JOURNAL OF BEHAVIORAL HEALTH, 2023
VOL 12, NO. 3, PAGE 1 – 6

COMMENTARY

Open Access

The Enablers and Barriers Associated With the Performance of Physical Exercise in Patients with Gestational Diabetes Mellitus

Godsday Udoji Ogbutor[1], Ephraim Chukwuemeka[1], Nworah Awele Maria[1], Akaeme Daniel Chidubem[1], Onapkoma Bight Eniwareke[1], Overcomer Temiloluwa Binuyo[1], Kizito Emeka Bright[1], Ezunu Emmanuel[2], Omorode Deborah[3], Collins Ogbeivor[4], Ruth Kikachukwu Chibuzor[1] and Ogbutor Great Emeke[3]

[1]Department of Physiotherapy, Federal Medical Centre Asaba, Delta State Nigeria.
[2]Department of Internal Medicine, Federal Medical Centre Asaba, Delta State, Nigeria.
[3]Faculty of Medicine, Delta State University Abraka, Delta State, Nigeria.
[4]Rehabilitation Department, John Hopkins Healthcare Aramco, Dhahran, Kingdom of Saudi Arabia.

ABSTRACT

Background: Scientific evidence has shown that ante-natal lifestyle therapies such as physical exercise can enhance pregnancy outcomes and lower the risk of gestational diabetes (GDM). However, more than 60% of women with gestational diabetes do not perform physical exercise and a sedentary lifestyle may heighten the risk of this disease. The purpose of this study was to identify the factors that promote or hinder the performance of physical exercise in patients with gestational diabetes mellitus.

Materials and Methods: The study employed a cross sectional design and a purposive sampling technique was used to recruit the respondents. The research instrument was a modified and pre-tested self-administered questionnaire adapted from previous studies. A structured barrier and enabler (BE) questionnaire was used for data collection.

Results: All respondents cited lack of time as a barrier, followed by children's demands (34.2%), laziness (15.8%), being unaccustomed to physical exercise (14.5%), and lack of information (2.6%). On the other hand, 28.9% of the women claimed that social media, 15.8% "being fit", 15.8% "being healthy", 7.9% "looking nice" and 2.9% "being active" were their major stimulus or enablers.

Conclusion: This study reflects that the value placed on the performance of physical exercise is secondary to cultural demands. While the women in this study viewed physical activity as important for their health, it was usually prioritized behind their demanding roles as mothers, partners and homemakers.

Recommendations: Physical Exercise prescriptions should consider the geographic and cultural orientation of the people for effective compliance. Moreover, a public health approach aimed at enlightening the populace of the importance of physical exercise in patients with gestational diabetes mellitus would be of tremendous help at minimizing the barriers and promoting the participation of these categories of patients in the performance of physical exercise.

ARTICLE HISTORY

Received Date: 25 May 2023
Accepted Date: 08 July 2023
Published Date: 14 July 2023

KEYWORDS

Barriers, Enablers, Physical Exercise, Gestational diabetes, Patients.

Introduction

Physical inactivity has been identified as being a major lifestyle shift that is responsible for the onset of various disease conditions and the increased prevalence of chronic diseases hence; physical exercise has been recommended by both national and international committees in the management and/or prevention of chronic diseases [1]. Physical inactivity is a known risk factor for obesity, insulin resistance and type 2 diabetes, and the physiological and hormonal changes that accompany pregnancy further increase the risk of Gestational diabetes mellitus [2]. Pregnancy-related physical inactivity has been linked to an increased risk of gestational diabetes mellitus and excessive weight gain, which further increase the incidence of pregnancy complications in later life for both the mother and child [3-5].

In recent times, an increased global interest has arisen amongst scientists in physical activities that promote health [6]. Lately, clinical researchers have articulated a burgeoning attention in the investigation of the occurrence and degree of specific

Contact: Dr. OGBUTOR Udoji Godsday, Department of Physiotherapy, Federal Medical Centre, Asaba, Delta State, Nigeria, Tel: +2348138474624.

alterations in the physiological parameters of various systems of the human body following the application of physical exercise [7]. Ogbutor et al. stated that physical exercise produces one of the greatest remarkable burdens on the various systems of the body in contrast with any of the various human stressors encountered in life's normal event [7]. During physical exercise, an enormous homeostatic disruption of the human physiological system occurs for which the various regulatory systems respond by an internal adjustment so as to accommodate for the swift energy demands of the exercising muscles. The physiological responses and adaptations to various intensities of physical exercise is now acknowledged as an essential instrument, which can aid the diagnosis and treatment of various diseases [8,9]. Consequently, physical exercise is now been widely accepted as a means for the primary prevention of chronic diseases and effective treatment and rehabilitation regimen in patients [7,10].

