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Can Physical Activity Patterns before and during Pregnancy and Anxiety be Related to Preterm Birth?

Zohreh Pourahmad [1], **Bahia Namavar Jahromi** [2], **Maryam Koushkie Jahromi** [3*]

[1] Department of Sport Sciences, Shiraz University, Shiraz, Iran

[2] Department of Obstetrics and Gynecology, School of Medicine, Infertility Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

[3] Department of Sport Sciences, Shiraz University, Shiraz, Iran

*Corresponding author: Maryam Koushkie Jahromi, Department of Sport Sciences, Shiraz University, Shiraz, Iran. E-mail: mkoushki@rose.shirazu.ac.ir

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Abstract

Introduction: Changes of physical activity before and during three trimesters of pregnancy known as pattern of physical activity and anxiety during pregnancy can be two concerns of pregnant women about preterm birth which require clarification. So, this retrospective study aimed to assess the effect of pattern of physical activity, and anxiety on preterm birth in Iranian pregnant women.

Methods: This study was a kind of descriptive correlation which was performed retrospectively. Participants of this study (2019-2020) included 118 pregnant women with preterm (n=62) and term (n=56) birth who participated in the study voluntarily and were selected according to the study inclusion criteria. The energy cost of physical activity before and during three trimesters of pregnancy, and anxiety level were recorded through interview using pregnancy physical activity (PPAQ) and Hospital Anxiety and Depression Rating Scale Anxiety (HADS) questionnaires respectively.

Results: There was no significant difference between preterm and term birth groups regarding total physical activity, and sedentary behavior energy expenditure before and during pregnancy as well as anxiety during pregnancy($P>0.05$). Physical activity pattern was not significantly different between the two groups ($P>0.05$). However, physical activity before pregnancy was significantly higher than all trimesters of pregnancy in both groups of the study ($P<0.001$). In two groups of preterm and term deliver, physical activity reduced in the third compared to the second trimester of pregnancy similarly.

Conclusions: Physical activity reduced during pregnancy in preterm and term birth women similarly. In this study, physical activity, sedentary behavior and anxiety during pregnancy and before it were not effective on the pre-term birth.

INTRODUCTION

Preterm birth (< 37 weeks of gestation) is an important cause of neonatal morbidity and mortality and chronic neurocognitive and motor impairments and chronic disease [1, 2]. Preterm birth is a serious issue worldwide, especially with an increasing trend in Southern Sub-Saharan Africa between 1990 to 2019 [3]. According to a review study, the overall prevalence of preterm birth in Iran, has been estimated to be a total of 10%. The lowest frequency of preterm labor was 5.4% in Bam and the highest frequency was 19.85% in Tehran [4]. Some factors such as socio-demographic status, ethnicity and aging of mothers have been reported as risk factors for preterm birth [5]. Despite the relationship between preterm birth and a wide range of socio-demographic, medical, obstetric, fetal, and environmental factors, approximately two-thirds of preterm births occur without an evident risk factor [6]. Psychological and physical stress can be arisen as effective factors on preterm birth. Increasing anxiety and physical activity are associated with activating hypothalamic-pituitary-adrenal (HPA) axis [7, 8]. Increase of stress hormones may result in increased uterine contractility, and cytokine production, which independently may cause preterm birth or increase susceptibility to infection, and

increase the risk of preterm birth. Also, stress may change health behaviors that lead to preterm birth. However, findings on the relationship between stress and preterm birth are contradictory [9]. On the other hand, findings cautiously suggest that regular enjoyable physical activity could be recommended to improve stress hormones [10].

Physical activity during pregnancy can induce some health effects [11, 12]. There are controversies regarding the effect of physical activity on pre term birth. Some randomized studies [13, 14], cohort studies [15, 16] and case-control studies [17] have assessed the relationship between physical activity and preterm births, and findings were different.

Some studies [18, 19] and even, health care providers recommend reduction of physical activity during pregnancy [20]. According to several ancient and traditional evidence, pregnant women are advised to rest more and to refrain from daily physical activity and exercise, which may be due to increased energy requirement and fear of physical and skeletal harm to the mother [20]. Often, due to the mother's physical weakness or disorders, rest is recommended, and on the other hand, many mothers, especially in the primiparous pregnancies, tend to have more rest and not perform daily activities [21].

