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Physical activity patterns six weeks after delivery in postpartum women with prior gestational diabetes mellitus

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ABSTRACT

Objectives: Gestational diabetes mellitus (GDM) is a world health concern. Women with a history of GDM have a high prevalence of developing type two diabetes mellitus, recurrence of GDM, and impaired glucose intolerance in their future life. Physical activity (PA) is a key component to attenuate the development of these complications. Therefore, the aim of this study was to evaluate the PA patterns of GDM women at 6 weeks postpartum.

Material and Methods: This descriptive cross-sectional component of a large quasi-experimental study was conducted in three selected districts of Sri Lanka in 100 postpartum mothers. Anthropometric and glycemic parameters were assessed at 6 weeks postpartum. Pre-tested International PA Questionnaire (short-version) was used to assess PA. The PA level and intensity were calculated in metabolic equivalent task minutes per week (MET-minutes/week). Data were analyzed by SPSS 21 version. Both continuous and categorical data were analyzed. Ethical clearance was obtained from the University of Sri Jayewardenepura.

Results: Mean HbA1c value was 6.64 ± 1.95. Median truncated PA was 3250 MET-minutes/week. The main contributors to energy expenditure in the study sample were moderate intensity household activities and walking with 58% of mothers walking more than 150 min/week. Although in the categorical analysis, 52% of mothers reported high level of PA, only 10% participated in at least one vigorous intensity activity continuously for more than 10 min to achieve reduced metabolic risks. Average sitting time of mothers was about 3 h/day which is in par with the breast-feeding recommendation. None of the PA MET values significantly correlated with the glycemic parameter, HbA1c.

Conclusion: Although it appears that majority of mothers are physically active, these activities are not optimum in terms of reducing the metabolic risk. We suggest designing exercise protocols incorporating day-to-day moderate intensity activities and walking in a structured and scientific manner to achieve maximum benefits for this special group of women.

Keywords: Energy expenditure, Gestational diabetes mellitus, International physical activity questionnaire, Physical activity patterns, Postpartum mothers

INTRODUCTION

Physical activity patterns of Sri Lankan mothers with a history of gestational diabetes mellitus (GDM) at 6 weeks postpartum

GDM is considered a threat to maternal and child health. It is estimated that 16% of live births to women have some form of hyperglycemia in pregnancy and 84% of those cases are due to

GDM.[1] GDM mothers are reported to have a 7.43-fold relative risk of developing type 2 diabetes mellitus (T2DM) in future life, compared to non-GDM mothers.[2] International Diabetes federation further reports that vast majority of cases of antenatal hyperglycemia were from middle- and low-income countries.[1] Since GDM is common among Asian populations,[3] it is vital to have an effective preventive program/strategy to prevent progression of GDM to overt diabetes.

Physical activity (PA) during postpartum period is known to enhance maternal insulin sensitivity,[4] reduce the risk of T2DM[5] without negatively affecting milk production or composition.[6]

Furthermore, it is reported that regular exercise training significantly reduces the HbA1c[7] which is considered the gold stand for monitoring glucose control.[8] Walking, pelvic floor exercises, and stretching are recommended for women immediately after the delivery.[5,6] Although the PA recommendation for postpartum mothers is for more than 150 min/week,[5,9] maximum benefits are achieved by gradually increasing the intensity from moderate to vigorous activity.[5,10] However, many obstacles such as lack of family and social support[11] their exercise beliefs and disparities in access to health-care[10,12] hinder them from engaging in PA. In addition, lack of time, tiredness, excessive child care demands, and lack of awareness of the type of PA that is beneficial to prevent T2DM are also reported as barriers.[11]

The physiological changes due to pregnancy persist for 4 to 6 weeks postpartum and exercise routines should ideally be introduced gradually during this period.[10] Since PA guidelines for women in Asia pacific region are sparse, a meticulous assessment of the baseline PA patterns is justifiable as an initial step of developing a feasible and an easily implementable PA program for these women. Hence, the objective of this study was to evaluate the PA patterns of Sri Lankan GDM mothers at 6 weeks postpartum.

