International Journal of Endorsing Health Science Research
©Int. j. endorsing health sci. res.
Published by Advance Educational Institute and Research Centre

IJEHSR

Original Article

The association of maternal age, body mass index, physical activity with Gestational Diabetes Mellitus

doi: 10.29052/IJEHSR.v6.i3.2018.25-33
Corresponding Author Email:
hhk.hina@gmail.com
Received 05/04/2018
Accepted 23/08/2018
Published 01/09/2018

Hina Hazrat[1], Sadaf Ahmed[1,2] & Shamoon Noushad[2,3]

[1]Department of Physiology, University of Karachi, Karachi, Pakistan

[2]Advance Educational Institute and Research Centre, Karachi, Pakistan

[3]Department of Public Health and Epidemiology, Dadabhoy Institute of Higher Education, Karachi, Pakistan.

OPEN ACCESS

Abstract

Background: Gestational diabetes mellitus (GDM) represents the state of carbohydrate intolerance during gestation. GDM is found as a risk factor for adverse outcomes of gestation concerning maternal and fetal health conditions. Increasing maternal age is found associated with GDM and also other obstetric complications. High maternal weight is reported to be linked to elevated risk of GDM. Relation of increased maternal age and elevated body mass index (BMI) state with GDM suggests a need of effective measures for improving the maternal and fetal health conditions and alienate the GDM associated obstetric concerns. Previous studies have found possible role of physical activity and exercise in reducing the risk of GDM development. This study aimed to explore GDM prevalence among participants and to perform comparative analysis of maternal age and BMI between participants without GDM and participants with GDM.

Methodology: This cross-sectional study was conducted from March 2014 to September 2014, participants (n=133) filled in a questionnaire which aimed to assess parameters like age, BMI and physical activity for the study. Women in gestation were randomly invited to participate in study, and informed signed consent was obtained from each participant prior participation. Participants were categorized in two groups, participants without GDM and with GDM. For each participant, maternal age, BMI and involvement in physical activities were recorded. Data were analysed using IBM SPSS Statistics 24.

Results: Mean values of maternal age and BMI were found to be lower for participants without GDM as compared to that of participants with GDM. Participants without GDM reported to be involved in household activities, occupational activities and exercise whereas participants with GDM were found to be only involved in household activities.

Conclusion: In conclusion, this study may suggest possible influence of maternal age in GDM. Moreover, in view of findings which indicated higher mean value of maternal BMI of participants with GDM compared to that of participants without GDM, and in view of physical activity state, weight management and healthy lifestyle may be encouraged.

Keywords

Glucose Intolerance, Gestational Diabetes Mellitus, Maternal Age, Maternal BMI, Physical Activity.

Check for updates

Introduction

GDM, state of glucose intolerance during gestation[1], is considered as a risk factor for programming of multiple adverse health outcomes[2&3]. It is found related with development of type 2 diabetes and metabolic syndrome[4-6]. Moreover, GDM impacts offspring epigenetics contributing in programming of obesity later in life[7], and in fetal metabolic processes[8&9]. Increasing maternal age is found associated with GDM and other obstetric complications[10]. Pregnant women aged ≥35 years are found to be at higher risk for developing complications, including gestational diabetes, compared with women of younger age[11].

Studies carried out in Pakistan have found increasing maternal age[12,13], BMI[12,13], parity[13], history of GDM[13] and family history of diabetes[12,13] as risk factors of GDM. Moreover, these studies determined insignificant association of ethinicity[12] and socioeconomic status[13] with GDM. Previous study has presented role of elevated visceral and total adipose tissue depth plays an important role during first trimester in predicting risk of dysglycemia[14]. Adipose tissue malfunctioning is implicated in GDM development[15]. Moreover, a recent study has presented visceral fat mass as a risk factor of GDM in obese BMI state[16]. The occurrence of dyslipidemia in early gestational period is found related with GDM development despite the state of BMI, as higher levels of triglycerides in lean and obese women are found related to raised possibility of GDM[17]. Another study has also reported elevated levels of triglycerides in GDM[18].