Common changes from active status during pre-pregnancy to inactivity during pregnancy or changes in each trimester of pregnancy are very common, which can be the cause of some problems. The greatest reduction observes in sports and intense activities, however other types of physical activity reduce as well. This reduction even occurs more likely in women who consider themselves as active before pregnancy. Fewer than 5% increase their physical activity. Lack of motivation has been mentioned as the most important effective factor of reducing activity [22].

Pattern of physical activity or physical activity changes before pregnancy and during each trimester of pregnancy may be effective on adaptation to physical activity. There is no specific recommended pattern for changing the level of physical activity before to during three trimesters of pregnancy. Therefore, the question was raised whether the pattern of physical activity from pre-pregnancy to pregnancy is effective on preterm birth?

Another proposed effective factors on preterm birth is anxiety which affect one third of women during pregnancy [23]. Its possible effect can be related to stress hormones [24]. Regarding the effect of exercise or physical activity and anxiety on stress hormone [8], assessing the effect of these two physical and psychological stress (anxiety and physical activity) can be important. So, another aim of the study was assessing the effect of anxiety during pregnancy on preterm birth. This study was necessary, because it includes physical activity pattern (not merely physical activity) as well as anxiety as physical and mental stress. Also, culture is effective on physical activity [25], anxiety [26], and preterm birth [27]. In Iran housekeeping is their only job of many women, while there are varieties in their daily activities. So, the findings of this study can be useful for similar cultures.

METHODS

Participants' Selection and Ethics

This study was a kind of descriptive correlation which was conducted retrospectively in Iranian pregnant women. The study population included women who referred to four hospitals for delivery between December 2019 and August 2020 in Shiraz as the third populated multicultural city in Iran. Participants of the study were selected through convenience sampling. The researcher referred to some hospitals in Shiraz and after primary visiting and evaluation of about 3,10 preterm birth cases and 180 term births, and according to the inclusion criteria of the study, 70 women with preterm birth defined as alive birth before the completion of 37 weeks of gestation, and 70 pregnant women with alive term birth (after 37 weeks) were selected as the study participants.

Inclusion criteria were pre term or term birth and ages 18 to 42 years and preterm birth without a known reason or previous risk factors before the week 37. Exclusion criteria were experiencing disorders of pregnancy induced hypertension, abnormal amniotic fluid volume, premature rupture of membranes, previous history of preterm birth, history of urinary tract infection during pregnancy, systemic diseases, anemia as the independent risk factors for preterm birth [28], placenta previa, thyroid disorders, threatened abortion, gestational hypertension, diabetes, pre pregnancy obesity (BMI>30) or underweight(BMI<18.5), hospitalization more than two days after delivery and not interested in cooperation for the study. Finally, regarding to some exclusion criteria the participants of the study included 62 preterm and 56 term birth. For estimating sample size we used G*Power software (3.1.9.7) [29].

In order to detect an effect size of Cohen's d = 0.5 with 80% power (alpha =two-tailed), G*Power suggests we would need 51 participants per group (N = 101) in an independent samples t-test. The smallest effect size of interest was set to d = 0.5 based on a meta-analysis study [30].

Measurements

Socio-demographic characteristics, age, and reproductive and maternal health, and any kind of medication data were collected through interview during the recruitment stage. Pre-pregnancy body mass index (BMI) and weight change during pregnancy was recorded according to the previously measured information available in the hospital as the mother's

health documents. For estimating BMI, weight and height had been measured at the prenatal or first month of pregnancy care visit by an electronic scale with a 50 gram of accuracy (Seca 284).

Due to the special physical conditions of the subjects, which could make them impatient and affect the written answers to the questions, the questionnaires were completed in the form of interviews.

Physical activity pattern was measured using the Pregnancy Physical Activity Questionnaire (PPAQ). Physical activity levels were categorized in the different activity including "housework/caregiving", "transportation", "sports/ exercise/recreation", and "employment" and each category was assessed with 16 detailed questions.

The intensity of physical activities were categorized as light to moderate, moderate and vigorous intensity. The duration of every kind of activity and its frequency in a day, week, month and during three months was determined and multiplied by its equivalent MET (metabolic equivalent of task) related to its intensity according to the compendium of physical activities [31]. Energy expenditure of each level of physical activity was calculated by multiplying total minutes spent on every kind of activity per week with its corresponding MET value. Validity and reliability of Persian version of PPAQ was approved by available study [32].

Anxiety symptoms were assessed with the Hospital Anxiety and Depression Rating Scale Anxiety (HADS-A). 14 questions of HADS consists of two subscales as follows: seven items assess symptoms of depression (HADS-D) and seven items assess symptoms of anxiety (HADS-A). For each question a possible scores (0–3) is considered. The HADS validity has been approved for use in the primary care setting [33]. The validity and reliability of its Persian version was approved by a study [34].

