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Research Article

Assessment of Physical Activity Status and Its Determinants Among Antenatal Mothers with Gestational Diabetes Mellitus in a Selected Institute in Southern, Sri Lanka: A Descriptive Cross-Sectional Study

Gunasekara, T.[1], Nanayakkara, P.M. & Sundarapperuma, T.D.

[1] *Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka*

Abstract

Objective: Assessment of physical activity (PA) status and its determinants among antenatal mothers with Gestational Diabetes Mellitus (GDM) in a selected institute in Southern, Sri Lanka

Methods: **A** descriptive study was conducted at the antenatal clinics and wards in a selected institute in Southern, Sri Lanka, from February to April 2023**.** Antenatal mothers who were in their third trimester and diagnosed with GDM were selected using the convenience sampling method while excluding antenatal mothers with physical disabilities, severe chronic illness, or psychiatric illnesses, and who were advised to restrict PA. The data were collected by a self-administered questionnaire. Part A of the questionnaire consisted of questions on sociodemographic data and clinical data. In Part B, physical activity was assessed using an internationally validated tool, the International Physical Activity Questionnaire (IPAQ)-short version. Data were analyzed using the IPAQ scoring protocol and the Add type of statistics.

Results: A total of 168 antenatal mothers were included in the sample. Almost half (47.28%) of the participants were in the below 25 years age group, 97% were married, and 50% were Buddhists. Around half of the antenatal mothers (49.4%) from the total sample were educated up to secondary school. Most of them were housewives (56.5%) and had a middle monthly income (54.2%). The majority of the antenatal mothers (45.2%) were obese based on their pre-pregnancy weight and had 2 or more than 2 children. The percentage of antenatal mothers with a history of GDM is 45%, and a family history of DM was 60.7% and 73.8%, respectively. Around 75% of the antenatal mothers had no other chronic diseases. The mean (SD) energy expenditure of the study group was 921.93 (135.98). Vigorous activities, moderate-level activities, and walking followed by 32.1%, 89.4%, and 96.4%. As per the IPAQ categorical analysis, 58.9% of participants were in low levels of PA. Family support (p=0.031) and pre-pregnancy body weight (p=0.004) showed a significant association with the level of PA.

Conclusions: The level of PA is considerably low among study participants. Vigorous activities are the least common activity type among antenatal mothers. The findings of the study will be useful in developing a scientifically validated physical activity protocol for antenatal mothers with GDM

Keywords: *Gestational diabetes mellitus (GDM), International physical activity questionnaire (IPAQ), Physical activities (PA), Antenatal mothers*

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Correspondence: *Sundarapperuma, T.D., Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna.*
Email: thamudids@ahs.ruh.ac.lk https://orcid.org/0000-0001-7701-5989
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Introduction

Gestational Diabetes mellitus (GDM) is a rising threat around the globe. GDM makes a considerable contribution to the global diabetes epidemic. The term GDM refers to carbohydrate intolerance that manifests as hyperglycemia and begins or is first seen during pregnancy (Metzger et al., 1998). This definition covers antenatal women who have undiagnosed pre-diabetes as well as those who develop glucose intolerance or diabetes while carrying a child. It was estimated that in the year 2017, 16.2% of live births to women had some form of hyperglycemia during pregnancy, and 86.4% of those were due to GDM (Carracher et al., 2018).

The factors that increase the risk of GDM are referred to as the determinants of GDM. Those factors include BMI, history of GDM, family history of DM, and having other comorbid conditions like lipid abnormalities and hypertensive disorders (Kumar et al., 2010). Gestational diabetes mellitus is reported to be common among Asian populations (Chu et al., 2009), and additionally, 88% of prenatal hyperglycemia instances were found in middle- or low-income nations, according to the survey (Carracher et al., 2018). As a lower-middle-income country, Sri Lankan antenatal mothers are also vulnerable to GDM and its adverse health consequences.