One of the factors triggering manifestation of GDM has been shown to be weight changes which transduce its influence on metabolic pathways[19]. Increased gestational weight gain may elevate GDM occurrence, presenting gain in weight as modifiable risk factor for GDM[20]. Triglycerides/high density lipoprotein ratios as well as haemoglobin A1c and pre-pregnancy BMI status are found to stand as possible prediction markers of GDM and large for gestational age (LGA) risk[21]. Healthy weight from the period of preconception to postpartum is encouraged[19]. Consistent with other studies, high maternal weight is reported to be related with increased chance of GDM development[22]. Overweight, obesity and GDM are found associated with LGA risk[23] and increased placental leptin methylation[24] which may contribute its role in intrauterine reprogramming of offspring obesity[25] and other offspring health complications[24].

The association between increased maternal age[11], obesity[9&22] and GDM suggests need for effective interventions to improve the health state and reduce GDM associated obstetric and fetal complications[26]. Increased maternal physical activities may contribute in reducing GDM risk[27]. Findings of previous study suggested possible role of exercise in reducing GDM development[28]. Role of physical activity[29] and exercise[28] in reducing chances of GDM development is found significant, and is suggested as one of possible interventions in the GDM management[30]. This study aimed to explore prevalence of GDM among study participants and analyse association of maternal age, BMI and physical activity in participants, without and with GDM.

Methodology

For the purpose of assessing prevalence of GDM among study participants (n=133) and analysing association between maternal age, BMI, physical activity and GDM, a questionnaire was designed and administered in this cross-sectional study conducted from March 2014 to September 2014. Ethical approval for this study was obtained from Institutional Review Board of Advance Educational Institute and Research Center. Women in gestation were randomly invited to participate in study, and prior participation in study, informed signed consent was obtained from each participant. The study participants were categorized into two groups; participants without GDM and participants with GDM. Each participant self-reported the presence or absence of GDM during present gestation. Maternal age, BMI and engagement in physical activities were recorded for each participant.

Data were presented as mean ± standard deviation. Shapiro-Wilk test was used to determine normality, and Levene's test was used to assess equality of variances of data. When normal distribution and equal variances of data were assumed, independent sample t-test was used, otherwise Welch's t-test was utilized. P ≤ 0.05 was termed statistically significant. IBM SPSS Statistics 24 was used for statistical analysis.

Results

Among all study participants (n=133), a total of 6.02% (n=8) participants self-reported for GDM during present gestational period.

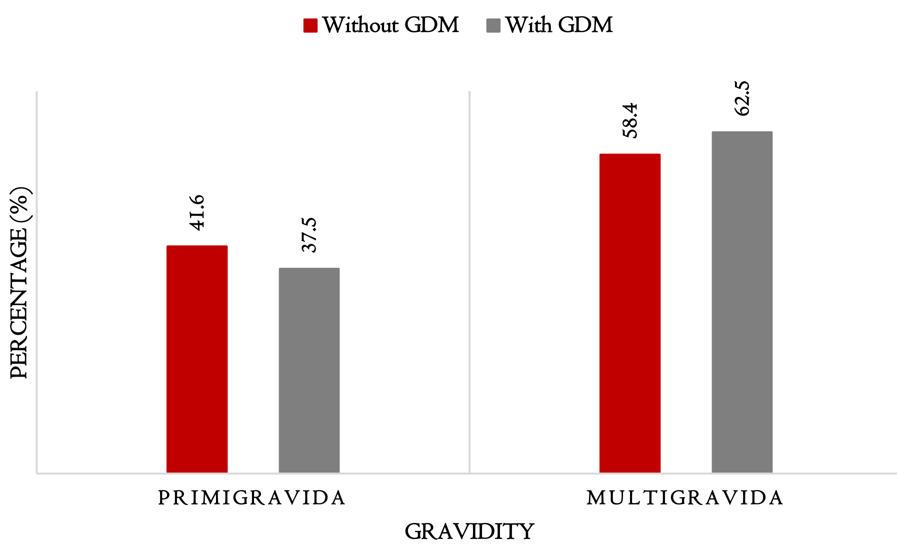

Figure 1: Frequency of primigravidas and multigravidas.

Participants without GDM (n=125) were 41.6% (n=52) primigravidas and 58.4% (n=73) multigravidas. Moreover, participants with GDM (n=8) were 37.5% (n=3) primigravidas and 62.5% (n=5) multigravidas (Figure 1).

