Evaluation of Postural Stability in Pregnant Women

ABSTRACT

Aim: The hormonal, physiological and anatomical changes throughout pregnancy affect the musculoskeletal system that lead to postural instability which may impair their lifestyles and increased risk of collapses. This study was aimed to assess postural balance in females during the second and third trimester of pregnancy.
Study design: a case control study.
Place and Duration of Study: Biomechanics lab. in Faculty of Physical Education at Kafrelsheikh University, between February and July 2015.
Methodology: In this study, postural stability throughout the second and third trimester was measured using the Biodex Balance System (BBS) in 14 pregnant females(age range 25-30 years). The overall (OA), anterior-posterior (AP) and medial-lateral (ML) stability index scores were obtained at level 8 and 7.
Results: The mean OA, AP and ML scores were significantly higher in the third trimester compared to second trimester ($P < .05$). There was no significant difference in the ML between the stability level 8 and 7 ($P > .05$) during the second or third trimester.
Conclusion: Pregnant females have poor postural stability as well as decreased postural equilibrium in the third trimester compared with the second trimester of pregnancy.

Keywords: Balance; posture; maternity; second trimester; third trimester.

1. INTRODUCTION

Pregnancy is a strange health condition, seen as physiological process, which include sequential modification on the bodily organs along with corporal systems of women [1]. Women that are pregnant undergo numerous anatomical, physiological, and hormonal changes [2], which could lead to musculoskeletal complaints, in addition to impacting the pregnant woman's balance [3,4].The effect of pregnancy on the musculoskeletal system results in modifications of the static posture of women, which may impair their everyday tasks and increase the risk of falls[2], which occur within 25% of pregnant women [5].Pregnancy-related collapses are generally common. In general, pregnant women fall at a similar rate (27%) to women older than 70 years (28%). collapses are the leading cause of emergency department, hospital admissions in pregnancy[2].Women that are pregnant encounter a substantial weight gain, an anterior shift in the location of the centre of mass, increased ligamentous laxity, reduced neuromuscular control as well as coordination, changed biomechanics, reduced abdominal muscle strength, increased spinal lordosis, and changes in mechanical loading and joint kinetics [6]. Many of these postural alternations can produce overloads in the main joints as well as results in musculoskeletal discomfort and pain symptoms. This change can increase the risk of collapses1.Numerous investigators have examined different aspects connected with postural stability during maternity. Jang et al.[7] found greater anterior–posterior and radial sway, no change in medial–lateral sway, and a wider preferred stance breadth in pregnant women during quiet stance in comparison to non-pregnant ladies. Oliveira et al.[8] assessed changes in body sway during maternity by stabilogram and observed a decrease in postural balance in situations of a diminished support base or with eyes closed. Ribas and Guirro [9] analyzed plantar pressure and postural stability during the three trimesters of maternity and found a substantial decrease with postural stability within the final trimester, linked to higher anterior-posterior displacement during this time period. Butler et al.[5] concluded that postural stability declines progressively in the course of maternity and remains diminished at 6 to 8 weeks after delivery. This particular research furthermore suggested that there is an increased dependency on visual cues to keep stability in the course of maternity. Thus, the results involving pregnancy about the musculoskeletal

system result in great modifications in static and dynamic posture for females. The maintenance of postural stability in the standing position is a complex undertaking and, in spite of being popular with lifestyle and throughout pregnancy, the woman's body seems to have already changed the postural control that during the last trimester, there is a tendency to reduce the postural steadiness [10]. However, few studies assessed modifications with postural control throughout pregnancy. The purpose of that study was to evaluate the postural equilibrium throughout different phases of pregnancy. The outcomes obtained may improve health care intervention in the adaptive musculoskeletal modifications and their outcomes over the gestational time period.

