



## DEVELOPMENT OF A MOBILE APPLICATION BASED SPECIFIC STRESS SCALE FOR GESTATIONAL DIABETES MELLITUS

**ANANDHASAYANAM ARAVAMUTHAN<sup>1</sup>, SARANYA PUZHAKKAL<sup>2\*</sup>, JITHIN THULAMKUNNUPARAMBIL GOVINDANKUTTY<sup>2</sup>, SNEHA THOMAS<sup>2</sup>, AND VARADHARAJAN VENKATRAMAN<sup>2</sup>**

<sup>1</sup>*Research Scholar, Department of Pharmacy Practice, JKKMMRF College of pharmacy, Erode, Tamilnadu, India.*

<sup>2</sup>*Sixth year Doctor of Pharmacy, Department of Pharmacy practice, JKKMMRF College of pharmacy, Erode, Tamilnadu, India.*

### ABSTRACT

Gestational diabetes mellitus (GDM) is the type of diabetes that occurs in women at the time of gestation or pregnancy. Prevalence of GDM is increasing worldwide. Yearly 21 million new cases are reported. A normal pregnancy itself is linked with unique physical and psychological challenges and which is documented by medical fraternity. But no mention is made on psychological complaints specific to pregnant women diagnosed to have diabetes. It is well documented that diabetes is linked with significant distress level because it demands many lifestyle changes and pregnancy itself is a challenging condition. It stands to reason that a diabetic pregnancy will be linked with significant stress. Maternal exposure to stress can adversely affect the health of both foetus and mother. Stress can also affect diabetic management by influencing diet compliance, medication adherence and blood glucose monitoring. Studies also stated that stress can cause hyperglycaemia by altering hormone balance in body. Therefore any action plan for GDM must include proper stress management to obtain a desired outcome. Customised scales are available to measure the stress related to diabetes and normal pregnancy. But there was no specific scale available to measure GDM related stress scale. This study was undertaken to develop a mobile application based specific stress scale for GDM. A new scale called Gestational Diabetes Stress Scale (GDSS) was developed and introduced through a mobile application. This is a 16 item scale. GDSS gives total score and four subscale scores. A mean item score greater than or equal to 3 indicates the need of clinical attention. The total score is used to measure the overall stress level in patient. And the four subscale scores are to identify the possible sources of stress, which means whether the stress is due to emotional burden and/or medication related and/or health care set up and/or due to any economic or social relationship related and thus it allows the health care professional to manage the stress accordingly, thereby the gap in measuring gestational diabetes mellitus related stress was bridged and through the mobile application all the needed patients and health care providers can use it.

**KEY WORDS:** *Gestational diabetes mellitus, Gestational diabetes stress, Stressscale, Gestational stress*



**SARANYA PUZHAKKAL<sup>\*</sup>**

Sixth year Doctor of Pharmacy, Department of Pharmacy practice,  
JKKMMRF College of pharmacy, Erode, Tamilnadu, India.

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## INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance starting with pregnancy or noticed during pregnancy. If the glucose tolerance is not noticed before pregnancy, we call it pre-existing diabetes mellitus.<sup>1</sup> In general, a 2 hour 75 gmoral glucose tolerance test at 24 to 28 weeks of gestation is used for the screening of GDM. If the fasting blood glucose level is  $\geq 92$ mg/dl or 1 hour value is  $\geq 180$ mg/dl or 2 hour value is  $\geq 153$  mg/dl GDM can be diagnosed. GDM affects the health of pregnant females and about 3-10% of all pregnancies are complicated by diabetes.<sup>2</sup> The prevalence of GDM is increasing worldwide. Yearly 21 million of the world (7% of the population) is reported to be a GDM.<sup>3</sup> However, prevalence of GDM will vary depending on the population, human race and the diagnostic criteria defined by each country. International Diabetes Federation estimates that 16% of the children born alive in 2013 all around the world had complications due to hyperglycemia during pregnancy. It is believed that this prevalence will increase because of the growth of risk factors, mainly obesity and lifestyle.<sup>4</sup> Approximately 90% of the diabetes cases in pregnant women are considered GDM.<sup>5</sup> The prevalence of GDM is higher in Asian, Latin-American and Indian women.<sup>1</sup> A large majority of pregnant women return to normoglycemia after birth, but among all 2/3 will have gestational diabetes mellitus again in a next pregnancy, 20% have impaired glucose tolerance in the postpartum period and 50% will have diabetes mellitus type 2.<sup>6</sup>