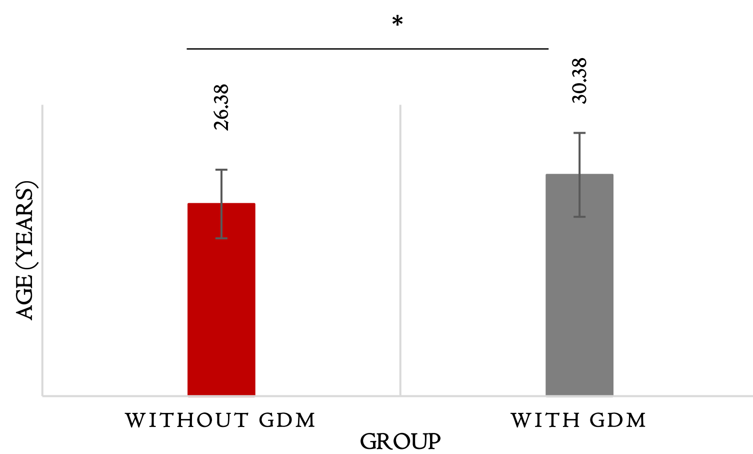

Figure 2: Maternal age of participants without GDM and with GDM.

Participants without GDM and with GDM had mean value of 26.38 ± 4.71 years and 30.38 ± 5.76 years for maternal age respectively, and this difference was identified to be statistically significant ($p < 0.05$) using independent samples t-test. * represents $p < 0.05$ (Figure 2).

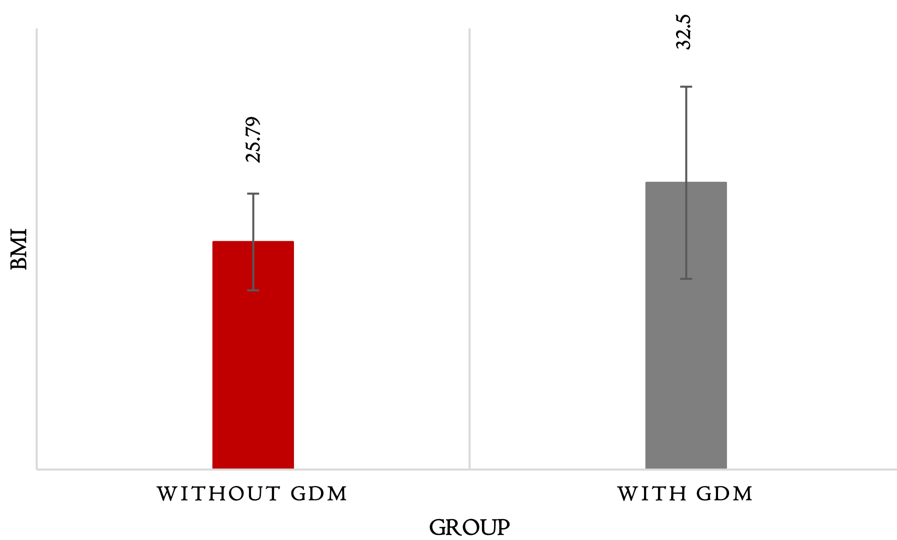

Figure 3: BMI of participants without GDM and with GDM.

Participants without GDM presented mean values of 25.79 ± 5.48 and participants with GDM had a mean value of 32.5 ± 10.89 for maternal BMI. Although, the mean values for BMI were found to be increased for participants with GDM, compared to that of participants without GDM, however this difference was statistically insignificant using Welch's t-test ($p > 0.05$) (Figure 3).