SPSS software (version 26) was used to analyze the findings. The normality of data was confirmed by Kolmogorov–Smirnov test. Statistical tests of analysis of variance with repeated measures, and logistic regression tests were used to examine intragroup changes and the relationship between the study variables respectively, and independent t-test was used for intergroup comparisons.

Table 1. Comparison of maternal characteristics according to the term of birth using t test or chi-square test

Characteristics	Term of Birth		P Value
	Preterm (n=62) (%)	Term (n=56) (%)	
Age at birth (year)			
-<25	13(21)	18(32.1)	0.327
-56	12(19.4)	14(25)	
-66	25(40.3)	15(26.8)	
->35	11(17.7)	9(16.1)	
Education (%)			0.856
-illiterate	0(0)	0(0)	
-Diploma	10(16.1)	12(21.42)	
-University (undergraduate)	47(75.80)	42(75.00)	
-university (post graduate)	5(8.08)	2(3.57)	
Maternal occupation (%)			0.987
-Housewife	52(82.30)	46(82.10)	
-employed	11(17.70)	10(17.90)	
Maternal monthly income			0.88
-no	50(80.60)	44(78.60)	
-Low	4(6.50)	5(8.90)	
-Medium	7(11.30)	6(10.70)	
-High	1(1.60)	1(1.80)	
Father monthly income			0.589
-No	1(1.60)	2(3.60)	
-Low	5(8.10)	4(7.10)	
-Medium	45(72.60)	36(64.30)	
-High	3(4.80)	5(8.90)	
Type of birth (number)			0.882
-Cesarean	44(71)	41(73.20)	
-Vaginal	(۲۹)۱۸	15(26.80)	
Number of previous birth			0.106
0	24(39.34)	21(37.5)	
-1	17(27.86)	26(46.42)	
-2	17(27.86)	8(14.28)	
-≥3	3(4.91)	1(1.78)	
Participating in exercise (met)			
-Before pregnancy	40(64.51)	37(66.07)	0.754
-First trimester	26(41.93)	30(53.57)	0.206
-Second trimester	28(45.16)	31(55.35)	0.349
-Third trimester	30(48.38)	32(57.14)	0.342

Table 2. Means (standard deviation) of energy expenditure or time of different types of physical activities before and during 3 trimesters of pregnancy and comparisons between preterm and term birth mothers using t test

Activities	Energy Expenditure (Met/Week) (Mean± SD)		t	P
	Preterm Birth	Term Birth		
Before pregnancy				
Daily physical activity (MET-min/week)	1338.78(525.33)	1456.99(644.04)	0.670	0.504
Exercise (MET-min/week)	508.06(621.21)	451.76(493.97)	0.535	0.594
Sitting (min/week)	2162.49(1235.85)	2333.00(1245.45)	0.746	0.457
During Pregnancy				
1st trimester				
Daily physical activity(MET-min/week)	939.92(516.80)	1139.83(665.52)	0.410	0.682
Exercise(MET-min/week)	181.50(184.41)	181.11(120.63)	0.410	0.682
Sitting(min/week)	1782.68 (1044.57)	2098.75 (1250.60)	1.495	0.138
2nd trimester				
Daily physical activity(MET-min/week)	975.69(506.25)	1126.23(1557.26)	0.081	0.935
Exercise (MET-min/week)	191.10(184.08)	171.05(198.17)	0.559	0.557
Sitting	1792.16 (1051.15)	2069.12 (1255.68)	1.303	0.195
3rd trimester				
Daily Physical activity(MET-min/week)	931.82(487.82)	1064.69(529.88)	0.201	0.115
Exercise (MET-min/week)	196.81(185.87)	177.88(105.32)	0.706	0.482
Sitting(min/week)	1697.78 (1018.01)	2014.56 (1250.22)	1.508	0.134

*One metabolic equivalent (MET) is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O2 per kg body weight x min