A recent Sri Lankan study has found that the prevalence of GDM in the Gampaha district is 13.9% (Sudasinghe et al., 2016), which is a 65.5% increase compared to the prevalence of GDM in Homagama MOH area (8.4%), Colombo in 2004 (Ginige, 2004). This confirms the increasing trend of GDM in the local setting. There are numerous negative effects of maternal hyperglycemia on the mother, the fetus, and the offspring. A recent meta-analysis suggested that mothers with a previous history of GDM have a 7.43-fold relative risk of developing type 2 diabetes mellitus (T2DM), a 2 to 5-fold relative risk 2 of metabolic syndrome and 1.7-fold risk of cardiovascular disease compared to those with a normal glycemic pregnancy history (Gebregziabher et al., 2019). The chances of pregnancy-induced hypertension, macrosomia, congenital abnormalities, and neonatal hypoglycemia were all observed to be enhanced by hyperglycemia, according to other reports.

The management of GDM aims to optimize glucose control and improve pregnancy outcomes. Appropriate lifestyle modifications are important in managing GDM and its complications. Physical activity (PA) is one of the major lifestyle modifications. PA is essential for a healthy pregnancy in the absence of medical or obstetric difficulties. It improves cardiovascular health, increases fitness, and reduces maternal outcomes like GDM, preeclampsia, and premature birth (Gebregziabher et al., 2019). Further, these activities help to use insulin more efficiently and enhance glucose homeostasis through a variety of pathways that either directly or indirectly affect insulin sensitivity. However, it is reported that a majority of antenatal mothers may not think about it due to a lack of knowledge about exercise during pregnancy, safety concerns, and cultural standards (Dye et al., 1997), along with uncertainty of risks and benefits of exercise during this period. Several studies have been

conducted to assess the level of PA among antenatal mothers with GDM, but few studies have been published in Sri Lanka related to this topic. Hence, it is imperative to assess the determinants, level, and patterns of physical activities. The findings of this study will be a guide for future researchers to implement or develop any intervention program with the aim of controlling the development of complications related to GDM. The aim of this study was to evaluate PA status and its determinants among antenatal mothers with GDM attending a selected institute in Southern, Sri Lanka.

Methodology

Study design and setting

A descriptive cross-sectional study was conducted over 02 months, starting from February to April 2023, in antenatal clinics and antenatal wards in the selected institute in Southern Province, Sri Lanka. This institute was the German-Sri Lanka Friendship Hospital for women, which is the largest maternity hospital in South Asia, serving around 200 outpatients daily.

Study participants

Antenatal mothers who were in the third trimester and diagnosed with GDM by consultant obstetricians and gynecologists were included in the study. Antenatal mothers who had a physical disability, severe illness, or psychiatric illness and who were advised to restrict PA were excluded from the study.

Sample size and sampling technique

The sample size was calculated using the following formula (Lawanga and Lameshow, 1991).

$$n = \frac{z^2 p (1-p)}{d^2}$$

n= sample size

p= assume GDM prevalence, as 13.9% {A recent Sri Lankan study has found that the prevalence of GDM in the Gampaha district is 13.9%}(Sudasinghe et al., 2016)

z= critical value according to the confidence interval (confidence interval 95%, critical value is 1.96)

d= precision, set as 0.05

$$n = \frac{1.96^2 \, 0.139 \, (1-0.139)}{0.05^2}$$

= 184.

A convenience sampling technique was used to recruit mothers for this study. All the antenatal mothers who fulfilled the inclusion criteria were invited to the study.

Data collection

Data collection was conducted at the antenatal clinics and wards of the German Sri Lanka Friendship Hospital for Women. Ethical clearance was obtained from the Faculty of Allied Health Sciences, University of Ruhuna. The objectives of the study were explained, and written consent was taken. A structured, self-administered questionnaire that consists of two main sections was administered.