MATERIAL AND METHODS

Study design and setting

This descriptive cross-sectional community based component was a part of a quasi-experimental study conducted in selected Medical Officer of Health (MOH) divisions of three districts in Sri Lanka. Four MOH divisions were selected from each district by cluster randomization method.

Study participants

Postpartum mothers with a history of GDM in their index pregnancy, who delivered a single healthy baby, were invited to the study at 6 weeks postpartum. GDM had been diagnosed by a consultant obstetrician and gynecologist based on ADA guidelines[13] at 24–28 weeks of gestation. The mothers with a history of GDM in their previous pregnancies and/or a history of any other chronic illnesses and employees in health sector were excluded from the study. Thirty to thirty-five mothers were recruited purposefully from each district to achieve a total sample size of hundred.

Data collection

Data collection was conducted in the office of the Public Health Midwife (PHM) of selected MOH divisions. Informed written consent was obtained from all mothers before they were recruited. Ethical clearance was obtained from the relevant Ethics Committee. Data on socio-demographic variables, anthropometry, glycemic control, and PA were obtained.

Assessment of socio-demographic variables

A pre-tested, self-administered questionnaire was used to collect socio-demographic data.

Anthropometric measurements

Weight, height, waist, and hip circumferences were recorded by the standard techniques.[14] BMI (kg/m^2) was calculated from weight and height measurements and a BMI of less than 25, between 25 and 30 and more than 30 kg/m^2 were considered as normal weight, overweight, and obese, respectively.[14] Waist to hip (WHR) and waist to height ratios were calculated. The WHR cut off for abdominal obesity was considered as 0.85.[14] A waist to height ratio of <5, 5, or >5 but <6 and 6 or >6 were considered as no risk, increased risk, and very high risk, respectively.[15]

Assessment of HbA1c

Glycemic control was assessed by HbA1c at and a value of A1c below 5.7% was considered normal while 5.7–6.4% and ≥6.5% were considered as pre-diabetes and diabetes, respectively.[16]

Assessment of PA

The International PA Questionnaire (IPAQ) short version was used to assess the levels and patterns of PA. This is a standardized instrument commonly used to measure PA of different populations and varying sociocultural settings. The reliability and validity of the IPAQ short version have been widely assessed. Some questions in the standard questionnaire were replaced with others to suit the Sri Lankan setting. It was translated to Sinhala and back translated to English to reduce interpretation errors. IPAQ was administered by a trained investigator as the mothers were in varying literacy

levels. In addition, the mothers were instructed to list their activities in a separate log book for a period of 1 week before the interview and IPAQ data were matched with log book entries to minimize subjective errors. Both the frequency (the number of days per week) and the duration (the average time in minutes) of moderate and vigorous intensity activities and walking were assessed separately. Data were cleaned by removing the activities which lasted for <10 min. The cutoff limits for the PA categories were based on the current PA guidelines.[17]

Data analysis

Analysis of PA data

The PA level and intensity were calculated in metabolic equivalent task minutes per week (MET-minutes/week). The following MET values were used for the analysis of different types of activities: Walking = 3.3 METs, Moderate PA = 4.0 METs, and Vigorous PA = 8.0 METs. Both continuous and categorical data were analyzed. Energy expenditure was presented as median values with interquartile ranges (non-truncated data) and as means (truncated data).

Categorical scores were presented as low, moderate, and high. In the categorical analysis, mothers who engaged in vigorous-intensity activity for at least 3 days achieving an expenditure of at least 1500 MET-minutes/week or 7 days of any combination of walking, moderate-intensity, or vigorous-intensity activities achieving an expenditure of at least 3000 MET-minutes/week were categorized as high. Mothers who engaged in vigorous-intensity activity for at least 20 min/day for 3 or more days per week or moderate-intensity activity and/or walking for at least 30 min/day for 5 or more days or any combination of walking, moderate-intensity, or vigorous intensity activities for 5 or more days achieving a minimum energy expenditure of 600 MET-minutes/week were categorized as moderate PA. Low category was simply defined as not meeting any of the criteria for moderate or high categories. Sitting time was also assessed and was reported as a median value with interquartile ranges. All activities exceeding 180 min were truncated as the rule permits a maximum of 21 h of activity for each category in a week.

