. This is especially true in case of T2DM which is a psychosomatic illness wherein, treating only the somatic and symptomatic aspect of the disease will not aid in curing the patient. The psychiatric aspect of the disease, especially stress, must also be focused on. Thus, all-inclusive treatment constitutes treatment of stress as well as T2DM, since without treating stress, not only are we giving way for recurrences to occur, but also for less than perfect adherence to prevail, which hinders the proper and effective treatment of the condition. Recognizing stress and other factors that hinder adherence to diabetic treatment as well as preventing them thus, an important adjunct to the treatment of T2DM.

Aims

Assessment of stress levels in subjects and their impact on treatment of diabetes:

- To express the effect of stress on blood glucose parameters.
- To define the effect of stress on treatment adherence.
- To outline the effect of stress on the glycaemic control of the patients.

To check the adherence of the subjects to treatment advised for diabetes.

- To compare the adherence levels with glycaemic control of patients.
- To elicit the most common reasons for non-adherence to treatment.

Subjects and Methods

The study was a cross-sectional descriptive epidemiological study done in SMMCHRI over 2 months, with 400 subjects, in the Department of Psychiatry and General Medicine, SMMCHRI. The subjects were pre-

established type 2 diabetics attending SMMCHRI with age of onset of diabetes greater than 30 years, with fasting and post-prandial blood glucose levels taken recently. Diabetics with age of onset less than 30 years and type 1 diabetics were excluded. The data was collected by interviews / questionnaires.

Ethics Committee Approval and Patient Consent

The proposal was presented to the Institutional Ethics Committee (IEC) of SMMCHRI and approval was obtained on the 25th of April, 2016. The study subjects were selected based on the inclusion and exclusion criteria. The patients who were interviewed had agreed to participate in the study and were educated about the nature and goal of the study prior to obtaining their consent. They were then given the consent form for their perusal and consent was sought.

Data collection

Individual patient data were collected with the help of two questionnaires. The subjects were instructed on how to fill the questionnaires, which had been translated into the native language for comprehension by them. Subjects who did not know how to read were interviewed instead.

Treatment adherence questionnaire – details

There are a total of 16 questions in it. Out of these 16 questions, 4 pertain solely to insulin based treatment and hence, the non-insulin users only have a total of 12 questions to answer to. The higher the score, the greater is the adherence level of the subject. It is a manually formulated questionnaire with important questions about the treatment protocol not only involving the medicine aspect, but also relating to diet pattern, exercise regimens, proper diabetic footwear usage and regularity of diabetic investigations and consultations. It also emphasizes specially on the patient's knowledge about the condition and the mode of presentation. It investigates the patient on how often they realize that their blood sugar is very high or very low based on how they feel. This provides scope for the patient to learn important signs of diabetic health through the process. It has questions about maintenance of diabetic chart or file for continuous monitoring of health. The extra 4 questions on insulin treatment emphasize on the patient's ability to manage his/her own injection schedule and dose. It also questions about the site of insulin injection and rotation of sites to prevent lipodystrophy. Hence, it is a very useful and easy questionnaire that can be used to obtain well-rounded information about all the aspects of diabetic treatment followed by the patients.

Perceived stress questionnaire – details

Stress has two major components: Depression and Anxiety. The 10- question Perceived Stress Scale (PSS), founded by Cohen et al. (1983) is an open access, valid

and reliable scale covering both anxiety and depression, that could be used to measure the degree of individual's response to stressful situations. It has been mentioned specifically that the PSS is an effective scale to measure the relationship between stress appraisal and the risk for any disease (Al Kalaldehy 2012).

Interpretation of the data

The main goal was to study the impact of the stress levels on treatment adherence of the subjects. The stress was calculated using the Perceived Stress Scale (PSS) and the results were interpreted using the article on the PSS (Cohen 1983). The levels of treatment adherence of the subjects were converted to their respective percentages for standardization. The data were then used to derive the following:

- The relationship between stress levels and the blood glucose parameters.
- The effect of stress on treatment adherence of the subjects.
- Correlation between stress levels and the HbA_{1c} levels.
- Correlation between treatment adherence and HbA_{1c} levels.
- Reasons for non-adherence to treatment.

Statistical Analysis and Interpretation

The continuous variables were described in terms of Averages (Mean, median and mode) and categorical variables were described in terms of Percentages. The Categorical variables were interpreted using χ^2 tests, and normally distributed continuous variables were interpreted using t tests. The relationships between the variables were studied by product moment correlations and the associations between the variables were found out by χ^2 tests. In respect of continuous variables, more than two groups were signified by ANOVA test. The above statistical procedures were performed by the IBM SPSS Statistics-20. $P \leq 0.05$ was considered to be statistically significant.