Gestational Diabetes (GDM) is a form of hyperglycaemia among pregnant women [11]. It is defined as glucose intolerance with onset or first recognition during pregnancy. Pregnancy is normally accompanied by progressive insulin resistance that begins near mid-pregnancy and progresses through the third trimester to levels that approximate the insulin resistance seen in type- 2 diabetes [11-13]. The diabetes is considered a GDM if the hyperglycaemia is diagnosed for the first time during pregnancy. GDM's standard screening test is the 75-g oral glucose tolerance test.

(OGTT) between 24 weeks and 28 weeks of gestation [14]. Gestational diabetes mellitus (GDM) is a common disease that typically affects around 5.8% (1.8-22.3%) of European pregnancies [15]. Ferrara revealed a steady increase in the prevalence of GDM, which was established to reflect the frequency of Type 2 diabetes in the underlying population. In the US, Hispanic African-American women are found to be at higher risk for GDM than non-Hispanic white women [16].

The insulin resistance of pregnancy may result from a combination of increased maternal adiposity and the insulin-desensitizing effects of hormones made by the placenta [17]. This is further proven by the rapid abatement of insulin resistance after delivery, thereby suggesting a major contribution from placental hormones [16]. Rieck et al., revealed that Pancreatic-cells normally increase their insulin secretion to compensate for the insulin resistance of pregnancy [18]. As a result, changes in circulating glucose levels over the course of pregnancy are quite small despite the large changes in insulin sensitivity. Consequently, robust plasticity of-cell function in the face of progressive insulin resistance is the hallmark of normal glucose regulation during pregnancy [17,18]. Like all forms of hyperglycaemia, GDM results from an endogenous insulin supply that is inadequate to meet tissue insulin demands [19]. Inadequate insulin secretion is most easily demonstrated in late pregnancy, when insulin requirements are uniformly high and differ only slightly between normal women and women with GDM [20]. In contrast with healthy pregnant women, insulin responses to nutrients are much lower in women with GDM [21]. One potential pathophysiology for GDM is a limitation in pancreatic -cell reserve that becomes manifest as hyperglycaemia only when insulin secretion does not increase to match the increased insulin needs of late pregnancy [17]. Insulin levels are often similar between women without and with a history of GDM suggesting that inadequate insulin secretion in the GDM group was limited due to pregnancy [22]. However, women with a history of GDM are usually considerably more insulin resistant than non-pregnant normal women [22]. Thus, insulin levels would be higher in the prior GDM patients if the cell's function were normal [17]. The similarity of insulin levels in the face of differing insulin resistance reveals at a qualitative level a -cell defect in women with prior GDM [17]. The defect can be quantified by expressing insulin levels relative to each individual's degree of insulin resistance, using the hyperbolic relationship that exists between insulin sensitivity and insulin secretion [17,18]. That approach reveals a large defect in pancreatic -cell function in women with GDM both during and after pregnancy [23].

Scientific data show that antenatal lifestyle therapies such as physical exercise and diet can enhance pregnancy outcomes and lower the risk of gestational diabetes. Physical exercise such as walking, swimming, water activities, dancing, stationary cycling, modified yoga, resistance exercises, and stretching are regarded as safe [24,25]. There is significant evidence to support the notion that physical exercise during pregnancy should involve both aerobic and strengthening exercises, as well as stretching and yoga [26]. Pelvic floor exercises should also be included to help reduce the risk of developing urine incontinence [27]. Several international organizations, committees and policymakers have recommended 30 minutes of moderate-intensity aerobic activity on most days of the week [27-30].

Despite the well-documented health benefits, 60 to 80% of pregnant women and more than 60% of women with GDM, do not engage in the recommended levels of physical activity [31-33]. Physical activity levels have also been reported to reduce markedly during pregnancy even amongst women that previously engaged in physical exercise [26]. This study therefore was designed to identify the factors that promote or hinder the performance of physical exercise in patients with gestational diabetes mellitus.