Part A: Collected socio-demographic data and BMI. The questionnaire was pretested using 10 antenatal mothers in Matara hospital, and modifications were made accordingly. BMI was collected from the

pregnancy record.

Part B: The International PA Questionnaire (IPAQ) short version (IPAQ, 2005) assessed the levels and patterns of PA. This standardized instrument is commonly used to measure PA of different populations and sociocultural settings. The reliability and validity of the IPAQ short version have been widely assessed around the globe (Schuhl, 2014), and previous studies in Sri Lanka have used it for non-pregnant women (De Silva et al., 2016) and postpartum women (Sundarapperuma et al., 2020)

Data analysis

Data was analyzed using SPSS version 26 statistical software package, and IPAQ data was analyzed by IPAQ scoring protocol (IPAQ, 2005). Descriptive statistics were used to describe socio-demographic and BMI measurements. BMI was categorized according to the following criteria. Below 18.5 as under-weight, 18.5-24.9 as normal, 25- 29.9 as overweight, 30 - 39.9 as obesity, and more than 40 as severe obesity (World Health Organization, 2010).

Monthly income was categorized as follows. Below Rs. 40,000.00 as low income, Rs 40,000.00- 80,000.00 as middle income, above Rs 80,000.00 as high income. Vigorous, moderate, and walking PA were reported as means and interquartile ranges. The metabolic equivalent task minutes per week (MET-minutes/week) were used to calculate the PA level and intensity. The analysis of various activity kinds employed the following MET values: Walking, Moderate PA, and Vigorous PA, each equal to 3.3, 4.0, and 8.0 METs, respectively. With interquartile ranges, median values for energy use were displayed. There were three categories of scores: low, moderate, and high (IPAQ, 2005). Antenatal mothers who participated in at least three days of vigorous activity with a weekly energy expenditure of at least 1500 MET-minutes or seven days of any combination of walking, moderate-intensity, or vigorous activity with a weekly energy expenditure of at least 3000 MET-minutes were classified as high in the categorical analysis. Mothers who engage in vigorous-intensity activity for at least 20 minutes per day, three or more days a week, moderate-intensity activity and/or walking for at least 30 minutes per day, five or more days a week, or any combination of walking, moderate-intensity or vigorous-intensity activity for five or more days a week were classified as moderate PA. These activities must result in a minimum energy expenditure of 600 MET minutes per week. Mothers who did not satisfy any of the requirements for a moderate or high category (IPAQ, 2005) were put into the low category. After calculating total MET minutes/week, according to the IPAQ scoring protocol, the level of PA was categorized as high, moderate, and low. (IPAQ, 2005)

The association between PA and other factors was compared by using the chi-square test, and the differences between the means of body weight and PA status were compared by ANOVA.

Results

Socio-demographic characteristics of study participants

The total number of 168 antenatal mothers

was included in this sample. Socio-demographic factors of subjects are shown in Table 1. The majority of antenatal mothers were below 25 years old and married. Most of the mothers were Buddhist and completed their secondary education.

Clinical history and BMI of antenatal mothers

The clinical history of the subjects was taken from their pregnancy report. Mothers' mean (±SD) of weight, height, and BMI were 67.5 (±11.85) kg, 1.5(±0.11) m, 30.32 (±6.11) $kg/m^{2,}$ respectively. The majority of them (76, 45.2%) were obese, around 102(60.7%) had a previous history of GDM and 66 (39.3%) had a family history of DM 124 (73.8%) had a family history of DM, 42 (25%) had other pregnancy induced diseases (Table 2).

Frequency distribution of PA status

The mean (SD) energy expenditure of the study group was 921.93 (135.98) MET-minutes/week. One third (33.33%) of mothers continuously participated in at least one moderate intensity activity for more than 10 min in the 1-week period immediately before data collection (Table 3). A majority of mothers had not engaged in vigorous activity but had engaged in walking.