RESULTS

The percentage scores of treatment adherence have been categorized into four groups:

Very poor: 0–25; Poor: 25–50;
Fair: 50–75; Good: 75–100

The stress levels were divided into five categories based on the scores.

Very Low: 0–7; Low: 8–11; Average: 12–15;
High: 16–20; Very High: >21

Stress levels and blood glucose parameters

The levels of stress were correlated with the levels of FBS and PPBS of the subjects (Table 1). It was found that there was a positive correlation between both the FBS and PPBS values and the stress levels. Thus, when

there was an increase in the stress levels, the blood sugar values also increased concurrently. The relation between FBS and stress levels was significant ($P < 0.05$). There was however, no significance in the correlation between PPBS and the stress levels ($P > 0.05$).

Table 1. Correlation between Stress levels and the Blood Glucose parameters of the subjects

Variables	n	r	Significance
Stress X FBS	400	0.108	$P < 0.05$
Stress X PPBS	400	0.062	$P > 0.05$

FBS – Fasting Blood Sugar; PPBS – Post-prandial Blood Sugar

Stress levels and treatment adherence

The relationship between stress levels and treatment adherence is a very important one since there is a direct effect of stress on the adherence. Table 2 was prepared with Stress levels as the independent variable and the adherence as the dependent variable. It was found that ‘Very low’ stress levels were associated mostly with ‘Good’ treatment adherence levels. Similarly, ‘Very High’ levels of stress were maximally associated with ‘Poor’ levels of adherence. This relationship was found to be very highly significant ($P < 0.001$).

The correlation between the stress levels and adherence levels was studied (Table 3) and it was found that there was a very significant negative correlation between the two ($R = -0.174$). Thus, as stress levels increased the treatment adherence levels would decrease.

Stress levels and HbA_{1C} levels

A Regression analysis was done in order to find out the relationship between stress and the glycemic index. The results were used to plot the estimation curve which showed a positive correlation between the stress and HbA_{1C} levels (Figure 1). The Regression equation was found to be:

$$HbA_{1C} = 6.764 + 0.053 * StressScore$$

where, 0.053 is the correlation between the two values. Thus, as the stress levels increased, the HbA_{1C} levels also increased. This was perfectly in accordance with the widely known fact that stress increased the propensity of developing T2DM in adult life. This finding was however, not significant, with $P > 0.05$.

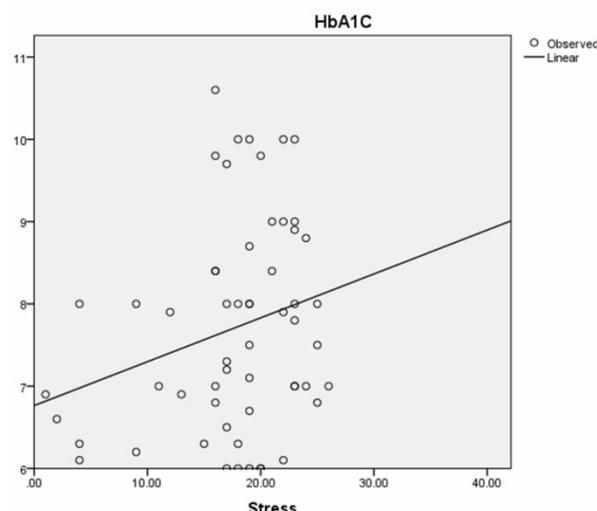


Figure 1. Correlation between stress and HbA_{1C} levels among the subjects

Adherence and HbA_{1C} levels

The relationship between adherence to treatment and glycemic index was studied with the help of Regression. It was found that Adherence was negatively related to the HbA_{1C} levels. Thus as the level of adherence increased, the HbA_{1C} levels decreased and good glycemic control was achieved. The results were plotted in the form of an estimation curve which showed the negative correlation between the two variables (Figure 2). The regression equation was:

$$HbA_{1C} = 8.883 - 0.019 * AdherencePercentage$$

where, 0.019 is the level of correlation between the HbA_{1C} levels and the adherence percentage and the symbol (-) shows the direction of the correlation. This correlation was found to be significant ($P < 0.05$).

Regression analysis between the HbA_{1C} levels and the treatment adherence and stress score of the subjects:

$$y = 7.965 - (0.18 * Adherence) + (0.047 * Stress)$$

Adherence was found to have a negative correlation and stress, a positive correlation, with the HbA_{1C} levels of the subjects. Thus, the glycemic index of a patient depends on his/her stress and adherence levels.