Materials and Methods

The study employed a cross-sectional design with the primary aim of investigating the barriers and enablers associated with the performance of physical exercise among gestational diabetes patients. The study was carried out in the Department of Obstetrics and Gynecology, Federal Medical Center (FMC), Asaba, Delta State, Nigeria. Federal Medical Center, Asaba is the only Federal tertiary healthcare facility situated in Delta State and as such receives referrals from all regions of the state and neighboring states. Therefore, the study population is a representative sample of the state. A purposive sampling technique was used to recruit the respondents. Inclusion into the study was subject to a normal medical examination, determined by a consultant Gyneacologist. Only subjects, with no clinical evidence of infectious, inflammatory and/or chronic diseases were recruited. Other considerations were women diagnosed with gestational diabetes mellitus, Aged 18 to 40

years, singleton pregnancy and a normal 18-week ultrasound scan, able to read and write in English. Subjects were excluded from the study if their age is below or above the age range of 18-40 years or have a queried health status with clinical evidence of chronic diseases. Further exclusion criteria were based on patients with twin pregnancy, underage pregnancy and women with glucose intolerance. All participants received assurances of the confidentiality and anonymity of their responses. Data were collected using a self-administered pretested close ended questionnaire. The questionnaire contained three domains; the first is the socio-demographic and maternal characteristics such as age, education, religion, residence, employment, parity, gestational period, etc., the second on barriers and the third on enablers. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 20 and results were entered as frequency and percentages.

Results

Sociodemographic data of the participants Employment status, Age, Education and Ethnicity (n = 76).

Table 1: Sociodemographic data of the participants Age, Employment status, Education and Ethnicity.

Variable	Frequency	Percentage (%)
Age		
26-30	15	19.7
31-35	54	71.1
36-40	7	9.2
Education		
Secondary	51	67.1
First Degree	6	7.9
Postgraduate	19	25.0
Ethnicity		
Igbo	63	82.9
Urhobo	7	9.2
Yoruba	6	7.9

71.1% of the sample population was within the age range 31-35years, while 19.7% was within age range 26-30years and 9.2% within age range 36-40years. 67.1% of the sampled population attained only secondary education, while 7.1% attained First Degree and 25% attained postgraduate education. 82.9% of the sampled population were of the Igbo ethnicity in Nigeria, while Urhobo and Yoruba tribes were 9.2% and 7.9% respectively.

Table 2: Sociodemographic data of the participants Employment status, Employment type, Occupation and Monthly Income.

Sociodemographic data of the participants (n = 76) Employment status, Employment type, Occupation and Monthly Income		
Variable	**Frequency**	**Percentage (%)**
Employment status		
Employed	72	94.7
Unemployed	4	5.3
Employment type		
Self Employed	61	80.3
Civil Employed	4	5.3
Private Organization	7	9.2
Nil	4	5.3
Occupation		
Banker	5	6.6
Caterer	4	5.3
Civil Servant	4	5.3
Hair Stylist	4	5.3
Lawyer	2	2.6
Trader	53	69.7
Nil	4	5.3
Monthly Income		
Nil	4	5.3
Low income	59	77.7
Middle Income	9	11.8
High Income	0	0
No disclosure	4	5.3

The majority of the sampled population (94.7) were employed while 5.3% were unemployed. None of the employed individuals (0%) had a high monthly income, while 77.7 of the individuals had a low monthly income, 11.8% had a middle monthly income while 5.3% did not disclose their monthly income.

Sociodemographic data of the participants Week of Pregnancy, Number of Pregnancies, Number of successful Pregnancies and number of Abortions (n = 76).

Table 3: Sociodemographic data of the participants Week of Pregnancy, Number of Pregnancies, Number of successful Pregnancies and number of Abortions.

Variable	Frequency	Percentage (%)
Week of Pregnancy		
<25	0	0
25 – 30	38	50
31 – 36	32	42.1
>36	6	7.9
Number of Pregnancies		
1	13	17.1
2	31	40.8
3	22	28.9
4	8	10.5
5	2	2.6
Number of Successful Pregnancies		
0	4	5.3
1	13	17.1
2	39	51.3
3	18	23.7
4	2	2.6
Number of Abortion		
Nil	66	86.8
1	10	13.2

50% of the population were between their 25th -30th week of pregnancy, 42.1% were between 31- 36 week of pregnancy while 7.9% had already passed their 36th week of pregnancy. 17.1% were on their first pregnancy while the rest of the participants (82.9%) were in-between their 2nd - 5th pregnancy. The majority (86.8%) of the sampled population had no previous history of abortion while 13.2% have had a previous history of one (1) abortion.