Frequency distribution of the level of PA (categorized) of subjects

The majority, 99 (58.9%), were in the low level of PA; 56 (33.3%) were in the moderate level of PA; only 13 (7.7%) were in the high level of PA.

Association between socio-demographic factors and the level of PA

According to the results, there were no significant differences between age, religion, education, occupation, and monthly income (Table 4). However, a significant difference was observed between good family support and PA. (p=0.031).

Association between clinical history, BMI, and level of PA

According to the results, there were no significant differences between the number of children, history of GDM, family history of DM, and having another disease (Table 5). There was a significant difference between body weight (p=0.004) and PA.

Discussion

GDM has become a rising threat to health globally. The GDM mother and offspring have a considerably higher risk for perinatal, postnatal, and long-term complications throughout their life. The risk can be minimized by modifying their lifestyle scientifically. PA is one of the major key factors of lifestyle modification. This descriptive study assessed the PA status and its determinants among antenatal mothers with GDM attending a teaching hospital.

In the present study, most of the antenatal mothers were between 20-25 years old, married, and educated up to the secondary level. The monthly family income of the majority was lower (<LKR 40,000.00) than the mean Sri Lankan household income of LKR 62237.00 (Department of Census and Statistics 2016), which may be why most women in this study were housewives.

In the pre-conception period, though it is recommended to maintain a healthy weight,

Table 1: Socio-demographic factors of subjects (n=168)

Factor	Category	Frequency (%)
Age	Below 25 years	47 (28%)
	25-30 years	38 (22.6%)
	30-35 years	46 (27.4%)
	Above 35 years	37 (22%)
Marital status	Married	163 (97%)
	Unmarried	5 (3%)
Religion	Buddhist	84 (50%)
	Islam	58 (34.5%)
	Catholic and other	26 (15.5%)
Education	Primary education	42 (25%)
	Secondary education	83 (49.4%)
	Tertiary education	43 (25.6%)
Occupation	Professional	24 (14.3%)
	Non-professional	25 (14.9%)
	Labor	24 (14.3%)
	House wife	95 (56.5%)
Monthly income	Low income	52 (31%)
	Middle income	91 (54.2%)
	High income	25 (14.9%)
Number of children	Less than 2	32 (19%)
	Two or more	136 (81%)
Good family support	Yes	142 (84.5%)
	No	26 (15.5%)

Table 2: Clinical history of subjects (n=168)

Factor	Category	Frequency (%)
BMI	Underweight	4 (2.4%)
	Normal	28 (16.7%)
	Over weight	51 (30.4%)
	Obesity	76 (45.2%)
	Severe obesity	9 (5.4%)
History of GDM	Yes	102 (60.7%)
	No	66 (39.3%)
Family history of DM	Yes	124 (73.8%)
	No	44 (26.2%)
Having any other pregnancy-induced disease	Yes	42 (25%)
	No	126(75%)

Table 3: Status of PA (n=168)

Type of PA	Category	Frequency (%)
Vigorous	Perform	54 (32.1%)
	Not perform	114(67.9%)
Moderate	Perform	151(89.9%)
	Not perform	17(10.1%)
Walking	Perform	162(96.4%)
	Not perform	6(3.6%)
Sitting	Perform	168(100%)
	Not perform	-

Table 4: Association between socio-demographic factors and level of PA (n=168)

Variable	Categories	Low n (%)	Moderate n (%)	High n (%)	Total	P value
Age	Below 25 years	26 (55.3%)	14 (29.8%)	7 (14.9%)	47	0.262
	25-30 years	21 (53.3%)	14 (36.8%)	3 (7.9%)	38	
	30-35 years	32 (69.6%)	13 (28.3%)	1 (2.2%)	46	
	Above 35 years	20 (54.1%)	15 (40.5%)	2 (5.4%)	37	
Religion	Buddhist	52 (61.9%)	24 (28.6%)	8 (9.5%)	84	0.429
	Islam	34 (58.6%)	22 (37.9%)	2 (3.4%)	58	
	Catholic and other	13 (50%)	10 (38.5%)	3 (11.5%)	26	
Education	Primary	26 (61.9%)	12 (28.6%)	4 (9.5%)	42	0.842
	Secondary	50 (60.2%)	28 (33.7%)	5 (6%)	83	
	tertiary	23 (53.5%)	16 (37.2%)	4 (9.3%)	43	
Occupation	Professional	14 (58.3%)	7 (29.2%)	3 (12.5%)	24	0.230

