

## Diagnostic Value of Fetal Movement Counting by Mother and the Optimal Recording Duration

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### ABSTRACT

**Introduction:** Fetal movement counting is a method used by mother to quantify her baby's movements. However, the optimal number of movements and the ideal duration of counting them have not been recognized. The aim of this study was to determine the diagnostic value of the two common fetal movements counting methods by mother including "ten fetal movements counting in two hours" and "three fetal movements counting in one hour" and the required mean time for counting fetal movements in the two methods. **Methods:** 300 subjects were selected by random sampling among clients with complains of decreased fetal movements referring to AL-Zahra teaching hospital in Tabriz, Iran. Full training about how to perform the two methods of counting and how to record was instructed by researcher. Immediately after counting movements, biophysical profile test was performed. **Results:** Among 291 mothers in the two groups, 99.7% had active fetuses based on both methods of fetal movement counting. 96.9% of these active fetuses obtained score of 10 in biophysical profile. There was a statistically significant relation between the results of both two methods of counting and the biophysical profile as the gold standard. Sensitivity, specificity, positive and negative predictive values of both methods were equally 100%, 96%, 10% and 100%, respectively. Mean time (SD) for ten movement counting was 22.1(4.6) and for three movement counting was 8.0(2.8) minutes. **Conclusion:** The findings of this study showed that fetal movement counting test can be used as an initial screening method in predicting fetal health.

## Introduction

The aim of care in pregnancy is birth of a healthy baby and to satisfy mother.<sup>1</sup> Since the maternal mortality rate has significantly decreased in developing countries, emphasis has shifted towards assessing fetal health.<sup>2</sup> According to the American College of Obstetricians and Gynecologists and American Academy of Pediatrics, the goals of monitoring fetal health before delivery

include preventing fetal death and avoiding the unnecessary interventions.<sup>3</sup>

There are many methods for assessing the fetal health during pregnancy,<sup>1</sup> among which fetal movement counting is the oldest, most common, simplest, and most economical compared to all fetal assessment techniques and it is applicable to large number of women.<sup>1, 4-7</sup> The mother's report of decreased fetal movements is a frequent reason for unplanned health consultations during the third trimester<sup>8,9</sup> with a range between 4-16%

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in various populations.<sup>8,10</sup> On the other hand, diminishing or cessation of fetal movements is associated with a range of pathological pregnancies and poor fetal and pregnancy outcomes.<sup>9,11,12</sup> Therefore, various guidelines for assessing mother's perception of fetal movement or fetal-kick counts have been created with different alarm limits and different time frames.<sup>8,13-15</sup>

In a review study, it was concluded that the strongest definition of normal fetal movement activity comes from definition of Moore and Piacquadio who recommended less than 10 fetal movements within two hours as the alarm limit.<sup>13</sup> On the other hand, the method of three fetal movements counting in one hour could be the simplest way for mother to assess the fetal condition<sup>6</sup> because most mothers are able to feel the three fetal movements in few minutes, therefore, very little time is needed.<sup>16</sup> As much the counting period gets longer, the accuracy of method becomes less instead of reduction in false positive rates<sup>17,18</sup> and so, it will not allow early detection of fetal complications.<sup>19</sup> on the other hand, shortening the time at which reduction of fetal movement is considered important will increase the sensitivity of the method at the instead of it's specificity.<sup>20</sup>

The optimal number of movement and the ideal duration for counting them has not been specified.<sup>3,21,22</sup> Cochrane database states that there is not enough evidence to recommend or not recommend formal fetal movement counting<sup>1,23</sup> and more research should be conducted to determine the diagnostic value of formal fetal movement counting.<sup>1</sup> Thus, this study aimed to determine the diagnostic value of two common techniques of fetal movement counting, namely 'ten movements in two hours' and 'three movements in one hour', and to compare the mean time taken to complete the required number of movements in the two methods.

## Materials and methods

This was a descriptive study that was carried out from June to October 2011, in Al-Zahra educational curative center, affiliated with Tabriz University of Medical Sciences. Data gathering tools were personal and social demographic questionnaire and obstetric checklist, tables for recording of fetal movements and forms for recording of biophysical profile.