Table 2. Relationship between stress levels and treatment adherence among the subjects

Stress levels	Treatment Adherence Score								Total		Results
	Very Poor		Poor		Fair		Good		No.	%	
	No	%	No.	%	No.	%	No.	%	No.	%	
Very low	0	0.0	2	2.2	13	6.9	27	27.0	42	10.5	$\chi^2=72.346$
Low	5	26.3	12	13.0	7	3.7	2	2.0	26	6.5	
Average	5	26.3	9	9.8	27	14.3	14	14.0	55	13.8	df=12
High	1	5.3	24	26.1	63	33.3	27	27.0	115	28.8	
Very High	8	42.1	45	48.9	79	41.8	30	30.0	162	40.5	Sig = $P < 0.001$
Total	19	100.0	92	100.0	189	100.0	100	100.0	400	100.0	

No – Number; Sig – Significance

Table 3. Correlation between the stress and treatment adherence levels of the subjects

Variables	n	r	Significance
Stress X Adherence	400	-0.174	$P < 0.001$

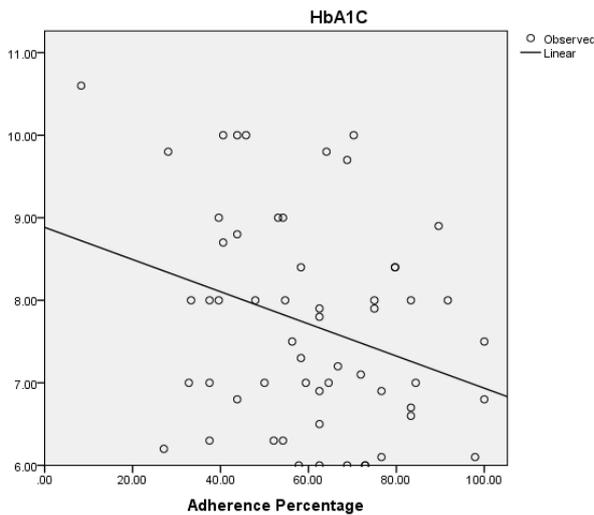


Figure 2. Correlation between adherence percentage and HbA_{1C} levels among the subjects

Reasons for non-adherence

Treatment regimens in type 2 diabetes are complicated, involving lifestyle adaptations as well as regular medicine intake. It is therefore very easy for people to become defaulters. Figure 3 graphically depicts the various reasons for non-adherence as told by the subjects. The figure shows that the most common reasons given were ‘alcohol addiction’, ‘no awareness’ and ‘not feasible’. Closely following these are the reasons ‘careless’ and ‘stress’. The above Figure 3 shows the percentage of each of the reasons for non-adherence to treatment as told by the subjects. The most common reasons were alcohol addiction (29.9%) and absent awareness (28.7%). The least common reason was due to complications (1.5%).

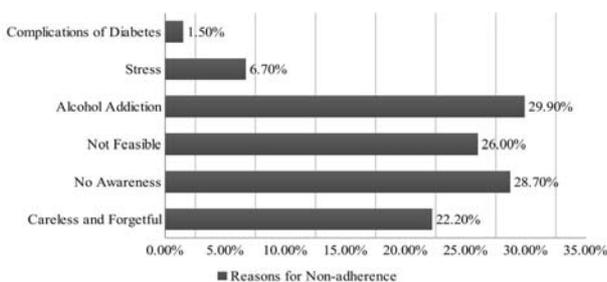


Figure 3. Percentage distribution of the various reasons for non-adherence to treatment

DISCUSSION

This study brings out how stress affects T2DM by blighting the treatment aspect of the disease. The study population, per se, is a rather stressful one by virtue of its poverty, and hence exhibited decreased levels of

adherence as expected. This manifested in the form of a very high glycemic index. It is thus, an evident outcome that diabetic treatment consists of targeting not only the somatic aspect, but also the stressors, psychiatric and otherwise. To back these results, a study based on the hypothesis that reducing stress would improve glycemic target achievement showed that stress management training did in fact, show a significant reduction in the HbA_{1C} levels and that a cost-effective stress management program along with basic medical treatment for the condition would go a long way in curing the patient (Richard 2002). Several other studies also recommended to include mental health programs as a part of treatment for T2DM (Avci 2016, Glover 2016, Richard 2002).

The relationship between stress and T2DM has long since been established and it was cited to be a very important risk factor for the onset of T2DM (Kawakami 1999, Knol 2006). It was revealed that two out of every five diabetic patients were suffering from alexithymia and hence the treatment for diabetes should also include mental health care services (Avci 2016). Another study brought out how stress affected the lifestyle. It showed that improvement in the lifestyle of diabetics and hence, their diabetic status, can be obtained only by targeting stress along with diabetes during treatment for the same (Glover 2016).