Statistical analysis

Data were analyzed using SPSS version 21 statistical software package. Descriptive statistics were used to describe socio-demographic, anthropometric measurements, and HbA1c values. Details of specific type of physical activities in the cohort, namely, the vigorous-intensity, moderate-intensity, and walking were presented as means, medians, and the interquartile ranges. Siting time was presented as the median and interquartile range. The levels of PA in the cohort determined by categorical scores were presented as frequencies. All data were truncated to normalize the distribution. The differences between means were compared by independent sample *t*-test and ANOVA. The significance was set at $P < 0.05$. Relationship between the HbA1c and the specific types of physical activities was determined by zero-order correlation. Partial correlation was run to determine the relationship between HbA1c and the types of physical activities while controlling the factors (the number of children and the number of family members) that showed a significant association with physical activities.

RESULTS

Description of the study sample

The mean age (±SD) of study participants was 33.6 ± 5.8 years. About half the sample of mothers were housewives ($n = 53$) and 76% have studied only up to the ordinary level. Monthly income of the majority ($n = 75$) was below 50,000 SLR (313 USD). Exactly half of the sample ($n = 50$) had five or more dependents in their families. The majority of the mothers ($n = 75$) had 1or 2 children. Fifty-five mothers had a positive family history of diabetes mellitus out of which in 25, both parents were diabetics.

Table 1 shows the anthropometric characteristics and HbA1c values of the subjects in the study sample categorized according to recommended cutoff values.

Description of PA

The median (IQR) energy expenditure of the study group (non-truncated) was 3659.50 MET-minutes/week (IQR = 123–12,000) and the truncated PA was 3250 MET-minutes/week (IQR = 123–5106). Seventy-three percent of mothers participated in at least one moderate intensity activity continuously for more than 10 min in the 1 week period immediately before data collection and the common activities included were hand washing of clothes (67%) and sweeping the house and the garden (65%). However, when vigorous intensity activities are considered, only 10% participated in at least one activity continuously for more than 10 min during a period of 1 week and the common activities were drawing water from a well, chopping firewood, and digging the ground for gardening. Although walking was the most common activity in the group (76%), only 58% of mothers had walked for more than 150 min/week. In the categorical analysis, it was found that 52% of mothers had a high level of PA while 19% and 29% had moderate and low levels of PA, respectively. The median sitting time of the study group was 1260 min (IQR = 1260–3360)/week. Almost all mothers (98%) were engaged in breastfeeding or lulling the baby to sleep during their sitting time.

Table 1: Anthropometric characteristics and HbA1c values (categorized) of the study sample (n=100).

Anthropometric measurements	*n*
BMI (kg/m^2)	
Mean±SD (n=100) 25.99±4.67	
Normal weight (18.5–<25)	37
Over weight (25–30)	48
Obese (>30)	15
Waist:hip ratio	
Mean±SD (n=100) 0.94±0.12	
Normal (≤0.85)	25
Abdominal obesity (>0.85)	75
Waist:height ratio	
Mean±SD (n=100) 0.59±0.11	
No risk (below 0.5)	10
Increased risk (0.5–<0.6)	43
Very high risk (>0.6)	47
HbA1c	
Mean±SD (n=100) 6.64±1.95	
Normal (<5.6%)	36
Pre-diabetes (5.7–6.4%)	64

Table 2 shows the comparison of physical activity levels (MET-minutes per week) of subjects against socio-demographic characteristics, anthropometric measurements, and HbA1c values of the study population. Moderate intensity activity was significantly higher among mothers who have 5 or more than 5 family members and walking was significantly higher among the mothers who have 5 or more family members and mothers who have more than 2 children.

Table 3 shows the correlations between HbA1c values and physical activity levels before controlling and after controlling for the number of family members and the number of children. None of the physical activity levels correlated significantly with HbA1c at 6 weeks postpartum.