After the approval of the ethics committee, sufficient explanation about the study was given to the eligible participants with complaint of decreased fetal movements. After providing written consent, subjects were randomly selected using numbers generated from a web site ([www.randomizer.org](http://www.randomizer.org)). The inclusion criteria were: gestational age of 32-40 weeks according to the last menstrual period and first trimester ultrasound, ability to read and write, age range of 18 to 35 years, singleton pregnancy, not addicted to drugs, not smoking or consuming alcohol, not taking sedatives or tranquilizers (barbiturates, narcotics and benzodiazepine), not given prescription of corticosteroids (dexamethasone and betamethasone), no rupture of membrane, no spotting or bleeding, no ultrasound evidence of fetal abnormalities, not having mental disorders, not having oligohydramnios or polyhydramnios and no bilateral hip dislocation.

Sample size was determined as 289 subjects considering  $\alpha = 0.05$ , power=0.8, sensitivity of 84.6%,<sup>24</sup> and accuracy of 0.02. To increase the validity and taking into account the possibility of sample loss, 300 subjects were selected. In order to avoid bias, subjects were randomly divided into two groups with six blocks; that in the first group, the mother should firstly carry out the method of ten fetal movements counting within two hours and then the method of three fetal movements in one hour and in the second group this process was vice versa. Counting fetal movements was performed in a room in the hospital. The full training about how to perform the two methods of fetal movements

counting and how to record information in related tables was done individually for each mother by the researcher in a face to face manner.

The tables which were given to mothers for recording the fetal movements included starting time, fetal movements, finishing time, total time and the total number of fetal movements. The mother was instructed to empty her bladder, drink a glass of juice and immediately lie on her left side, put her hand on her abdomen and without any stress concentrate on fetal movements and start counting them.<sup>21,23,25</sup> The mother should have recorded the exact time of starting fetal movement counting using a clock that was given to them in the right place of the table and should have marked the table by crosses for the clear fetal movement that she felt. In the counting method of 'ten fetal movements in two hours' the mother had to mark each clear fetal movement in the table. At the time the tenth movement was noticed the counting was ended and its time was recorded. If after two hours the ten fetal movements were not noticed then the counting was stopped and was considered as decreased fetal movement. This was also the same for the counting method of 'three fetal movements in one hour'; if there was less than three fetal movements in one hour it was considered as decreased fetal movement.<sup>6,16,26</sup> During the counting methods, mother's blood pressure and fetal heart rate was assessed every 15 minutes.

The items for total time and total fetal movements of recorded fetal movements were completed by researcher. The total time was calculated by subtracting the finishing time from the starting time, and the total fetal movement was calculated by counting the number of crosses in the fetal movement cell that recorded by the mother. Immediately after finishing the methods of fetal movement counting, the biophysical profile test was performed. This test includes five biophysical variables: Non-stress test, fetal breathing, fetal movement, fetal tone and amniotic fluid. Score of 2 was considered for each normal

item and 0 for each abnormal item. Therefore, maximum score of five items was 10 and the minimum score was zero.<sup>3</sup>

The time required for the non-stress test was minimum 20 minutes and maximum 40 minutes (to calculate the fetal sleep cycles).<sup>3,14</sup> The maximum time needed for calculating fetal breathing, movement and tone was 30 minutes.<sup>12,27</sup> The radiologist who performed the biophysical profile test was not aware of the research process. After finishing this test the results were given to an obstetrician and gynecologist for interpretation and her recommendations were applied.

The only limitation of the study was the accuracy of mothers in counting the fetal movements that could not be fully controlled. In order to control this, the mothers were trained accurately and were encouraged to be accurate. These methods were valid based on medical literature in various studies.<sup>3,26-29</sup> To check the reliability, two radiologists were used to perform the pilot observation on the first 30 subjects simultaneously, and the Kappa agreement was obtained (0.98). Data were analyzed by SPSS version 13, using chi-square test or Fisher's exact test and Spearman's correlation coefficient. P-value less than 0.05 was considered statistically significant.