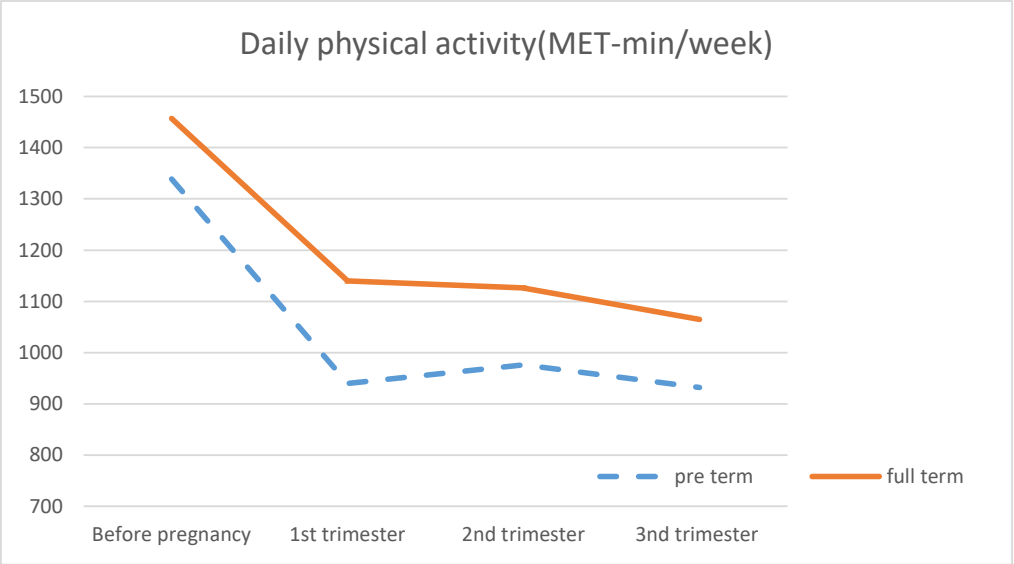

Figure 1. Comparing pattern of physical activity between two groups. One metabolic equivalent (MET) is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O2 per kg body weight x min

RESULTS

Participants of the study were compared in two groups of preterm birth (age: 30.54±5.92 year) and term birth (age: 28.77±6.17 years). Table 1 indicate maternal characterizes and descript of physical activity which has been compared in preterm and term birth mothers. As shown in Table 1, there was no significant difference between two groups regarding the variables.

Comparison of preterm and term birth women indicated that there was no significant difference considering daily physical activity and exercise energy expenditure and sitting time (P>0.05) (Table 2).

The pattern of changes in physical activity over time was similar between the two groups (interaction; F=0.515, P = 0.606). Figure 1 shows the similarity of the pattern of changes in physical activity between the two groups. As indicated in Figure 1, although the overall level of physical activity before and during three trimesters of pregnancy in term birth was higher than preterm birth mothers, however the difference was not statistically significant. But regardless of the type of birth (premature and timely), the overall changes in physical activity over time were significant (F=66.189, P <0.001). In general, no significant difference was observed between the physical activity pattern of the two groups (F=2.788, P = 0.098).

In the preterm birth group, the energy expenditure of physical activity in the first (p<0.001, CI: 2870.823, 4949.27), second (P<0.001, CI: 2737.87, 4521.98) and third (P<0.001, CI: 3180.39, 5586.12) trimesters of pregnancy was significantly reduced compared to before pregnancy. Regarding term group, similar to preterm group physical activity of first (P<0.001, CI: 2316.25, 3874.57), second (P<0.001, CI: 2292.21, 4315.45) and third (P<0.001, CI: 3180.39, 5586.27) trimesters of pregnancy reduced compared to before pregnancy.

There was no significant difference between physical activity of other paired comparisons of three trimesters of pregnancy (P>0.05).

Considering depression and anxiety scores, total scores of HADS questionnaire indicated that frequency (percentage) of the rankings in preterm group was as: normal 3(5.2%), borderline abnormal (19(32.8%), abnormal 36(62.1%), and in term group, it was as 3(5.8%), 13(25%) and abnormal 36(69.2%). There were no significant difference between preterm and full term birth regarding anxiety (P= 0.670), and depression (P=0.673).

DISCUSSION

In summary, there was no significant difference between preterm and term birth groups regarding energy expenditure of daily physical activity and exercise and sitting time. Total pattern of physical activity was similar in preterm and full term groups. In the both groups, daily physical activity during three trimesters of pregnancy reduced compared to before pregnancy. Total daily physical activity energy expenditure, before and during pregnancy, in full term births was higher than pre term birth, although it was not statistically significant. The frequency of participants in exercise that was mainly performed as walking with mild to moderate intensity was also similar between the two groups.