	Non- professional	11 (44%)	12 (48%)	2 (2%)	25	
	Labor	19 (79.2%)	5 (20.8%)	0 (0%)	24	
	Housewife	55 (57.9%)	32 (33.7%)	8 (8.4%)	95	
Monthly income	Low income	31 (59.6%)	16 (30.8%)	5 (9.6%)	52	0.962
	Middle income	54 (59.3%)	31 (34.1%)	6 (6.6%)	91	
	High income	14 (56%)	9 (36%)	2 (8%)	25	
Good Family Support	Yes	88 (62%)	46 (32.4%)	8 (5.6%)	142	**0.031**
	No	11 (42.3%)	10 (38.5%)	5 (19.2%)	26	

Table 5: Association between clinical history, BMI, and PA

Variable	Category	Low	Moderate	High	Total	P Value
Number Of Children	Less than 2	19 (59.4%)	8 (25%)	5 (15.6%)	32	0.318
	2 or more than 2	79 (58.5%)	48 (35.6%)	8 (5.9%)	135	
History Of GDM	Yes	64 (62.7%)	32 (31.4%)	6 (5.9%)	102	0.351
	No	35 (53%)	24 (36.4%)	7 (10.6%)	66	
Family History Of DM	Yes	76 (61.3%)	39 (31.5%)	9 (7.3%)	124	0.579
	No	23 (52.3%)	17 (38.6%)	4 (9.1%)	44	
Have Other pregnancy-induced diseases	Yes	27 (64.3%)	13 (31%)	2 (4.8%)	42	0.604
	No	72 (57.1%)	43 (34.1%)	11 (8.71%)	126	
Pre-pregnancy BMI	Underweight and normal	15 (46.9%)	13 (40.6%)	4 (12.5%)	32	0.004
	Overweight	28 (53.8%)	17 (32.7%)	7 (13.5%)	52	
	Obesity	56 (66.7%)	26 (31%)	2 (2.4%)	84	

more than two-thirds of the study participants were in the obese category according to the WHO cutoffs. Obesity is one of the major risk factors for GDM (Yang et al., 2009). Further, the majority of antenatal mothers have a history of GDM and a family history of DM. It seems that they have a high future risk of getting long-term complications.

The International Physical Activity Questionnaire short version is a globally validated tool (Schuhl., 2014) which was used to assess the status of physical activities in the present study. The mean PA score was 921.93 MET minutes/ week. A previous study in 2020 reported a noticeably high mean value (3659.50 MET minutes/week) compared to our study. (Sundarapperuma et al., 2020). Further, in contrast to the previous study where initial postpartum activities of the antenatal mothers have been assessed (Sundarapperuma et al., 2020), in the present study, more than half of the antenatal mothers were found to have a low level of PA even in the categorical analysis. The reason may be the study participants' differences and cultural restrictions during pregnancy and postpartum.

Vigorous activities help to burn more calories in the human body. However, only 32.1% of participants engaged in vigorous activities, while 33.33% were engaged in moderate activities. Although vigorous-intensity activities are preferable to moderate-intensity ones for lowering metabolic and other health concerns (Garber et al., 2011). These findings seem to be parallel with the study conducted by De Silva, who reported that domestic activities are the major type of activity in Sri Lankan women (De Silva et al. 2016). It is more likely that women who are members of large families will expend energy on everyday family obligations since they tend to participate in PA more than those who belong to small family units. Since domestic activities play a significant part in these women's daily patterns of PA.