2. MATERIAL AND METHODS

Study design and sampling following the hospitals ethical committee approved the study at the obstetric department (Antenatal Clinic) of the Kafrelsheikh general hospital. Experimental procedures were explained to each pregnant participant and written informed consent was obtained from the subjects (31 pregnant women). This study was done in Biomechanics lab. in Faculty of Physical Education at Kafrelsheikh University from February 2015 to July 2015. The gestational age during the subjects' first data collection session was occurring during their second trimester at 20-24 weeks. Their second visit occurred during the middle their third trimester at 30-34 weeks. 17 subjects did not complete the second visit because of: a decision to withdraw from the study (n = 10), delivery of the baby prior to 30 weeks (n = 1), pre-eclampsia or other complications in their pregnancy (n = 1), injuries sustained from a fall required the subject to be placed on bed rest (n = 2), being overweight (n=2) and relocation to another governorate (n = 1).The inclusion criteria were maternal age between 25 and 30 years, low risk pregnancy, single fetus, primigravid, high school graduated, body mass index (BMI) would not exceed 30 kg/m^2. Potential participants who were pregnant were excluded from the study if they were less than 20^{th} week of pregnancy, were carrying more than one fetus, or if they had a history of any of the following: gestational diabetes, pre-eclampsia, toxemia, gestational hypertension, previous abortion, or if they were considered by their obstetrician to have a high-risk pregnancy. Potential pregnant participants were excluded if they had a history of type-I or -II diabetes, or any other condition that could affect sensation, a leg or foot fracture and ankle or knee sprain within the last year, current back or knee pain. Subjects were also excluded if they were a current smoker or if they currently took any medication that would affect their ability to balance. The design of this study was a case control study. The dynamic balance parameters(Anterior posterior (AP), Mediolateral (ML) and Overall (OA) stability indices) measured by the Biodex Balance System, It is a balance screening and training tool Biodex Medical System (Inc, Shirley New York, U.S.A). It consists of a movable balance platform, which provides up to 20 degrees of surface tilt in 360^{o} range. The stability levels available in the system range from a completely firm surface (Stability level-8) to a very unstable surface (Stability level-1) [10]. The biodex balance assessment was performed in standing position. The pregnant participants were instructed to focus on the visual feedback screen directly in front of the patient and attempt to maintain the cursor at the center of the screen while standing on the unstable platform (either stability level -8 and 7). Statistical Analysis: Means and standard deviations were calculated for each variable using descriptive statistics. The paired t - test was used to analyze and compare the gained results within each phase of pregnancy (2^{nd} & 3^{rd} trimester) and Independent t-test was carried out to assess differences in the balance parameters between the second and third trimester. A P-value of $< .05$ was taken to represent statistical significance. Data analysis was performed using SPSS software version 18.

3. RESULTS

All data had been collected and statistically analyzed and presented under the following headings;

3.1 Physical characteristics of the patients:

14 participants were included in this study; the mean age was 27.02±1.2 years, BMI was 26.6±1.06 and 27.39±2.15 Kg/m^2 during the second and third trimesters of pregnancy.

3.2 Stability Indices (OA, AP and ML):

3.2.1 Stability level -8

Pregnant women's stability indices (OA, AP and ML) were significantly different between the second and third trimester at stability level-8 ($P< 0.05$), as the mean values of OA, AP and ML during the second

trimester were 3.35± 1.14, 3.82± 1.15 and 2.14± 0.6, while during the third trimester were 5.36± 1.12, 4.8± 0.16 and 4.15± 0.6 respectively (Table 1).

Table 1. Mean ± SD of stability indices for participants at stability level-8 during the 2nd and 3rd trimester.

Stability Index		Mean ± SD	P-value	Significance
OA	2nd trimester	3.35±1.14	P< .05	S
	3rd trimester	5.36± 1.12		
AP	2nd trimester	3.82±1.15	P< .05	S
	3rd trimester	4.8±0.16		
ML	2nd trimester	2.14± 0.6	P< .05	S
	3rd trimester	4.15 ±0.6		

SD: Standard Deviation, P. value: probability value, S: Significant.

3.2.2 Stability level -7

Pregnant women's stability indices (OA, AP and ML) were significantly different between the second and third trimester at stability level-7 (P< 0.05), as the mean values of OA, AP and ML during the second trimester were 4.8± 0.9, 5.1± 1.2 and 2.8± 1.4, while during the third trimester were 6.9± 1.04, 6.7± 1.13 and 4.5± 1.01 respectively (Table 2).

Table 2. Mean ± SD of stability indices for participants at stability level-7 during the 2nd and 3rd trimester.

Stability Index		Mean ± SD	P-value	Significance
OA	2nd trimester	4.8±0.9	P< .05	S
	3rd trimester	6.9± 1.04		
AP	2nd trimester	5.1±1.2	P< .05	S
	3rd trimester	6.7±1.13		
ML	2nd trimester	2.8± 1.4	P< .05	S
	3rd trimester	4.5 ±1.01		

SD: Standard Deviation, P. value: probability value, S: Significant.

When comparison between the mean values of Pregnant women's stability indices during the second or third trimester; OA and AP were statistically significantly different (*P < .05)* between stability level-8 and 7, with no significantly different (*P > .05*) at ML.

.