### ***Complications of GDM***<sup>7</sup>;

Fetal complications include Macrosomia, spontaneous abortion, congenital malformation, intrauterine death. Maternal complications like Risk of diabetes recurrence in future pregnancies, future possibility of diabetes mellitus, polyhydramnios, pregnancy toxemia, urinary tract infection, candidiasis, higher incidence of premature childbirth, caesarean delivery are seen. In addition to the stress of pregnancy itself, GDM is also a stress factor.<sup>8-10</sup> Women with GDM experience shock, fear and stress.<sup>11, 12</sup> Neonatal complications encountered include Hypoglycemia, hypocalcaemia, polycythemia, jaundice requiring phototherapy, trauma (shoulder dystocia) and respiratory distress syndrome. Maternal stress during pregnancy can cause emotional or cognitive problems in child, including an increased risk of

attention deficit/hyperactivity, anxiety and language delay.<sup>13</sup>

### ***Gestational Diabetes Related Stress***

The unique psychosocial problems and challenges faced by women experiencing pregnancy have been documented by obstetricians.<sup>14</sup> However, no mention is made of psychosocial complaints specific to pregnant women diagnosed to have diabetes. It is clearly documented that diabetes is associated with distress<sup>15</sup>; and pregnancy is in itself a stressful condition.<sup>16</sup> It stands to reason that a diabetic pregnancy will be linked with significant stress. This medical concern becomes even more important, as we understand that maternal exposure to stress, in the form of grief or bereavement, leads not only to maternal ill health, but impacts the health of the unborn foetus, increasing its chances of developing both type 1 and type 2 diabetes.<sup>17</sup> Western works is available which highlights the existence of significant psychosocial stress, and need for better psychological care for women with pregnancy complicated by diabetes.<sup>18-21</sup> Normal pregnancy is a developmental crisis with tremendous physiological and psychological changes. Psychological stress involves emotional disequilibrium, increased anxiety and personality reorganisation. Additionally, various behavioural changes such as inability to sleep, rapid alteration in mood etc also occur during pregnancy. GDM complicate the psychological disturbances of a normal pregnancy. Because it is both potentially life-threatening condition and the management involves many lifestyle changes. Women who are diagnosed with GDM must modify their environment, diet and activity such as they have to monitor their blood glucose level several times a day, adhere to dietary restriction, often self-administer insulin etc. And awareness of pregnancy related diabetes can also increase the emotional distress. Thus, GDM is a serious condition occurs in the lives of women during a stressful period.

### ***Complications of GDM related stress***<sup>22</sup>;

Researchers reported that stress is correlated with increased glucose levels. Although the relationship between stress and metabolic control remains unclear, stress can affect diabetic control through influence on diet compliance and medication adherence or glucose monitoring. Thus stress can result in uncontrolled GDM, which will lead to all GDM related complications. Studies also reported that pregnant women who control her diabetes experience better infant outcome like better behavioural and intellectual development of the

offspring. A study investigated the impact of stress exposure, psychological stress responses and physiological stress responses (salivary cortisol, plasma copeptin levels) on glucose concentration during pregnancy. Concluded that some indicators of stress exposure and psychological stress responses were associated with fasting glucose concentration in pregnant women, thus stress is an important risk factors for GDM development also women after GDM diagnosis reported more major life events compared to healthy pregnant controls.<sup>18</sup>