## Results

From 300 mothers, 9 cases (4 in the first group and 5 in the second group) were excluded from the study because of high blood pressure. The findings of this study showed that 50.9% of mothers were nulliparous and 49.1% were multiparous. 84.5% had normal pregnancy and 15.5% had high risk pregnancy (medical or obstetric problems). Mean age (standard deviation) of mothers was 25.5 (4.9) years. The mean gestational age according to last menstrual period was 38 (1.7) weeks. Based on ultrasound of the first trimester, it was 37.7 (1.8) weeks that the correlation between them was statistically significant ( $p < 0.001$ ,  $r_s = 0.76$ ).

On the basis of results of this study from a total of 291 mothers in both groups, 99.7% had active fetus (0.3% inactive). According to the two counting methods of ten fetal movements in two hours and three fetal movements in one hour, from 146 subjects in the first group, only one fetus was inactive, and from 145 subjects in the second group no fetus was inactive (Table 1).

Biophysical profile test showed that 96.9% of fetuses had score of ten or normal (3.2% less than ten or abnormal (Table 2). In the first group, 4 cases had score of 8 with nonreactive nonstress test; one case had score of 6 without movement and reduction in respiratory activity. In the second group, 5 cases had score of 8 with nonreactive nonstress test. One fetus that was inactive according to the results of both fetal movement counting tests had score of 8 in biophysical profile, with nonreactive nonstress test.

In all the cases except one, while fetus was counting tests, it was also active during biophysical profile test. The one case that was inactive according to both fetal movement counting tests was active during biophysical profile test (Table 3). Sensitivity, specificity, positive and negative predictive values of both fetal movement counting tests were equal considering biophysical profile as the gold standard and were 100, 96, 10 and 100 percent, respectively.

The average time required for the method of ten fetal movements counting in two hours was 22.1 (4.6) minutes and for the method of three fetal movements counting in one hour was 8.0 (2.8) minutes. From 290 mothers that had active fetus; 74.9% felt ten movements during first 30 minutes, 20.1% felt it during the second 30 minutes, 4.7% felt it during the third 30 minutes and 0.3% felt it during the fourth 30 minutes. Moreover, 97.3% felt the

**Table 1.** Frequency distribution of fetal movements of two fetal movement counting tests

Fetal movements	Level	Group 1 N (%)	Group 2 N (%)
Ten movements in two hours test	< 10	1 (0.7)	0 (0)
	10	145 (99.3)	145 (100)
Three movement in one hour test	< 3	1 (0.7)	0 (0)
	3	145 (99.3)	145 (100)

**Table 2.** Frequency distribution of biophysical profile score based on the two fetal movement counting tests

Fetal movement counting test	Level	Biophysical profile score			Total N (%)	P
		10 N (%)	8 N (%)	6 N (%)		
Ten movements in two hours count test	Active	281 (96.9)	8 (2.9)	1 (0.3)	290 (100)	< 0.001
	Inactive	0 (0)	1 (100)	0 (0)	1 (100)	
	Total	281 (96.9)	9 (3.1)	1 (0.3)	291 (100)	
Three movements in one hour count test	Active	281 (96.9)	8 (2.9)	1 (0.3)	290 (100)	< 0.001
	Inactive	0 (0)	1 (100)	0 (0)	1 (100)	
	Total	281 (96.9)	9 (3.1)	1 (0.3)	291 (100)	

**Table 3.** Frequency distribution of fetal movement in biophysical profile test based on the results of the two fetal movement counts

Fetal movement counting test	Level	Fetal movement during biophysical profile test			P
		Active N (%)	Inactive N (%)	Total N (%)	
Ten movements in two hours count test	Active	280 (99.7)	1 (0.3)	290 (100)	< 0.001
	Inactive	1 (100)	0 (0)	1 (100)	
	Total	290 (99.7)	1 (0.3)	291 (100)	
Three movements in one hour count test	Active	289 (99.7)	1 (0.3)	1 (100)	< 0.001
	Inactive	1 (100)	0 (0)	1 (100)	
	Total	290 (99.7)	1 (0.3)	291 (100)	

three movements during the first 30 minutes and 2.7% felt it during the second 30 minutes. 2.4% of the mothers felt the three movements in less than 1 minute.