In contrast to our findings, a meta-analysis study suggested that higher leisure-time activity was associated with reduced risk of preterm birth [35]. However, this study also stated that further randomized controlled trials with sufficient frequency and duration of activity and with larger sample sizes were required to conclusively demonstrate an association. Similar to our findings, some studies have indicated that moderate exercise does not increase the risk of preterm birth and do not induce any significant effect on pre-term birth [13, 36-38]. In contrast to our findings, another study found that although exercise during pregnancy did not induce negative effect on gestational age, the risk of preterm birth increased non-significantly [37], while in the present study , overall physical activity of term birth was higher than pre-term birth. These controversies may be justified by some reasons. Various levels of physical activity may induce different effects. An extremely low level of physical activity during pregnancy significantly increased the risk of preterm birth and instrumental delivery. Conversely, moderate physical activity during pregnancy decreased the risk of preterm birth [39].

Although the physiological mechanisms related to physical activity and preterm birth is not clearly understood, some hypotheses may justify that physical activity did not cause preterm birth. Firstly, insulin sensitivity can be improved through physical activity and can reduce inflammatory condition, which is an important risk factor for preterm birth [40]. Other physiological mechanisms of adaptation with physical activity during pregnancy is that exercise improves placental vascularization and reduces oxidative stress [36, 41].

Findings of the present study indicated that total physical activity level reduced during pregnancy in term and pre-term birth women. So that, the mean of total energy expenditure of their daily physical activity during pregnancy was lower than the recommendations by ACOG. Reducing the level of physical activity levels during pregnancy were reported by many studies [42]. Because pregnancy is associated with social, psychological, behavioral and biological changes, reduction of physical activity is predictable. Lack of confidence about physical activity during pregnancy may be an effective factor. Some health care providers do not recommend physical activity during pregnancy [20]. Also in ancient and traditional evidence, pregnant women are advised to rest more and to refrain from daily physical activity and exercise [20].

Regarding anxiety, the results of the study suggested that there was no significant difference between preterm and term groups anxiety. However, considering that it was observed that the index of anxiety and depression in the two groups was higher than the average, the obtained result, it may be a cause of non-significant difference between the two groups`. Our results was supported by some previous findings indicated no significant association between anxiety and preterm birth [43]. Another study assessed anxiety using the HADS and found no significant correlation between anxiety and preterm birth [44]. A meta-analytic review [45] found no significant relationship between anxiety symptoms to preterm birth. While, in contrast to our finding, another review found a significant association between prenatal maternal anxiety and preterm birth [46]. Considering present study findings of no significant difference in physical activity between pre-term and term birth, the possible effect of physical activity on reducing pre term birth through reducing anxiety cannot be discussed to justify the present study findings and needs future clarifications. Similar to our findings, and according to previous findings, high anxiety disorder is prevalent in pregnant women; however, estimates vary considerably, and evidence is inconclusive and considerable heterogeneity limits conclusions regarding risk factors or outcomes [47] .

The strengths of this study are: (1) physical activities other than exercise programs, such as work-related activities, housework, and leisure-time activities, were measured, so that, all daily physical activities have been assessed; (2) it was tried to exclude all possible effective factors on preterm birth except for possible effect of physical activity and anxiety as physical and psychological stressors;(3) the fluctuations of physical activity before and during three trimesters of pregnancy

was evaluated in order to assess the effect of possible adaptations.

The main limitation of our study was that we considered various exclusion criteria that could be effective on preterm birth and this limited the number of participants and regarding limited number of participants, generalization of findings must be with caution. Other limitations of the study included not evaluating all psychological stressful conditions during pregnancy, not controlling nutrition of participants, and not controlling all other possible (not certain) effective factors on preterm birth.

CONCLUSIONS

According to the study findings, total physical activity reduces during pregnancy in preterm as well as term birth women, and inactivity or recreational or occupational physical activity, as well as sports and even anxiety cannot be the cause of preterm birth and factors other than physical activity and anxiety can affect the time of birth. However, any recommendation about intense physical activity during pregnancy needs future research clarifications.

CONFLICTS OF INTEREST

There is no conflict of interest or competing interest to be declared.

ETHICAL CONSIDERATIONS

All participants contributed in the study voluntarily. They were assured that their information would remain confidential and that there would be no danger or harm to them and signed informed consent. This study was approved by ethic committee of Shiraz University of Medical Sciences (IR.SUMS.REHAB.REC.1398.025).

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AUTHOR CONTRIBUTIONS

ZP: Project development, data collection and analysis, manuscript writing, MKJ and BNJ: project development, data analysis, manuscript writing and editing.

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