Sociodemographic data of the participants Gestational Week of GDM Diagnosis, History of GDM in previous Pregnancies, Family History of T2DM and Number of Children (n = 76).

Table 4: Sociodemographic data of the participants Gestational Week of GDM Diagnosis, History of GDM in previous Pregnancies, Family History of T2DM and Number of Children.

Variable	Frequency	Percentage (%)
Week of GDM Diagnosis		
<25	0	0
25 – 30	38	50
31 – 36	32	42.1
>36	6	7.9
History of GDM in previous Pregnancies		
Yes	0	0
No	76	100
Family History of T2DM		
Yes	32	42.1
No	44	57.9
Number of Children		
Nil	6	7.9
1	11	14.5
2	39	51.3
3	18	23.7
4	2	2.6

GDM: Gestational Diabetes Mellitus. T2DM: Type 2 Diabetes Mellitus.

76.3% of the diagnosis were made between the gestational weeks of 25-30, while 18.4% were between 31-36 week of gestation, 2.6% were below 25 weeks of gestation, and 7.9% were above 36 weeks of gestation. None of the participants (0%) had a previous history of GDM, while 57.9% had a Family history of T2DM. 7.9% of the population were primigravida while 98.1% are multigravida ranging from one to four children.

Barriers of Physical Activity in Women with GDM

Table 5: Barriers associated with the performance of Physical Activity in Women with GDM.

Variables	Frequency	Percentage (%)
Time	76	100
Children	26	34.2
Lack of information	2	2.6
Laziness	12	15.8
Not used	11	14.5

All of the respondents reported time as a barrier, 34.2% reported children, 15.8% reported laziness, 14.5% was not used to it and 2.6% lack of information as barriers respectively.

Enablers of Physical Activity during Pregnancy in Women with GDM

Table 6: Enablers associated with the performance of Physical Activity in Women with GDM.

Variables	Frequency	Percentage (%)
Being active	2	2.6
Keeping fit for my baby	8	10.5
Remainder	12	15.8
Social media	6	7.9
To be healthy	12	15.8
To look good	22	28.9

28.9% reported their enabler was the need to look good, being healthy and keeping fit for their babies were reported to be enablers by 15.8% and 10.5% respectively, while 15% of the participants reported that reminding them was their enabler. 7.9% reported social media to be their enabler.

Discussion

This study examined the enablers and barriers associated with the performance of physical exercise in patients with gestational diabetes mellitus**.** A number of clinical studies have described different barriers and enablers associated with the performance of physical activity among pregnant women [34-39]. The findings from this study, revealed that time was a major constraint as 100% of the respondents reported time to be the barrier to the performance of physical exercise. Chen et al., 2015 state that time constraints may influence an individual's affective state, cognition and behaviour [40]. Weenig & Maarleveld, 2002 also reported that time constraints can induce time stress or pressure, which constitutes a typical psychological social stress [41]. It is suggestive therefore, that time constituted being a major barrier to the performance of physical exercise for these respondents and also contributed in the inflammatory pathway that predisposed these individuals to this disease [7]. Policymakers should therefore explore possible avenues that will create an enabling environment that could enhance the availability of time for leisure for these women. However, this finding is in contrast to a study by Evenson et al., which showed that majority of North Carolina pregnant women had enough leisure time for exercise but didn't participate due to health-related reasons [42]. The most reported reason in this study for lack of time is due to the attention and demand of the children. Women in Nigeria are generally known to be home builders as they take care of the home; clean the house, prepare meals, take care of the needs of the children and serve the husband. A closer look at the sample population shows that the respondents were predominantly of the Ibo tribe of Nigeria. A typical Ibo marriage prescribes shared roles for the partners, but specifically places the roles of homemaking to the female gender while the male gender provides the financial and material needs of the home. However, with the intermingling of western values, these roles have not been balanced because while most women assist in the financial and material needs of the home, most men have not been able to support with domestic tasks. The female gender is therefore cumbered with dual responsibilities of assisting in providing for the financial and material needs and childcare and homemaking. Purwano et al., 2017 explained the role of women in their families using Chinua Achebe's Things Fall Apart. She found that the Igbo women are primary educators for their children, as the caretakers of their children, and as the assistants of their husbands in farming [43]. As the primary educator, the woman is usually the closest person to her children and knows much about the growth and well-being of the children. They usually educate their children through the ritual of storytelling and showing good manner as well as behavior to their children [43]. They educate and socialize the children, inspire their curiosity to the social values, relationships and the human conditions. The stories the women tell also help the children develop their artistic consciousness, in addition to entertaining them. It is through storytelling that the children learn important lessons about the human condition, are taught the Ibo creation myths, and master the art of communicating