Walking is the most popular type of PA for health benefits (van der Pligt et al., 2016). In the present study, 96.4% of participants were engaged in walking. The mean walking was 445.31 MET minutes/ week, which was lower than the previous study, which observed 1492.65 MET minutes/ week (Sundarapperuma et al., 2020). According to Hayashi et al. (2018), simple walking is an excellent form of low-intensity exercise for regulating the casual glucose level in antenatal GDM patients. They advised antenatal women with GDM to walk at least 6000 steps every day (Hayashi et al., 2018).

Sedentary behavior was defined as "any waking behavior characterized by an energy expenditure of 1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture" (Tremblay et al., 2017). Sedentary lifestyles increase the risk of heart disease, diabetes, high blood pressure, osteoporosis, depression, and lipid problems. They also increase the risk of obesity and glycemic management issues. Physical inactivity is different from sedentary behavior. Therefore, antenatal mothers should limit their sitting time as much as they can. Results of the current study showed that 100% of antenatal mothers engaged in sitting. The mean sitting time was 5 hours/day. Sitting time exceeding

7 hours/day increases the risk significantly (Jalayondeja et al., 2017).

According to Borodulin et al. (2008), reduced PA during the second to the third trimester, with few reaching recommended levels, and antenatal women significantly reduced PA, with 26.49% meeting WHO recommendations (Sitzberger et al., 2022). A study was carried out by Pathirathna et al. (2019), over 50% of women met the required PA level in the second trimester, while only 45.2% did in the third.

A significant difference between family support to engage in physical activities ($p=0.031$) and PA was observed in our study. Similar to this study, another study in Australia reported that family support encouraged and helped them maintain a healthy lifestyle, cultural ideals of being a good wife and mother, and social roles were obstacles to healthy eating and, to a lesser extent, PA (Razee et al., 2010). In contrast to our findings, Miller et al. (2002) had reported that parenthood and role overburden were obstacles to PA (Miller et al., 2002). Women's attitudes toward motherhood, specifically the idea that other people's needs should come first, were linked to lower levels of physical activity (Lewis et al., 2005). The results are attributed to the cultural and ethnic differences between study populations.

Body weight and BMI are one of the major predisposing factors for GDM and T2DM. Several studies have reported that women who have a high pre-pregnancy BMI are not active enough during their pregnancy period (Hinton & Olson, 2001; Szablewska et al, 2023) A significant difference between body weight ($p=0.004$) and PA was observed in the present study as well. A negative energy balance must exist to reduce body weight effectively; however, an energy balance must also exist to maintain weight loss and avoid weight gain. Exercise can therefore be a crucial intervention to attain the target body-weight management. However, the impact of PA alone on weight loss can be only marginal (Jakicic, 2009).

Though IPAQ is a validated tool, recall bias can occur since we have to collect the previous seven days' data, as it is the nature of data collection. Further, socially desirable bias also could occur as the questionnaire was filled out by participants. The results are limited only to the one institution in the Galle district and a small number of participants, hence, generalizability issues can occur. Hence, it is suggested to relocate the study into different study groups with large numbers and settings.

Strengths and limitations of this study

An internationally validated and widely used IPAQ was used to assess the PA. However, it assesses one week of PA and it is a subjective tool, hence, some socially desirable answers may lead to biased results, which is a possible limitation of this study. A small sample size is also a limitation of the study

Conclusions

The findings of this study showed that vigorous PA was the least common activity type among antenatal mothers, and the majority of the antenatal mothers were at low levels of PA. A minimum number of antenatal mothers were engaged in high levels of PA. PA was associated with family support and body weight during pregnancy. The findings

of the study will assist in developing a scientifically validated PA protocol for antenatal mothers with GDM. It is recommended to use these findings as a basis to implement or develop any intervention program with the aim of controlling the development of complications related to GDM.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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