## Discussion

In this study, the results of two methods of "ten fetal movements counting in two hours" and "three fetal movements counting in one hour" were compared to biophysical profile that is a reliable predictor of fetal health<sup>16, 30, 31</sup> and an accurate indicator of impending fetal death.<sup>32</sup>

Several studies have been conducted to determine the diagnostic value of fetal movements counting. In a study by Wilailak et al.<sup>2</sup> that performed on 200 high risk pregnant women with gestational age of more than 32 weeks, they concluded that the best correlation was between fetal movements counting by mother and non-stress test as the gold standard when counting of ten movements were completed within two hours. It had 85.7% sensitivity, 76.8% specificity, 42.1% positive predictive value and 96.5% negative predictive value. It appears that the difference in the diagnostic value of this research with the present study was due to the high rate of false positive results of the non-stress test.<sup>30-32</sup>

Khooshideh et al.<sup>28</sup> carried out a study on 250 postdate singleton pregnant women. They concluded the positive predictive value of fetal movement counting by mother for prediction of meconium-stained amniotic fluid as the gold standard was very low (10%) but negative predictive value was 91%. In the present study (which did not include the post-term pregnancy), the positive and negative predictive value of fetal movement counting by mother compared to biophysical profile as the gold standard was 10 and 100 percent, respectively. The findings of these two studies showed that fetal movement counting is a good predictor of healthy fetus with high negative predictive value.

Leader et al.<sup>33</sup> in their study on 264 pregnant women admitted to the ward of

high risk pregnancy found that the sensitivity, specificity and positive predictive value of evaluation of fetal movements in assessing good and poor fetal outcomes was 86, 91 and 46 percent, respectively. These results showed the urgent need for further evaluation in patients with abnormal fetal movements. De Muylder<sup>34</sup> studied on 200 high risk pregnancies and showed the diagnostic value of kick chart in prediction of the risk of intrauterine fetal death yielded 87.5% sensitivity, 94.1% specificity, 43.7% positive predictive value and 99.3% negative predictive value. It was concluded that this test predicts the risk of intrauterine fetal death with acceptable sensitivity and specificity. In a study by Berbey et al.<sup>35</sup> on 752 pregnancies (550 normal pregnancies and 202 high risk pregnancies) with gestational age of more than 35 weeks, they found that decreased fetal movements reported by the mother were significantly predictive for the abnormal results of fetal tests and pregnancy outcomes. They concluded decreased fetal movements predicted the abnormal results of fetal tests in normal and high risk pregnancy with sensitivity of 57.7% and 56.5% and specificity of 96.2% and 88%, respectively. In the present study, there was a significant relation between fetal movements counting by the mother and the results of biophysical profile ( $p < 0.001$ ) in the way that the kick chart predicted the results of biophysical profile with sensitivity of 100% and specificity of 96%. Jones et al.<sup>36</sup> showed in their review study that evidence from the meta-analysis of randomized controlled trials did not show improvement in outcomes with formal instruction on monitoring of fetal movements. It probably reflects the low positive predictive value (2 to 5 percent)<sup>14,36</sup> of fetal movement counting protocols due to the subjective nature of this test.<sup>14</sup>

In the present study, besides determining the diagnostic value, the average time spent for specified number of fetal movements in each of these two methods was also computed. In the method of "ten fetal

movements counting within two hours" the mean time required to appreciate ten movements by the mother was 22.1 (4.6) minutes. In a study by Moore and Piacquadio study,<sup>37</sup> this time was 20.9 (18.1) minutes and 99.5% of mothers counted ten movements within 90 minutes.<sup>38</sup> In Smith *et al.*<sup>39</sup> study, the mean time for recording ten fetal movements by the mother was 19.7 (22.9) minutes, which were in agreement with the present study findings. In other studies<sup>23</sup> on women with normal and non-complicated pregnancies, 99% of them were able to feel ten fetal movements within 60 minutes. In the present study, 95% of women felt ten movements in 60 minutes.

In a study<sup>5</sup> on 1200 fetal movement charts, the mean time for counting ten fetal movements was less than 10 minutes. The differences with this study's findings might be due to different approaches. In the method of "three fetal movements counting in one hour" the mean time for counting three movements was 8.0 (2.8) minutes, which are in common with the results of a study that showed the most women feel three fetal movements in just a few minutes and so very little time is required.<sup>16</sup> Furthermore, in this study, four mothers were able to feel the three fetal movements in less than a minute.