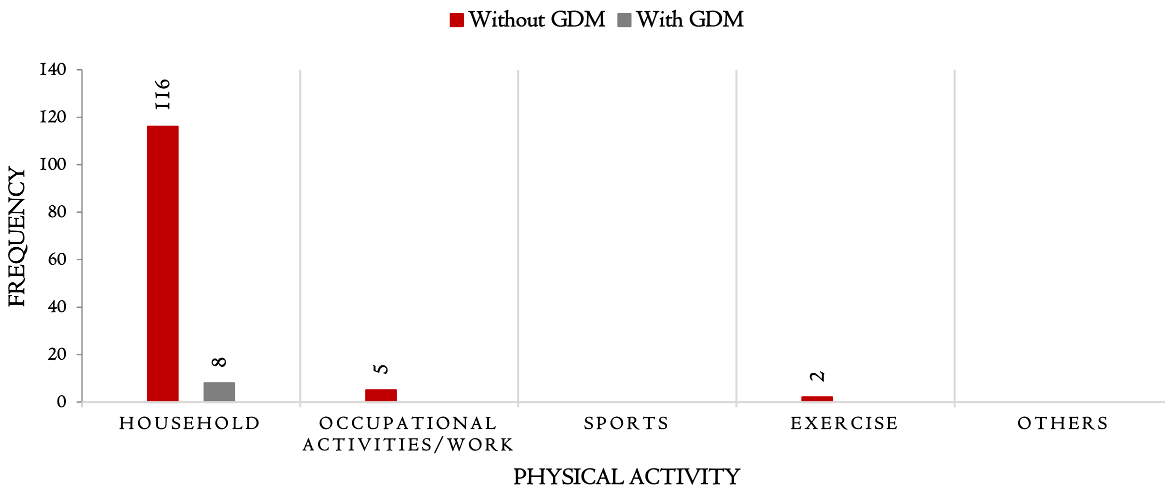

Figure 4: Frequency of participants involved in physical activities.

Among all participants in the group without GDM, 92.8% (n=116) were involved in household activities, 4% (n=5) reported engagement with occupational work and 1.6% (n=2) were found involved in exercise. All participants in group with GDM (n=8) reported to be engaged with household activities (Figure 4).

Discussion

GDM is found associated with a decrease in efficient pancreatic β-cell functioning[31] and insulin resistance coupled to decrease in glucose transport activity which is reported to be associated with reduction in insulin receptor phosphorylation[6]. Multiple studies have found GDM as a risk factor for various obstetric and neonatal complications related to health such as, type 2 diabetes[4&5], metabolic syndrome[4], LGA[32] and macrosomia[33]. This highlights the importance of GDM timely management to improve GDM associated perinatal outcomes[2&34].

In this study, a total of 6.02% participants self-reported for GDM during present gestational period among all study participants. A recent study from Pakistan has identified increased GDM frequency highlighting the importance of GDM screening in Pakistan[35]. This study found 37.5% and 62.5% of the participants with GDM to be primigravidas and multigravidas respectively, whereas 41.6% and 58.4% of the participants without GDM to be primigravidas and multigravidas respectively (Figure 1). Study has shown parity as a risk factor for GDM[13].

In this present study, participants without GDM, had lower mean value (26.38 ± 4.71 years) for maternal age as compared to participants with GDM (30.38 ± 5.76 years) (Figure 2). The American Diabetes Association recommends cut-off age ≥25 years for the screening of GDM[36&37], and maternal age ≥25 years is found predictive of GDM[37]. Study carried out in Pakistan has presented significant association of maternal age with GDM[13]. The association of maternal age and BMI with racial group in view of GDM prevalence is also reported[38]. Furthermore, there is an association found between maternal age and BMI in GDM development, particularly in Black African and South Asian women[38].

Maternal weight is found associated with risk of GDM development[22]. Participants in the group without GDM (25.79 ± 5.48) had lower mean value for BMI as compared to that of participants with GDM (32.5 ± 10.89) (Figure 3). Study carried out in Pakistan has found BMI as a risk factor for GDM[13]. Increased maternal BMI is found to mediate inflammatory response during GDM[39&40] which may play part in altering the maternal normal regulation of insulin signalling and glucose transport[40]. Recent study has shown possible role of chimerin and leptin and their adipose tissue expression in mediating insulin resistance condition and inflammatory state in GDM accompanied by obesity[41].

Maternal obesity coupled with GDM is found to impart its effects on perinatal outcomes[42]. Previous finding has shown link between maternal metabolic status and alteration in placental DNA methylation, which may play role in reprogramming of fetal metabolic status, thus leading to obesity and associated conditions[24]. Findings of Anderson supported association of maternal obesity and GDM with fetal central nervous system[43]. Moreover, increased maternal BMI and GDM is found associated with LGA[23].