DISCUSSION

T2DM has become a rising threat to health globally with increasing number of GDM women playing a vital contribution to it. The discussion is based on the results of a descriptive cross-sectional component of a large quasi-experimental study conducted to assess the effectiveness of a lifestyle intervention program designed for GDM mothers to attenuate the progression of GDM to T2DM. Anthropometry, HbA1c, and PA patterns of GDM mothers were explored at 6 weeks postpartum as part of the baseline information needed for designing the lifestyle intervention protocol. The data, in this study, were collected in three selected districts of the country. These three districts were selected to have a diverse sample of women representing urban and rural areas and mixed cultural contexts.[18] The study is distinctive as it describes the activity patterns of a group of women whose activities *per se* are vital in reducing their future risk of T2DM.

In postpartum women, it is expected that weight would return to preconception level by 6–12 weeks after the delivery.[19] Even though we do not have data regarding the preconception weights, according to our results, only one-third of the cohort is in the normal weight category according to the WHO cutoffs[14] at 6 weeks. Although it is reasonable to expect more women to return to normal weight by 12 weeks postpartum, a major change to the number is unlikely as the hemodynamic and genitourinary recovery mainly occur in the subacute postpartum period which extends from 2 to 6 weeks postpartum.[20] When other anthropometric indices are examined, both the waist-hip and waist-height ratios are at the risk level in most, with 75% of mothers having abdominal obesity as per the waist:hip and 90% in increased or very high risk groups as per the weight:height. However, it is doubtful whether 6 weeks postpartum is too early to categorize these mothers in the "abdominal obesity" group as body fat gained during the gestational period appears to deposit centrally contributing to increased waist girth.[21] Further, it is not clear on how the waist circumference reduces during the early postpartum period. Nevertheless, as central obesity is directly associated with increased risk of metabolic syndrome[22] and increased weight is known to facilitate the progression of GDM to T2DM,[23] regular PA is encouraged with a view to reduce the weight and the future chronic disease risk;[5] hence, the early postpartum period is considered a crucial time to introduce formalized physical activities to postpartum mothers to help them reduce the weight and other anthropometric parameters to recommended levels.

HbA1c was performed at 6 weeks postpartum since early glycemic screening is recommended between 4 and 12 weeks postpartum.[16] Although it is reported that blood glucose levels usually return to normal immediately after the delivery in GDM women,[24] in the present study 64% of mothers were in the pre-diabetic category at 6 weeks postpartum based on HbA1c levels. Anyhow, HbA1c represents the average glucose level over the past 3 months and therefore the value obtained would have got affected by the glycemic control during the latter part of pregnancy. On the other hand, mothers might have had prediabetes instead of GDM which had resulted in the obtained HbA1c values.

IPAQ short version is a validated tool which was used to assess physical activities in the present study. A widely used tool was used to enable comparison of our data with those of similar studies globally.[25,26] In the present study, the median PA score based on raw data was 3659.50 MET-minutes/week (60 MET-hrs/wk). Although data on energy expenditure during early postpartum period are sparse, a previous cohort study in Australian mothers at 3 months postpartum has

Table 2: Comparison of physical activity levels (MET-minutes per week) of subjects against socio-demographic characteristics and anthropometric measurements and glycemic study population.