## Conclusion

The findings of this study showed that there was a significant relationship between both two methods of fetal movement counting by the mother and biophysical profile. Both fetal movement counting tests with 100% sensitivity and 96% specificity predicted the results of biophysical profile test. It is clear that the use of fetal movement counting test can be useful in predicting fetal health. Noting that using ultrasound to assess the fetal health is not available in all countries especially in the developing countries, therefore, fetal movement counting and controlling can be used as a primary screening method to assess fetal health.

## Ethical issues

None to be declared.

## Conflict of interest

The authors declare no conflict of interest in this study.

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## References

1. Mangesi L, Hofmeyr GJ. Fetal movement counting for assessment of fetal wellbeing. Editorial Group: Cochrane Pregnancy and Childbirth Group. The Cochrane Collaboration. 2010; Issue 1.
2. Wilailak S, Suthutvoravut S, Cherng-sa-ad P, Herabutya Y, Chaturachinda K. Assessment of fetal well-being: fetal movement count versus non stress test. *Int J Gynaecol Obstet* 1992; 39(1):23-7.
3. Cunningham F, Leveno K, Bloom S, Hauth J, Rouse D, Spong C. *Williams Obstetrics*. 23<sup>rd</sup> ed. New York: McGraw-Hill Companies, Incorporated; 2009.
4. Varney H, Kriebs JM, Gegor CL. *Varney's Midwifery*. Boston: Jones & Bartlett Learning; 2004. p. 632-3.
5. Froen JF, Heazell AE, Tveit JV, Saastad E, Fretts RC, Flenady V. Fetal movement assessment. *Semin Perinatol* 2008;32(4):243-6.
6. Walsh LV. *Midwifery: community-based care during the childbearing year*. Philadelphia: Saunders; 2001.
7. Navot D, Yaffe H, Sadovsky E. Diagnosis of fetal jeopardy by assessment of fetal movement and heart rate accelerations. *J Perinat Med* 1983; 11(3):175-8.
8. Tveit JV, Saastad E, Stray-Pedersen B, Bordahl PE, Flenady V, Fretts R, Froen JF. Reduction of late stillbirth with the introduction of fetal movement information and guidelines - a clinical quality improvement. *BMC Pregnancy Childbirth* 2009; 9:32.
9. Holm Tveit JV, Saastad E, Stray-Pedersen B, Bordahl PE, Froen JF. Maternal characteristics and pregnancy outcomes in women presenting with decreased fetal movements in late pregnancy. *Acta Obstet Gynecol Scand* 2009; 88(12):1345-51.