### ***Sources of stress in gestational diabetes***

- Emotional distress because of the fear about the maternal and infant complications, lifestyle modifications needed for GDM management such as insulin administration, compliance with specific diet, regular blood glucose monitoring and frequent hospital visits.<sup>20,22,23</sup>
- Medication related distress, such as fear of administration of insulin with a syringe or frustration due to more oral medications.<sup>20,22,23</sup>
- Health care provider related, this involves the problems like getting insufficient time with physician for discussing their issues. And it is reported that women with GDM also had a belief that the medical profession discounted their physiological complaints.<sup>20,22,23</sup>
- Economic or social distress, studies reveal that GDM group report less social support from outside the family.<sup>19</sup> Also the unexpected cost for medicines and blood test after the diagnosis of GDM will also add to the stress level in pregnant women with GDM.

### ***Need of a specific scale for gestational diabetes related stress.***

There are specific scales available for measuring the stress during pregnancy such as pregnancy experience scale, Tilburg pregnancy distress scale, the A-Z stress scale etc. But the situation is different in case of pregnant women with GDM, because the fear of health complications, demand of life style modifications, administration of anti-diabetic medicines etc... Can add to the psychological disturbances in pregnant women. Specific scales are there to measure the stress in patients with diabetes mellitus. Psychometric validation of stress and compliance scale for diabetes (SCSD), Diabetes specific quality of life scale, Appraisal of diabetes scale, problem areas in diabetes scale, diabetes distress scale etc. All these also cannot be used in women with GDM. Because the disease condition, complications and

needs are entirely different in both cases. Treating gestational diabetes without including stress management as a part of the action plan is like trying to search a black cat in a dark room with blindfolded eyes. Because the uncontrolled stress itself can lead to hyperglycemia. During literature search we clearly understood that no specific and customized scale is available for measuring the stress level in women with gestational diabetes. In all the researches done in the past investigators used the scales which are designed for measuring general stress such as perceived stress scale, Anxiety stress scale etc and some investigators used both pregnancy stress scale and diabetic stress scale to assess the stress due to GDM. From the literature search we understood that there was a gap, no single instrument was available to measure gestational diabetes related stress. Therefore a specific scale to measure the psychological status of women with GDM was needed. To optimize the fetal and maternal outcome the proper management of the stress in pregnant women is very essential. And for preparing a suitable plan for stress management the physician need to know degree of stress level in each pregnant women having GDM along with the reason or sources for the stress.

### ***Need of mobile application***

Introducing a newly developed stress scale for GDM through a mobile application can allow the world wide access of the scale.

## **MATERIALS AND METHODS**

### ***Literature review***

Reviews are done on literatures to check whether there is any single instrument available to measure gestational diabetes related stress in women and found that no single scale is available to measure GDM related stress. Thus reached the conclusion that there is a gap in measuring GDM related stress.

### ***Review of the available scales:***

A literature search was conducted to find out all the available scales related to the subject. It was found that there are specific scales available for measuring the stress during pregnancy such as pregnancy experience scale, Tilburg pregnancy distress scale, the A-Z stress scale etc... All these scales are meant for measuring distress or anxiety in normal pregnancy. This cannot be used for GDM patients. Because GDM measuring distress or anxiety in normal pregnancy. This cannot be used for GDM patients. Because GDM will add to the stress level of pregnant women by demanding various lifestyle

modifications like diet restrictions, regular glucose monitoring, insulin administration etc... And also the fear of maternal and foetal complications will also be higher in pregnant women with GDM. Specific scale are there to measure the stress level in patients with diabetes mellitus like Psychometric validation of stress and compliance scale for diabetes (SCSD), Diabetes specific quality of life scale, Appraisal of diabetes scale, problem areas in diabetes scale, diabetes distress scale etc... All these also cannot be used in women with GDM. Because the disease condition, complications, needs and management plan are entirely different in case of GDM. Therefore to bridge the existing gap, a specific scale for measuring GDM related stress was needed. And that scale has to consider all the possible sources of stress in pregnant women with GDM.