The second leg of this study consisted of finding out the level of treatment adherence that was present among the study subjects. The subjects were mostly from the low socio-economic (SE) category. There is a huge gap between the low SE community and the treatment in the form of illiteracy and ignorance which is further augmented by the lack of money. Hence, in order to bridge this gap, the reasons for the gap as well as various factors affecting it must be familiarized. Lack of awareness and affordability were found to be major issues in the study population, especially since they came from the lower SE class. Several studies have been conducted on increasing the adherence to treatment (Verneire 2005). Increasing awareness among patients regarding diabetic management has shown to improve the glycemic control (Suresh 2005, Susan 2002).

Exclusivity of the study

Structured questionnaire formulated specially for the study was used to expose medication adherence.

Because the patients being interviewed were not expecting to be asked about their medication usage over the past month there was a less chance of them modifying their pill-taking behavior in anticipation of the interviews.

The study concentrated on stress being an important aspect in causing adverse results among treatment of T2DM. Detailed reviews of the pattern of non-adherence to treatment also put under focus the areas for physicians to concentrate in order to lessen the encum-

branch of diabetes in the future. This provides greater scopes for the improvement of the state of the diabetics in future, since elimination of these above mentioned reasons would by itself increase the treatment efficacy.

Another unique aspect of the study was that every data that was obtained was acquired from the patients themselves and not from the relatives or physicians. This brings out more honest results. Thus, this study concentrates more on the patient aspect of the disease and brings out how the patients lack in bridging that gap between themselves and their own treatments.

Limitations to the study

Since the patients were told prior to the interviews that their answers were going to be used for research, exaggeration of their adherence would have been a possibility. But this need for overstatement and dramatization could have also brought out the difficulties faced by the patients during treatment and enabled them to express concerns about any complications or stress issues that they might not have admitted to previously.

Also, since the patients were randomly selected, it is possible that the actual adherence in the population is actually lesser than that reported by this study. The patient cohort was a random sample of diabetics consisting of different classes of society, mostly the lower SE class. Even though hailing from a poor background, they were from in and around the area of the hospital. Hence, they had easy access to drugs and clinics at a subsidized rate and were relatively well engaged with the medical system in that most of them had laboratory testing and at least one doctor visit in the past 6 months. Thus they would have had fairly good adherence when compared to those living in remote and poor villages - with very low awareness about the disease and no accessibility to even Primary Health Centers (PHCs) - for whom the proposed interventions are actually intended, based on the results of this study.

There is a possibility that stress and poverty coincided with being the reason behind poor adherence to medication since most of the study subjects were poor.

CONCLUSION

There was a significant positive correlation between the stress levels and FBS, while PPBS had no significant relation with it.

Stress levels were found to adversely affect treatment adherence among the subjects. Being negatively correlated and significantly so, increased levels of stress were associated with very poor adherence while those with perfect adherence were found to be stress-free. This aspect of the study brings light to the fact that mental health and counseling should always be a part of proper diabetic treatment regimen. The interplay between different aspects of treatment will greatly benefit the patient, especially since the ones who need the most help in procuring medicines for diabetic treatment are

also the ones who are very much stressed (lower socio-economic category of people). Only when the mental health issues and stress of a patient are addressed will it be a comprehensive and rewarding consultation. Since dealing with stress will aid the patient's part in his/her own treatment, it will provide better results on the adherence front.

As far as the glycemic index was concerned, greater treatment adherence kept it in bay while higher stress levels were found to increase the HbA_{1C} levels. This gives an idea about how adherence and stress are very important aspects in controlling the glucose levels.

The most common reasons for non-adherence to treatment were lack of awareness, poverty and alcoholism. Stress and illiteracy came in next. The treatment areas should thus also include treating conditions like alcoholism, counseling and alleviating stress and also educating the patient regarding the disease and its treatment. Only when concentration is paid to all these aspects will the disease truly be under control and the treatment be called successful.

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Contribution of individual authors:

- R. Vasanth: The idea to use the Perceived Stress Scale, assistance in data collection and patient interviewing, the revision of the article and the final approval of the version to be published;
- Aparna Ganesh: The conception of the project idea, the idea to use a questionnaire for data collection, the framing of the treatment adherence questionnaire, the acquisition of data and its statistical interpretation and drafting of the project;
- R. Shanker: The idea to do a cross sectional study, assistance in the making of the treatment adherence questionnaire and the final approval of the version to be published.

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