Socio-demographic characteristics, anthropometrics characteristics, and HbA1c values		Vigorous intensity activity	Moderate intensity activity	Walking
Total	Mean	144.08	1527.60	1492.65
	Median	0.00	180.00	222.75
	IQR	(0.00–0.00)	(0.00–3360.00)	(66.00–2970.00)
Age				
Below 35 years (*n*=60)	Mean	180.00	1521.53	1510.00
	Median	0.00	160.00	412.00
	IQR	(0.00–0.00)	(0.00–3240.00)	(99.00–3415.5)
35 years and above (*n*=40)	Mean	90.20	1536.90	1465.20
	Median	0.00	180	99.00
	IQR	(0.00–0.00)	(0.00–3540.00)	(0.00–2970.00)
**P*		0.15	0.85	0.545
No of family members				
Below 5 (*n*=50)	Mean	0.81.6	1282.64	1152.82
	Median	00.00	200.00	132.00
	IQR	(0.00–0.00)	(95.00–2400.00)	(0.00–2376.00)
5 or more than 5 (*n*=50)	Mean	206.56	1772.72	1832.49
	Median	0.00	160.00	643.00
	IQR	(0.00–0.00)	(0.00–3600.00)	(90.75–4158.00)
**P*		0.086	0.012*	0.001*
Number of children				
One or two (*n*=75)	Mean	97.6	1513.49	1365.41
	Median	0.00	200.00	198.00
	IQR	(0.00–0.00)	(0.00–3360.00)	(66.00–2970.00)
More than 2 (*n*=25)	Mean	283.52	1570.24	1874.40
	Median	0.00	120.00	594.00
	IQR	(0.00–0.00)	(0.00–3600.00)	(33.004158.00)
**P*		0.038*	0.625	0.012*
BMI				
Normal weight (*n*=37)	Mean	214.05	1221.4054	856.31
	Median	0.00	100.00	118.8
	IQR	(0.00–0.00)	(00.00–2640.00)	(99.00–1287.00)
Over weight (*n*=48)	Mean	119.16	1728.66	1818.0938
	Median	0.00	540.00	1188.00
	IQR	(0.00–0.00)	(100.00–3600.00)	(16.5–4158.00)
Obese (*n*=15)	Mean	51.2	1640.00	2020.92
	Median	0.00	840.00	2772.00
	IQR	(0.00–0.00)	(120.00–3600.00)	(0.00–4158.00)
***P*		0.693	0.476	0.019**
Waist:hip ratio				
Below 0.85 or 0.85 (Normal *n*=25)	Mean	145.92	1438.56	1719.48
	Median	0.00	200.00	118.80
	IQR	(0.00–0.00)	(0.00–2880.00)	(0.00–3564.00)
Above 0.85 (abdominal obesity *n*=75)	Mean	143.46	1557.38	1417.06
	Median	0.00	160.00	247.50
	IQR	(0.00–0.00)	(10.00–3600.00)	(66.00–2970.00)
**P*		0.982	0.614	0.243
Waist:height				
No increased risk (below 5, *n*=10)	Mean	0.00	1142.00	1587.30
	Median	0.00	150.00	990.00
	IQR	(0.00–0.00)	(0.00–2640.00)	(123.00–3118.5)

(Contd...)

Table 2: *(Continued).*

Socio-demographic characteristics, anthropometrics characteristics, and HbA1c values		Vigorous intensity activity	Moderate intensity activity	Walking
Increased risk (≥5–<6 *n*=43)	Mean	145.11	1378.33	1236.50
	Median	0.00	120.00	132.00
	IQR	(0.00–0.00)	(0.00–2880.00)	(66.00–2772.00)
Very high risk (≥6 *n*=47)	Mean	173.78	1746.38	1706.87
	Median	0.00	840.00	594.00
	IQR	(0.00–0.00)	(100.00–3600.00)	(0.00–4158.00)
**P*		0.765	0.537	0.448
HbA1c				
Normal and (<5.6%, *n*=36)	Mean	48.88	1379.55	1674.75
	Median	0.00	324.00	1089.75
	IQR	(0.00–0.00)	(0.00–2880.00)	(16.5–4009.5)
Pre-diabetes (5.7–6.4%, *n*=64)	Mean	186.37	1611.00	1507.75
	Median	0.00	140.00	132.00
	IQR	(0.00–0.00)	(0.00–3600.00)	(00.00–4009.50)
**P*		0.064	0.135	0.373

*Significant at *P*≥0.05 independent sample *t*-test **significant at *P*≥0.05 one-way ANOVA

Table 3: Correlation between HbA1c and physical activity levels (MET values) at 6 weeks postpartum.