#### ***Developing Gestational Diabetes Stress Scale (GDSS)***

The goal of this study was to bridge the gap in the existing knowledge. Various stress scales available related to diabetes mellitus and pregnancy were analysed. And found that all this cannot be used for GDM patients. Because the unique psychological disturbances occur in GDM patients will be different from normal pregnancy and diabetes mellitus. Both diabetologist and gynaecologist were involved in the team. An interaction was done with pregnant women with GDM (50 patients) and without GDM (50 pregnant women). These interactions gave some major source of stress and classified it into four categories emotional burden, medication related, social or economic and health care set up related stress. GDSS was developed on the analysed factors, this scale has 16 items and for each item 5 options is given (score 1-5), and the higher score indicate the higher stress.

#### ***Getting approval for GDSS from ethical committee***

The ethical committee of Maruthi Medical Center and Hospital (Register number: 35597) has approved this GDSS. The various types of stress, various scales available and the gap in the current scales with respect to GDM was presented and the ethical committee cleared the request for approval to allow the use of the scale to validate in GDM

patients with recommendations from the gynaecologist and the diabetologist.

#### ***Validation of GDSS***

A team involving diabetologist, gynaecologist and pharmacists conducted validation study for the GDSS. A pilot study was designed and administered the GDSS scale to a pilot population of 35 GDM patients. Based on the findings the scale was revised. Initially a classification was made on the GDM patients according to their GDM management into two categories that is patients on Oral Hypoglycemic Agents (OHA) and Patients on insulin. From the findings it was again categorised into four. That is patients only need lifestyle modifications, patients only on insulin, patients only on OHA and patient on both insulin and OHA and separate scoring methods for measuring stress in these four categories were added. Then the upgraded scale was administered into another set of 105 GDM patients. A validation study was conducted for the GDSS scale via the online mobile application among 176 patients with GDM.

#### ***Developing GDSS Mobile application***

Newly developed GDSS was converted into a mobile application and uploaded in Google play store to ensure that GDM patients and health care providers around the globe can access this scale.

## **RESULTS AND DISCUSSION**

Unique psychological stress associated with diabetes and pregnancies are well documented by medical fraternity. And it is very clear that diabetic pregnancy will be linked with significant stress. During literature search we understood that there was a gap in finding out stress related to GDM. Specific scales are there to measure stress related to diabetes and pregnancy. But all these cannot be used in GDM patients. Because the methods of management for diabetes, complications and challenges due to diabetes will be entirely different in case of pregnancy. To prepare a suitable management plan for GDM, proper identification of the stress level in each patient is needed which shows the importance of developing a new specific scale to measure GDM related stress. (Table1).

**Table 1**  
**Gestational Diabetes Stress Scale (GDSS)**

SI NO	My feelings.	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	I felt very sad when diagnosed with gestational diabetes mellitus.	1	2	3	4	5
2	Taking insulin for GDM is painful. (only for women on insulin)	1	2	3	4	5
3	I don't get enough time with the physician to discuss my issues.	1	2	3	4	5
4	I lost interest or pleasure in doing things after diagnosed with GDM	1	2	3	4	5
5	I feel scared and sad that even though GDM will disappear after delivery, in future I may get diabetes.	1	2	3	4	5
6	I am not aware about my condition and also the precautions that I should take (diet, exercise and use of medicine).	1	2	3	4	5
7	I feel my behavioural pattern has changed after GDM diagnosis (aggression, over activity etc...)	1	2	3	4	5
8	I spend more money than what I estimated because of GDM.	1	2	3	4	5
9	I am afraid that because of GDM, I may end up with cesarean.	1	2	3	4	5
10	I don't get enough support from my family and friends.	1	2	3	4	5
11	I feel decreased productivity in my works (Daily chorus at home or professional duties or both).	1	2	3	4	5
12	I feel depressed that my child may also get affect because of my GDM.	1	2	3	4	5
13	Every time when I take insulin or oral antidiabetic agents I feel bad.	1	2	3	4	5
14	I am not able to be normal because of various restrictions due to GDM.	1	2	3	4	5
15	I feel no one is bothered for my GDM and I don't get proper care as I required.	1	2	3	4	5
16	I feel that I am taking too much of medications	1	2	3	4	5