Increased physical activity before and after gestation is found interlinked with significant decrease in GDM risk[27&29]. Participants without GDM reported engagement in household activities and all participants with GDM reported to be involved in household activities (Figure 4). It is shown that exercise for some women may impart its beneficial effect, such as lowering the risk of GDM[28]. In the present study, 1.6% (n=2) participants without GDM reported to be involved in exercise, whereas none from GDM group reported to be involved in exercise (Figure 4). Exercise is suggested to be incorporated into the GDM management interventions[30].

Keeping in view the limitations of this preliminary study, such as self-reported presence or absence of GDM, cross-sectional study design, and small and unequal sample size; it is recommended that future studies should include confirmatory test for detection of presence or absence of GDM for participants recruitment, design longitudinal study to determine association of age, BMI, and GDM and assess influence of GDM throughout gestation, in large sample size. Relation of maternal age, BMI and GDM highlight formation and implementation of effective interventions for GDM management[26]. Untreated GDM is found associated with perinatal morbidity risks; which highlights the importance of implementation of efforts for GDM management34 and prevention[44]; such as the improving the insulin sensitivity[44]. Moreover, GDM treatment is found to reduce perinatal morbidity and may contribute in quality of life improvement[45]. Lifestyle changes at the level of nutrition and physical activity may play role in GDM management and prevention[46].

Conclusion

This study may suggest possible impact of increasing maternal age in GDM. Moreover, in light of previous studies, and the findings of current study which indicated higher mean value of maternal BMI compared to that of participants without GDM, and in view of physical activity state, weight management and healthy lifestyle may be encouraged.

Conflicts of Interest

None.

Acknowledgement

Authors would like to thank all participants for completing study questionnaire, and making this study possible.

Funding

None.

References

1. Oats JJ. Fourth International Workshop-conference on Gestational Diabetes Mellitus: Overview and commentary on first session. Diabetes care. 1998;21:B58.
2. Ovesen PG, Jensen DM, Damm P, Rasmussen S, Kesmodel US. Maternal and neonatal outcomes in pregnancies complicated by gestational diabetes. A nation-wide study. The J Matern Fetal Neonatal Med. 2015; 28(14):1720-1724.
3. Sweeting AN, Ross GP, Hyett J, Molyneaux L, Constantino M, Harding AJ, et al. Gestational diabetes mellitus in early pregnancy: evidence for poor pregnancy outcomes despite treatment. Diabetes Care. 2016; 39(1):75-81.
4. Yogev Y, Visser GH, editors. Obesity, gestational diabetes and pregnancy outcome. Semin Fetal Neonatal Med. 2009; 14(2): 77-84.
5. Bellamy L, Casas J-P, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. The Lancet. 2009; 373(9677):1773-1779.
6. Friedman JE, Ishizuka T, Shao J, Huston L, Highman T, Catalano P. Impaired glucose transport and insulin receptor tyrosine phosphorylation in skeletal muscle from obese women with gestational diabetes. Diabetes. 1999; 48(9):1807-1814.
7. El Hajj N, Pliushch G, Schneider E, Dittrich M, Müller T, Korenkov M, Aretz M, Zechner U, Lehnen H, Haaf T. Metabolic programming of MEST DNA methylation by intrauterine exposure to gestational diabetes mellitus. Diabetes. 2013; 62(4):1320-1328.
8. Ruchat SM, Houde AA, Voisin G, St-Pierre J, Perron P, Baillargeon JP, Gaudet D, Hivert MF, Brisson D, Bouchard L. Gestational diabetes mellitus epigenetically affects genes predominantly involved in metabolic diseases. Epigenetics. 2013;8(9):935-943.
9. Joshi A, Goetzl L, Pinney Se. Effect of Gestational Diabetes and Maternal Obesity on Fetal Programming—Are miRNAs Key Epigenetic Modifiers or Biomarkers of an Altered Intrauterine Milieu? : Am Diabetes Assoc; 2018; 67(Supplement 1).
10. Cleary-Goldman J, Malone FD, Vidaver J, Ball RH, Nyberg DA, Comstock CH, Saade GR, Eddleman KA, Klugman S, Dugoff L, Timor-Tritsch IE.Impact of maternal age on obstetric outcome. Obstet Gynecol. 2005; 105 (5, Part 1):983-990.
11. Jolly M, Sebire N, Harris J, Robinson S, Regan L. The risks associated with pregnancy in women aged 35 years or older. Hum Reprod. 2000; 15(11):2433-2437.
12. Fatima SS, Rehman R, Alam F, Madhani S, Chaudhry B, Khan TA. Gestational diabetes mellitus and the predisposing factors. Insulin. 2017; 67(2):261-265.
13. Khan R, Ali K, Khan Z. Socio-demographic risk factors of Gestational Diabetes Mellitus. Pak J Med Sci. 2013; 29(3): 843–846.
14. De Souza LR, Berger H, Retnakaran R, Maguire JL, Nathens AB, Connelly PW, Ray JG. First-trimester maternal abdominal adiposity predicts dysglycemia and gestational diabetes mellitus in midpregnancy. Diabetes Care. 2016; 39(1):61-64.
15. Šimják P, Cinkajzlová A, Anderlová K, Pařízek A, Mráz M, Kršek M, Haluzík M. The role of obesity and adipose tissue dysfunction in gestational diabetes mellitus. J Endocrinol; 238(2):63-77.
16. Balani J, Hyer S, Shehata H, Mohareb F. Visceral fat mass as a novel risk factor for predicting gestational diabetes in obese pregnant women. Obstetric Medicine. 2018: 0(0) 1–5.