10. Radestad I. Fetal movements in the third trimester-- Important information about wellbeing of the fetus. *Sex Reprod Healthc* 2010; 1(4):119-21.
11. Hijazi ZR, East CE. Factors affecting maternal perception of fetal movement. *Obstet Gynecol Surv* 2009; 64(7):489-97.
12. Lalor JG, Fawole B, Alfirevic Z, Devane D. Biophysical profile for fetal assessment in high risk pregnancies. *Cochrane Database Syst Rev* 2008 ;( 1):CD000038.
13. Heazell AE, Froen JF. Methods of fetal movement counting and the detection of fetal compromise. *J Obstet Gynaecol* 2008;28(2):147-54.
14. Farley D, Dudley DJ. Fetal assessment during pregnancy. *Pediatr Clin North Am* 2009; 56(3):489-504.
15. Davies G. Antenatal Fetal Assessment. *J Soc Obstet Gynaecol Can* 2000; 22(6):456-62.
16. Freeman RK, Garite TJ, Nageotte MP. *Fetal Heart Rate Monitoring*. Philadelphia: Lippincott Williams & Wilkins; 2003.
17. Marnoch A. An evaluation of the importance of formal, maternal fetal movement counting as a measure of fetal well-being. *Midwifery* 1992; 8(2):54-63.
18. Valentin L, Marsal K. Pregnancy outcome in women perceiving decreased fetal movement. *Eur J Obstet Gynecol Reprod Biol* 1987; 24(1):23-32.
19. James DK, Steer PJ, Weiner CP, Gonik B. *High Risk Pregnancy: Management Options - Expert Consult*. Philadelphia: Elsevier Health Sciences; 2010.
20. Hill-Smith I. Professional and patient perspectives of NICE guidelines to abandon maternal monitoring of fetal movements. *Br J Gen Pract* 2004; 54(508):858-61.
21. Gurneesh S, Ellora D. DFMC Chart: An inexpensive way of assessing fetal well being at home. *J Obstet Gynecol India* 2009; 59(3):217-9.
22. Singh G, Sidhu K. Daily fetal movement count chart: Reducing perinatal mortality in low risk pregnancy. *Medical Journal Armed Forces India* 2008; 64(3):212-3.
23. Preston S, Mahomed K, Chadha Y, Flenady V, Gardener G, MacPhail J, Conway L. *Clinical Guidelines: Clinical practice guideline for the management of women who report decreased fetal movements* [Internet]. 2009[cited 2010 Nov21] Available from: <http://www.Stillbirthalliance.org.au/guideline4.htm/>
24. Jamal A, Marsoosi V, Eslamian A, Noori K. A prospective trial of the fetal biophysical profile versus modified biophysical profile in the management of high risk pregnancy. *Acta Med Iran* 2007; 45(3):204-8.
25. Orshan SA. *Maternal, Newborn, and Women's Health Nursing: Comprehensive Care Across the Life Span*. Philadelphia: Lippincott Williams & Wilkins; 2007. p. 466-72.
26. Swanson RW. Daily maternal counting of fetal movement as an antenatal screening test. Part I. A review. *Can Fam Physician* 1988; 34:561-5.
27. Ricci SS, Kyle T. *Maternity and Pediatric Nursing*. Philadelphia: Lippincott Williams & Wilkins; 2008. p. 324-5.
28. Khooshideh M, Izadi S, Shahriari A, Mirteymouri M. The predictive value of ultrasound assessment of amniotic fluid index, biophysical profile score, nonstress test and foetal movement chart for meconium-stained amniotic fluid in prolonged pregnancies. *J Pak Med Assoc* 2009; 59(7):471-4.
29. Ricci SS. *Essentials of Maternity, Newborn, and Women's Health Nursing*. Philadelphia: Lippincott Williams & Wilkins; 2007.
30. Gibbs RS, Karlan BY, Haney AF, Nygaard IE. *Danforth's Obstetrics and Gynecology*. Philadelphia: Lippincott Williams & Wilkins; 2008.
31. Tucker SM, Miller LA, Miller DA. *Mosby's Pocket Guide to Fetal Monitoring: A Multidisciplinary Approach*. 6<sup>th</sup> ed. Philadelphia: Elsevier Health Sciences; 2008.
32. Lowdermilk DL, Perry SE. *Maternity and women's health care*. Philadelphia: Mosby; 2007.
33. Leader LR, Baillie P, Van Schalkwyk DJ. Fetal movements and fetal outcome: a prospective study. *Obstet Gynecol* 1981; 57(4):431-6.
34. De Muylder X. The kick chart in high-risk pregnancies: a two-year experience in Zimbabwe. *Int J Gynaecol Obstet* 1988; 27(3):353-7.
35. Berbey R, Manduley A, Vigil-De GP. Counting fetal movements as a universal test for fetal wellbeing. *Int J Gynaecol Obstet* 2001; 74(3):293-5.
36. Jones NW, Bugg G, Gribbin C, Raine-Fenning N. Assessing fetal health. *Obstetrics, Gynaecology and Reproductive Medicine* 2008; 18(6): 145-49.
37. Moore TR, Piacquadio K. A prospective evaluation of fetal movement screening to reduce the incidence of antepartum fetal death. *Am J Obstet Gynecol* 1989; 160(5 Pt 1):1075-80.
38. Ratcliffe SD. *Family Medicine Obstetrics E-Book*. 2<sup>nd</sup> ed. Philadelphia: Elsevier Health Sciences; 2001.
39. Smith CV, Davis SA, Rayburn WF. Patients' acceptance of monitoring fetal movement. A randomized comparison of charting techniques. *J Reprod Med* 1992; 37(2):144-6.