5.DISSCUSION

Postural stability review via different practices might help with the particular growth of therapeutic methods to prevent postural instability and also falls during pregnancy. The primary purpose of this study was to evaluate the antenatal postural stability during the second and third trimester. Our results show that pregnant women's stability indices (OA, AP and ML) were significantly different between the second and third trimester at stability level-8 or 7, which can be explained by the fact that, the increase in weight

as well as the disequilibrium on the articulation system caused by the increase body mass and body size can shift the center of gravity , resulting in an unstable postural balance along with effect the actual biomechanics regarding good posture [7]. The actual ligamentous laxity inside the sacroiliac joint and pubic symphysis induced largely by means of elevated concentrations of the hormone relaxin on the first trimester, then decline early in the subsequent trimester to a level that remains stable throughout the rest of the pregnancy and into labor [11], in order to favor the passage of the fetus during labor, along with the normal weight gain that occurs during pregnancy, causing postural instability and discomfort in the joints of the pelvis, hip, knees and feet [12]. Other authors also observed the relationship between ligamentous laxity as well as the estrogen hormone [13]. Approximately 50 % of the weight gain is concentrated in the abdominal region anterior to the line of gravity, transferring the center of gravity (CG), which may promote postural instability[14]. It was observed that no significantly different at ML between stability level 8 and 7 during the second or third trimester, it is believed that by separating feet, the support base expands in the ML direction in relation to AP [15]. A major limitation of our study was the small sample size. Based on sample size estimation with the power of the study 1-B=80%, and in order to detect the effect size of d = 0.5 with a significance level of a < 0.05, 50-participants were needed for this study. Also, recruiting subjects for this type of study was difficult due to the emotional source as fear and lack of background about the scientific research. Other limitations were the psycho physiological, social and cultural level of participants. Lastly, since this study was conducted at a regional hospital in the Kafrelsheikh governorate with primigravida women, caution should be taken in generalizing findings to another setting and multiparous women. Obstetricians need to create their patients conscious of the increased threat of drops throughout maternity. This specific information may help affected individuals make a decision when certain activities may be best prevented while pregnancy. Future scientific studies should include the advancement of easy stability assessments which can be carried out in the medical center that can help physicians establish which of their patients are at a greater possibility of dropping. More research on the effectiveness| of exercise in drop avoidance throughout the gestational time period is actually advised.

4. CONCLUSION

Pregnant women have poor postural stability, with a decreased postural sense of balance throughout the third trimester of maternity compared with the second trimester.

REFERENCES

1.Ritchie JR. Orthopedic consideration during pregnancy. Clin.Obstet.Gynecol. 2003;45(2):456-466.

2.Dunning K, Le Masters G, Levin L, Bhattacharya A, Alterman T, Lordo K. Falls in workers during pregnancy: risk factors, job hazards, and high risk occupations. Am J Ind Med. 2003;44:664–72.

3.Ireland ML, Ott SM. The effects of pregnancy on the musculoskeletal system. Clinical Orthopedics and Related Research. 2000; 372:169-79.

4.Vullo VJ, Richardson JK, Hurvitz EA. Hip, knee, and foot pain during pregnancy and the postpartum period. The Journal of Family Practice. 1996; 43(1):63-8.

5.Butler EE, Colon I, Druzin ML, Rose J. Postural equilibrium during pregnancy: decreased stability with an increased reliance on visual cues. Am J Obstet Gynecol .2006;195:1104–8.

6.Weiss HB, Songer TJ, Fabio A. Fetal deaths related to maternal injury. JAMA. 2001;286:1863–8.

7.Jang J, Hsiao KT, Hsiao-Wecksler ET. Balance (perceived and actual) and preferred stance width during pregnancy. Clin. Biomech. (Bristol, Avon). 2008;23:468–76.

8.Oliveira LF, Vieira TM, Macedo AR, Simpson DM, Nadal J. Postural sway changes during pregnancy: a descriptive study using stabilometry. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2009; 147:25-8.

9.Ribas SI, Gurrio EC. Analysis of planter pressure and postural balance during different phases of pregnancy. Braz. J. Phys. Ther. 2007;11(5): 391-396.

10-Rozzi S, Lephart S, Sterner R, Kuligowski I. Balance training for persons with functionally unstable ankles. JOSPT.1999; 29(8):478-486.

11.Heckman JD, Sassard R. Musculoskeletal considerations in pregnancy. The Journal of Bone & Joint Surgery.1994; 76(11):1720-30.

12. Marnach ML, Ramin KD, Ramsey PS, Song SW, Stensland JJ, An KN. Characterization of the relationship between joint laxity and maternal hormones in pregnancy. Obstetrics & Gynecology. 2003; 101(2):331-5.

13.Charlton WP, Coslett-Charlton LM, Ciccotti MG. Correlation of estradiol in pregnancy and anterior cruciate ligament laxity. Clinical Orthopedics and Related Research. 2001; 1(387):165-170.

14. Niska M, Sofer D, Porat A, Howard CB, Levi A, Meizner I. Planter foot pressures in pregnant women. Israel Journal of Medical Sciences. 1997; 33(2):139-46.

15. Mochizuki L, Duarte M, Amadio AC, Zatsiorsky VM, Latash ML. Changes in postural sway and its fractions in conditions of postural instability. Journal of Applied Biomechanics. 2006; 22:51-60.