17. Li G, Kong L, Zhang L, Fan L, Su Y, Rose JC, Zhang W. Early pregnancy maternal lipid profiles and the risk of gestational diabetes mellitus stratified for body mass index. Reprod Sci. 2015;22(6):712-717.
18. Ryckman K, Spracklen C, Smith C, Robinson J, Saftlas A. Maternal lipid levels during pregnancy and gestational diabetes: a systematic review and meta-analysis. BJOG. 2015; 122(5):643-651.
19. Sorbye L, Skjaerven R, Klungsoyr K, Morken N-H. Gestational diabetes mellitus and interpregnancy weight change: A population-based cohort study. PLoS medicine. 2017; 14(8):e1002367.
20. Hedderson MM, Gunderson EP, Ferrara A. Gestational weight gain and risk of gestational diabetes mellitus. Obstet Gynecol. 2010; 115(3): 597–604.
21. Wang D, Xu S, Chen H, Zhong L, Wang Z. The associations between triglyceride to high-density lipoprotein cholesterol ratios and the risks of gestational diabetes mellitus and large-for-gestational-age infant. Clin Endocrinol. 2015; 83(4):490-497.
22. Chu SY, Callaghan WM, Kim SY, Schmid CH, Lau J, England LJ, Dietz PM. Maternal obesity and risk of gestational diabetes mellitus. Diabetes care. 2007;30(8):2070-2076.
23. Kim SY, Sharma AJ, Sappenfield W, Wilson HG, Salihu HM. Association of maternal body mass index, excessive weight gain, and gestational diabetes mellitus with large-for-gestational-age births. Clin Endocrinol. 2014; 123(4):737.
24. Lesseur C, Armstrong DA, Paquette AG, Li Z, Padbury JF, Marsit CJ. Maternal obesity and gestational diabetes are associated with placental leptin DNA methylation. Am J Obstet Gynecol. 2014; 211(6):654.e1-e9.
25. Gillman MW, Rifas-Shiman S, Berkey CS, Field AE, Colditz GA. Maternal gestational diabetes, birth weight, and adolescent obesity. Pediatrics. 2003; 111(3):e221-e226.
26. Kaul P, Savu A, Nerenberg KA, Donovan LE, Chik CL, Ryan EA, Johnson JA. Impact of gestational diabetes mellitus and high maternal weight on the development of diabetes, hypertension and cardiovascular disease: a population-level analysis. Diabet Med. 2015; 32(2):164-173.
27. Dempsey JC, Sorensen TK, Williams MA, Lee IM, Miller RS, Dashow EE, Luthy DA. Prospective study of gestational diabetes mellitus risk in relation to maternal recreational physical activity before and during pregnancy. Am J Epidemiol. 2004;159(7):663-670.
28. Dye TD, Knox KL, Artal R, Aubry RH, Wojtowycz MA. Physical activity, obesity, and diabetes in pregnancy. Am J Epidemiol.. 1997;146(11):961-965.
29. Tobias DK, Zhang C, Van Dam RM, Bowers K, Hu FB. Physical activity before and during pregnancy and risk of gestational diabetes mellitus. Diabetes care. 2011;34(1):223-229.
30. Bung P, Artal R, editors. Gestational diabetes and exercise: a survey. Semin Perinato. 1996; 20(4):328-333.
31. Buchanan TA, Metzger BE, Freinkel N, Bergman RN. Insulin sensitivity and B-cell responsiveness to glucose during late pregnancy in lean and moderately obese women with normal glucose tolerance or mild gestational diabetes. Am J Obstet Gynecol. 1990; 162(4):1008-1014.
32. Casey BM, Lucas MJ, McIntire DD, Leveno KJ. Pregnancy outcomes in women with gestational diabetes compared with the general obstetric population. Obstet Gynecol. 1997; 90(6):869-873.
33. Alberico S, Montico M, Barresi V, Monasta L, Businelli C, Soini V, Erenbourg A, Ronfani L, Maso G.The role of gestational diabetes, pre-pregnancy