***Instruction for scoring***

The gestational diabetes related stress scale gives a total stress score and four subscale scores, each addressing a different kind of stress. To score, sum the patient's responses to the appropriate items and divide by the number of items in that scale.

**A mean item score of 3 or higher (moderate to severe) is a level of stress need clinical attention.**

If the score is  $\geq 3$ , place a mark in the right side box to highlight the condition.

**Total score**

- I. Patients need only lifestyle modifications (Skip items 2,13,16)**
1. Sum of 13 item score:
  2. Mean item score ( $\div 13$ ):  $\geq 3$
- II. Patients only on insulin OR Patients on both insulin and OHA**
1. Sum of 16 item score:
  2. Mean item score ( $\div 16$ ):  $\geq 3$
- III. Patients only on OHA ( Skip item 2)**
1. Sum of 15 item score:
  2. Mean item score ( $\div 15$ ):  $\geq 3$
- A. Emotional burden (1,4,5,7,9,11,12):**
1. Sum of 7 items scores:
  2. Mean item score ( $\div 7$ ):  $\geq 3$
- B. Medication related stress ( Skip if the patient need only lifestyle changes)**
- I. Patients on insulin OR on both insulin and OHA (2,13,16):**
1. Sum of 3 item scores:
  2. Mean item score ( $\div 3$ ):  $\geq 3$
- II. Patients on OHA ( 13,16):**
1. Sum of 2 item score:
  2. Mean item score ( $\div 2$ ):  $\geq 3$
- C. Social or economical stress (8,10,14):**
1. Sum of 3 items score:
  2. Mean item score ( $\div 3$ ):  $\geq 3$
- D. Health care set up related stress (3,6,15):**
1. Sum of 3 items scores:
  2. Mean item score ( $\div 3$ ):  $\geq 3$

**GDSS mobile application**

Gestational diabetes stress scale mobile application can be downloaded from the link

<https://play.google.com/store/apps/details?id=com.byzero.gdss>

**CONCLUSION**

Gestational diabetes stress scale (GDSS) is a specific stress scale for pregnant women with diabetes. This is a 16 item scale, each item rated on a 5 point scale (1-5) with higher scores reflecting higher stress. GDSS gives a total score to understand the overall stress level in patients. It has four subscale scores, through which the possible sources of the stress can be identified, which means whether the stress is due to emotional burden and/or medication related and/or health care set up related and/or due to any economic or social relationship related and thus GDSS allows the health care professional to manage the patient stress accordingly. Patient or health care professional can download the GDSS mobile application from Google play store. Responses for each item can be filled by the patient. Patient can give score

according to their feelings. These 16 items in GDSS covered almost all possible problems related to GDM. The current findings suggest that GDSS is a valid and user friendly instrument specific for pregnant women with diabetes to access gestational diabetes related stress.

**AUTHORS CONTRIBUTION STATEMENT**

Mr. A. Anandhasayanam conceived the presented idea. He provided intellectual content and guided the entire work. Ms.P.Saranya and Mr. T.G. Jithin designed the gestational diabetes stress scale in consultation with all others. Mr. V. Varadharajan and Ms.Sneha Thomas worked for getting approval for GDSS from both Gynaecologist and Diabetologist. The entire team was involved in collecting and compiling the data required to give shape of the scale. Ms.P.Saranya prepared the

manuscript with others under the supervision of Mr.A.Anandhasayanam, who made corrections and he supervised the entire study. The mobile application was the collective work of all the authors.

## CONFLICT OF INTEREST

Conflict of interest declared none.

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