by retelling the stories themselves. It is obvious therefore, that these enablers and barriers could be related to the cultural values. While the women in this study viewed physical activity as important for their health, it was usually prioritized behind their demanding roles as mothers, partners and homemakers. It seemed that fulfilling these roles to the standard that women required of themselves left little time for physical activity.

Moreover, ante-natal women in contrast to post-natal women are not given maternity leave. In the western nations such as the United Kingdom, Pregnant women have basic financial support systems and allowances such as statutory maternity allowances and statutory adoption pay. These funds can avail them the opportunity to reduce their working hours and have more time for physical activity. This finding is consistent with other studies, which found that barriers to physical activity were primarily lack of time and childcare [16,20,23,24]. Though this study didn't correlate the number of children with participation in exercise, it can be assumed that the more children a pregnant woman has, the more time-consuming responsibilities she might have. Furthermore, this study shows that a very minimal percentage (2.6%) reported lack of information as a barrier to the performance of physical activity. This is in conflict with previous studies that reported a lack of awareness as the major barrier to physical activity among pregnant women [45-48]. It is possible that access to information globally has been a great help in the performance of physical exercise. The information and communication technology (ICT) sector in Nigeria has seen significant growth and development in recent years [1]. Providing the latest growth statistics in terms of the telecoms segment of the Nigerian ICT industry, in the last 20 years, Nigeria has achieved robust growth in its telecoms industry where it went from less than half a million connected telephone lines to over 200 million active mobile lines as at April 2022. Importantly, the broadband penetration in Nigeria is now 42.79 percent [2]. Nigeria as a country, has grown from Second Generation (2G) to 3G, 4G and now the 5G is about to come on board after conducting a globally-acclaimed transparent auction and awards of two 5G licenses [2]. The field of education has certainly been affected by the penetrating influence of ICT in Nigeria. ICT has made an impact on the quality and quantity of teaching, information and research [3]. Information from websites and social media that includes reminders and notifications may help to promote participation in physical exercises by creating awareness of the advantages of exercising. If mothers are aware of the advantages of regular exercise, their innate desire to protect their children may also motivate them to do physical exercise. This is similar to studies by (21) (16) (19) who reported that lifestyle changes were motivated primarily by concerns for the health of their babies and being healthy respectively. As the most common facilitator was said to be looking good, the findings of this study imply that women may not be aware of the complications that may arise from GDM.

Conclusion

Time was the main deterrent, and looking good was the main motivation to physical exercise. Because of this, there should be a variety of adaptable physical activity options available to suit their individual interests and hectic schedules.