body mass index and gestational weight gain on the risk of newborn macrosomia: results from a prospective multicentre study. BMC pregnancy childbirth. 2014; 14(1):23.
34. Langer O, Yogev Y, Most O, Xenakis EM. Gestational diabetes: the consequences of not treating. Am J Obstet Gynecol. 2005;192(4):989-997.
35. Riaz M, Nawaz A, Masood SN, Fawwad A, Basit A, Shera A. Frequency of gestational diabetes mellitus using DIPSI criteria, a study from Pakistan. Clin Epidemiol Glob Health. 2018.
36. Carr DB, Utzschneider KM, Hull RL, Tong J, Wallace TM, Kodama K, Shofer JB, Heckbert SR, Boyko EJ, Fujimoto WY, Kahn SE. Gestational diabetes mellitus increases the risk of cardiovascular disease in women with a family history of type 2 diabetes. Diabetes care. 2006;29(9):2078-2083.
37. Danilenko-Dixon DR, Van Winter JT, Nelson RL, Ogburn PL. Universal versus selective gestational diabetes screening: application of 1997 American Diabetes Association recommendations. Am J Obstet Gynecol. 1999; 181(4):798-802.
38. Makgoba M, Savvidou M, Steer P. An analysis of the interrelationship between maternal age, body mass index and racial origin in the development of gestational diabetes mellitus. BJOG. 2012;119(3):276-282.
39. Wolf M, Sandler L, Hsu K, Vossen-Smirnakis K, Ecker JL, Thadhani R. First-trimester C-reactive protein and subsequent gestational diabetes. Diabetes care. 2003;26(3):819-824.
40. Retnakaran R, Hanley AJ, Raif N, Connelly PW, Sermer M, Zinman B. C-reactive protein and gestational diabetes: the central role of maternal obesity. J Clin Endocrinol Metab. 2003; 88(8):3507-3512.
41. Tsiotra PC, Halvatsiotis P, Patsouras K, Maratou E, Salamalekis G, Raptis SA, Dimitriadis G, Boutati E. Circulating adipokines and mRNA expression in adipose tissue and the placenta in women with gestational diabetes mellitus. Peptides. 2018;101: 157-166.
42. Yogev Y, Langer O. Pregnancy outcome in obese and morbidly obese gestational diabetic women. Eur J Obstet Gynecol Reprod Biol. 2008; 137(1):21-26.
43. Anderson JL, Waller DK, Canfield MA, Shaw GM, Watkins ML, Werler MM. Maternal obesity, gestational diabetes, and central nervous system birth defects. Epidemiology. 2005; 16(1):87-92.
44. Butte NF. Carbohydrate and lipid metabolism in pregnancy: normal compared with gestational diabetes mellitus. Am J Clin Nutr. 2000; 71(5):1256-1261.
45. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. N Engl J Med. 2005; 352(24):2477-2486.
46. Mottola MF, Artal R. Role of exercise in reducing gestational diabetes mellitus. Clin Obstet Gynecol. 2016; 59(3):620-628.