	Total activity (MET)	Vigorous activity (MET)	Moderate activity (MET)	Walking (MET)
HbA1c*	r=0.0.115	r=0.057	r=0.142	r=0.045
	P=0.253	*P*=0.576	*P*=0.159	*P*=0.657
HbA1c**	r=0.103	r=0.023	r=0.137	r=0.032
	P=0.314	*P*=0.823	*P*=0.18	*P*=0.753

*Zero-order correlation **Partial correlation

reported a considerably lower value (25.7 MET-hrs/wk) compared to our mothers.[27] Further, more than half the sample of mothers in the present study were found to have a high level of PA even in the categorical analysis. These findings of postpartum mothers may be a reflection of the activity patterns of Sri Lankans in general, as a large survey of Sri Lankan adult population has reported that 60.4% females are highly physically active.[28]

Activity patterns of GDM mothers were evaluated at 6 weeks postpartum under four major sub groups, namely, vigorous and moderate intensity activities, walking, and sitting. Although vigorous intensity activities are more beneficial to reduce metabolic and other health risks compared to moderate intensity activities,[29] only one tenth of mothers in the present study engaged in vigorous activities at least once for a duration of 10 min continuously during the 1 week period studied. However, a considerable proportion of mothers appear to engage in hand washing of clothes, cleaning the house and garden, and mopping the floor which are considered as moderate intensity activities. These findings seem to go parallel with the findings of a study conducted by De Silva *et al.*[30] who reported domestic activities as the main group of activities in Sri Lankan women. Further, a significant positive relationship was observed in the present study between the number of members including children in a family and the quantum of PA. The finding that the women who are part of large families and having more children tend to engage in physical activities more compared to those in small family units further supports the likelihood of expending energy through routine family duties and responsibilities.

Since domestic work plays an important role in the daily PA pattern of these women, it is imperative that novel PA schedules for postpartum mothers should be designed to achieve maximum benefits through simple day-to-day household activities.

Walking is the most popular PA for health benefits.[27] Although lack of time due to high childcare demands is common in postpartum women,[11] more than half of the cohort of mothers in the present study have walked up to the recommended level of 150 min/week. Low cost, minimal risk, and cultural acceptability may be the probable reasons for acceptance by these mothers. Further it was observed that energy expenditure by walking is significantly higher in women who are part of large families compared to those belonging to small families. When duties

and responsibilities of Sri Lankan mothers are considered, it is possible that mothers in large families fulfill the required walking merely through engaging in their daily routine activities. This may be attributed to the increased household duties of women who have more children and large extended families. The positive association observed between higher BMI groups and energy expenditure by walking is quite encouraging as it is the target group that needs strict PA recommendations.

As sedentary behavior is associated with multiple chronic diseases which includes T2DM,[31] postpartum women should be encouraged to limit their sitting time as much as they can. A marked increased in the risk is reported when sitting time exceeds 7 h/day.[32] However, it is very encouraging to note that the mothers in the present study remain seated for about 3 h/day mainly to breast feed and lull the baby. Interestingly, the sitting time of our women goes in parallel with the breastfeeding recommendation of 20–30 min in every 2–3 h which comes to an average of approximately 3 h/day.[33]

According to the results of this study and other local studies,[28,30] it is legitimate to think that Sri Lankan women are physically active. However, there is evidence of increasing prevalence of metabolic diseases such as diabetes mellitus and their risk factors, obesity, and specifically abdominal obesity.[34] The suboptimal level of activity and the choice of the type of activity may be possible reasons contributing for the increase in prevalence of metabolic diseases in spite of these women being active. Regular exercise training is known to reduce the HbA1c, denoting improvements in glycemic control.[7] However, we did not observe any relationship between PA and HbA1c, as the activity level was assessed at 6 weeks postpartum, which is the average time a woman starts engaging in usual physical activities after the delivery.[35]

The availability of a culturally acceptable PA program with increasing awareness of its use to combat metabolic diseases may be the way forward. Although IPAQ is a cross culturally validated and widely used tool which is also validated for pregnant mothers, since it is a subject based questionnaire, the overestimation of PA levels is a possibility. Hence, it is recommended that subjective data are supplemented by objective estimations by a pedometer or an accelerometer.

CONCLUSION

The findings of this study demonstrate the PA patterns among postpartum mothers with a history of GDM at 6 weeks postpartum. The main contributors to energy expenditure in the study sample were moderate intensity household activities and walking. Being active was significantly associated with the number of family members including children. None of the PA MET values significantly correlated with the glycemic parameter, HbA1c.

However, the challenge is to design an exercise protocol for postpartum women incorporating day-to-day activities in a way to achieve maximum health benefits.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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