References

1. Ogbutor UG, Sumaila AV, Chukwuemeka E, Adebowale T, Akinyemi D, et al. Knowledge, Attitude and Performance of Physical Exercise among Pregnant Women Attending the Antenatal Clinic at Federal Medical Centre Asaba, Nigeria. Journal of Behavioral Health. 2022; 11(2): 1-10.
2. Ogbutor UG, Nwangwa EK, Ogbeivor C, Ezeonu N, Ephraim C, et al. Immune system response to isometric handgrip exercise and effects of duration and intensity of the exercise protocol on selected immune system parameters in prehypertensives. Int J PhysiolPathophysiolPharmacol. 2022; 14(1): 24-32.
3. doNascimento GR, Borges MDC, Figueiroa JN, Alves LV, Alves JG. Physical activity pattern in early pregnancy and gestational diabetes mellitus risk among low-income women: A prospective cross-sectional study. SAGE Open Med. 2019; 7.
4. Yong HY, MohdShariff Z, MohdYusof BN, Rejali Z, Bindels J, et al. High physical activity and high sedentary behavior increased the risk of gestational diabetes mellitus among women with excessive gestational weight gain: a prospective study. BMC Pregnancy Childbirth. 2020; 20(1): 597.
5. Ornoy A. Prenatal origin of obesity and their complications: gestational diabetes, maternal overweight and the paradoxical effects of fetal growth restriction and macrosomia. Reprod Toxicol. 2011; 32(2): 205-212.
6. Ogbutor UG, Nwangwa EK, Agbonifo CE, Nwabueze Z, Ephraim C, et al. Acute Blood Pressure and Pulse Rate Response to Isometric Handgrip Exercise at 30% Maximum Voluntary Contraction in Prehypertensive Subjects. Advances in applied physiology. 2022; 7(1): 8-14.
7. Ogbutor GU, Eze KN, Collins O, Nkemakonam E, Ephraim C, et al. Inflammatory Cytokine Response to Isometric Handgrip Exercise and the Effects of Duration and Intensity of the Isometric Effort in Prehypertensive Subjects. 2022.
8. Fresiello L, Meyns B, Di Molfetta A, Ferrari G. A model of the cardiorespiratory response to aerobic exercise in healthy and heart failure conditions: Frontiers in Physiology. 2016; 7: 189.
9. Al-Shreef FM, Abd El-Kader SM. Inflammatory cytokines and immune system modulation by aerobic versus resisted exercise training for elderly. African health sciences. 2018; 18(1): 120-131.
10. Buchanan TA, Xiang A, Kjos SL, Watanabe R. What is gestational diabetes?. Diabetes care. 2007; 30: S105- S111.
11. Vince K, Perković P, Matijević R. What is known and what remains unresolved regarding gestational diabetes mellitus (GDM). Journal of Perinatal Medicine. 2020; 48(8): 757-763.
12. Raets L, Beunen K, Benhalima K. Screening for gestational diabetes mellitus in early pregnancy: what is the evidence? Journal of clinical medicine. 2021; 10(6): 1257.
13. Donovan L, Hartling L, Muise M, Guthrie A, Vandermeer B, et al. Screening tests for gestational diabetes: a systematic review for the US Preventive Services Task Force. Annals of internal medicine. 2013; 159(2): 115-122.

14. Lavery JA, Friedman AM, Keyes KM, Wright JD, Ananth CV. Gestational diabetes in the United States: temporal changes in prevalence rates between 1979 and 2010. BJOG: An International Journal of Obstetrics & Gynaecology. 2017; 124(5): 804-813.

15. Ferrara A. Increasing prevalence of gestational diabetes mellitus: a public health perspective. Diabetes care. 2007; 30: S141-s146.

16. Plows JF, Stanley JL, Baker PN, Reynolds CM, Vickers MH. The pathophysiology of gestational diabetes mellitus. International journal of molecular sciences. 2018; 19(11): 3342.

17. Rieck S, Kaestner KH. Expansion of β-cell mass in response to pregnancy. Trends in Endocrinology & Metabolism. 2010; 21(3): 151-158.

18. Al-Noaemi MC, Shalayel MH. Pathophysiology of gestational diabetes mellitus: The past, the present and the future. Gestational diabetes. 2011; 6: 91-114.

19. Catalano PM, Huston L, Amini SB, Kalhan SC. Longitudinal changes in glucose metabolism during pregnancy in obese women with normal glucose tolerance and gestational diabetes mellitus. American journal of obstetrics and gynecology. 1999; 180(4): 903-916.

20. Sharma AK, Singh S, Singh H, Mahajan D, Kolli P, et al. Deep Insight of the Pathophysiology of Gestational Diabetes Mellitus. Cells. 2022; 11(17): 2672.

21. Berberoglu Z. Pathophysiology of gestational diabetes mellitus. Diabetes. 2019; 7(1): 97-106.

22. Berghella V, Saccone G. Exercise in pregnancy! Am J Obstet Gynecol. 2017; 216(4): 335-337.

23. Davenport MH, McCurdy AP, Mottola MF, Skow RJ, Meah VL, et al. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: a systematic review and meta-analysis. Br J Sports Med. 2018; 52(21): 1376-1385.

24. Tendais I, Figueiredo B, Mota J, Conde A. Physical activity, health-related quality of life and depression during pregnancy. Cad SaudePublica. 2011; 27(2): 219-228.

25. Padayachee C, Coombes JS. Exercise guidelines for gestational diabetes mellitus. World J Diabetes. 2015; 6(8): 1033-1044.

26. Hinman SK, Smith KB, Quillen DM, Smith MS. Exercise in pregnancy: a Clinical Review. Sports Health Multidiscip Approach. 2015; 7(6): 527-531.

27. Laredo-Aguilera JA, Gallardo-Bravo M, Rabanales-Sotos JA, Cobo-Cuenca AI, Carmona Torres JM. Physical activity programs during pregnancy are effective for the control of gestational diabetes mellitus. Int J Environ Res Public Health. 2020; 17(17): 6151.

28. Yaping X, Huifen Z, Meijing Z, Huibin H, Chunhong L, et al. Effects of moderate intensity aerobic exercise on blood glucose levels and pregnancy outcomes in patients with gestational diabetes mellitus: a randomized controlled trial. Diabetes Ther. 2021; 12(9): 2585-2598.

29. Symons Downs D, Ulbrecht JS. Understanding exercise beliefs and behaviours in women with gestational diabetes mellitus. Diabetes Care. 2006; 29(2): 236-240.

30. Hesketh KR, Evenson KR. Prevalence of U.S. pregnant women meeting 2015 ACOG physical activity guidelines. Am J Prev Med. 2016; 51(3): e87-e89.

31. Harrison AL, Taylor NF, Shields N, Frawley HC. Attitudes, barriers and enablers to physical activity in pregnant women: a systematic review. J Physiother. 2018; 64(1): 24-32.

32. Godsday OU, Kingsley NE, Chukwuebuka NB, Ephraim C, Emmanuel E, et al. Isometric handgrip exercise training improves spirometric parameters and pulmonary capacity. Pathophysiology. 2021; 28(3): 328-338.

33. Evenson KR, Moos MK, Carrier K, Siega-Riz AM. Perceived barriers to physical activity among pregnant women. Maternal and child health journal. 2009; 13: 364-375.

34. Sytsma TT, Zimmerman KP, Manning JB, Jenkins SM, Nelson NC, et al. Perceived barriers to exercise in the first trimester of pregnancy. The Journal of perinatal education. 2018; 27(4): 198-206.

35. Darroch F, Varcoe C, Hillsburg H, Neville C, Webb J, et al. Supportive movement: Tackling barriers to physical activity for pregnant and parenting individuals who have experienced trauma. Canadian Journal of Community Mental Health. 2022; 41(1): 18-34.

36. Dolatabadi Z, Amiri-Farahani L, Ahmadi K, Pezaro S. Barriers to physical activity in pregnant women living in Iran and its predictors: a cross sectional study. BMC Pregnancy and Childbirth. 2022; 22(1): 815.

37. Ahmadi K, Amiri-Farahani L. The perceived barriers to physical activity in pregnant women: A review study. Journal of Client-Centered Nursing Care. 2021; 7(4): 245-254.

38. Chen L, Qin KZ, Li GM, Li JX, Xiao B, et al. Zircon U–Pb ages, geochemistry, and Sr–Nd–Pb–Hf isotopes of the Nuri intrusive rocks in the Gangdese area, southern Tibet: Constraints on timing, petrogenesis, and tectonic transformation. Lithos. 2015; 212: 379-396.

39. Haruna AC, Keftin NA, Adole AM, Abdullahi U. An overview of challenges of Womens' participation in the practice of Building profession in Nigeria. International Journal of Education and Research. 2016; 4(6): 61-72.

40. https://osf.io/z4wc5/. 10.17605/OSF.IO/Z4WC5.

41. Kianfard L, Niknami S, SHokravi FA, Rakhshanderou S. Facilitators, Barriers, and Structural Determinants of Physical Activity in Nulliparous Pregnant Women: A Qualitative Study. J Pregnancy. 2022.

42. Bain E, Crane M, Tieu J, Han S, Crowther CA, et al. Diet and exercise interventions for preventing gestational diabetes mellitus. Cochrane database of systematic reviews. 2015; 4.

43. Jelsma JGM, Van Leeuwen KM, Nicolette O, Bunn C, Simmons D, et al. Beliefs, barriers, and preferences of European overweight women to adopt a healthier lifestyle in pregnancy to minimize risk of developing gestational diabetes mellitus: Journal of pregnancy. 2016.