

# The Effect of Aerobic Exercises on Maternal Outcomes: A Randomized Controlled Clinical Trial

Monireh Toosi,<sup>1</sup> and Marzieh Akbarzadeh<sup>2,\*</sup>

<sup>1</sup>Community Based Psychiatric Care Research Center, Department of Midwifery, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, IR Iran

<sup>2</sup>Maternal - Fetal Medicine Research Center, Department of Midwifery, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, IR Iran

\*Corresponding author: Marzieh Akbarzadeh, Maternal - Fetal Medicine Research Center, Department of Midwifery, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, IR Iran. Tel: +98-0716474250, Fax: +98-71647425, E-mail: akbarzadm@sums.ac.ir

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## Abstract

**Background:** Exercise can play a major role in health during pregnancy. Therefore, it is essential to consider the physiological conditions of females regarding the exercise.

**Objectives:** The present study aimed to determine the effect of a cycle of exercises on pregnancy outcomes.

**Methods:** In this clinical trial, 120 pregnant females referring to Shiraz hospitals in 2015 were randomly divided into the intervention and control groups. The intervention group subjects were required to do aerobic exercises for eight weeks since the 20th week of gestation in addition to receiving the routine care. However, mothers in the control group only received the routine pregnancy care. Then, pregnancy outcomes such as length of pregnancy, delivery phases, type of delivery and infants' physiological indexes such as Apgar score, weight, height and head circumference were measured. Finally, the data were transferred into the SPSS statistical software and analyzed using T-test and Chi-square test.

**Results:** The two study groups were similar based on their age, level of education, income, employment status and satisfaction with their husbands. Also, no significant difference was observed between the two groups regarding the length of pregnancy, weight, height and Apgar score at birth. However, a significant difference was observed between the two groups concerning type of delivery, duration of active phase of delivery and pain intensity in the active phase of delivery. In addition, back pain intensity significantly decreased in the intervention group, but increased with progress in pregnancy in the control group.

**Conclusions:** Special attention is paid to supportive methods such as exercising during pregnancy in the recent years. Exercising has positive effects on mothers and infants health. Thus, these exercises are recommended to be incorporated in pregnancy care.

**Keywords:** Aerobic Exercise, Pregnancy, Infant Weight, Duration of Pregnancy, Apgar Score, Type of Delivery

## 1. Background

Pregnancy is one of the most sensitive periods of females lives and is of great importance since mother's health directly affects another being's life (1). The positive effects of exercise are confirmed in the pregnant females who did regular exercises under a physician's supervision (2, 3). Besides, numerous studies revealed the beneficial effects of exercise on the mother, fetus and passing a safe pregnancy period as well as the physiological manifestations of exercise during pregnancy (4). Moreover, several researches indicate that doing exercise could be introduced as a prophylactic method to reduce back pain in pregnant mothers (5, 6). Following a regular exercise program can help females achieve positive mental effects, increase their self-confidence and prevent weight gain during pregnancy (7-9). Up to now, different results have been obtained regarding the effect of exercising in the pregnancy period. Yet, most scientific resources recom-

mend training the accurate principles of exercising and physical activity in pregnancy care (10). In addition, scientific findings emphasize that continuation of exercise during pregnancy would not harm the mother or the fetus (10). In general, doing exercises is considered as a common treatment method for back pains with no specific causes. Various studies showed that exercise therapy effectively improved chronic back pain, and no negative reports indicate the negative effects of exercise during pregnancy (11, 12). Furthermore, some studies demonstrated that the females who regularly exercised during pregnancy had shorter active phase of delivery, lower cesarean rate, lower meconium-stained amniotic fluid, lower fetal distress, fresher mood and could tolerate labor pain more easily (13). Physical activity can affect fetal growth through increasing the plasma volume, cardiac output and uteroplacental blood flow in mother and fetus (14, 15). Appropriate fetal growth is highly important during preg-

nancy, since any abnormal increase or decrease in fetal growth might be accompanied by death or considerable delivery complications (16). American gynecological and obstetrical society suggested the safety of physical activity during pregnancy and that females who were physically prepared could continue doing appropriate physical activities during pregnancy (16, 17). Also, the society of obstetricians and gynecologists of Canada and the Canadian society for exercise physiology stated that the pregnant females who had no limitations to do physical activities should be encouraged to do stretching exercises as a part of a healthy lifestyle (18). The most appropriate physical activities during pregnancy are aerobic exercises, including running slowly and light exercises. Fitness exercises and average strength training are also acceptable during pregnancy; of course, the alarming signs should be taken into account (15, 19). In spite of the knowledge about the physiological manifestations of exercise during pregnancy, no comprehensive information is available concerning the effects of various exercises at various time points during pregnancy on the mother and her fetus. Considering the importance of mothers' health during pregnancy and delivery, researches should be conducted on the effective factors of healthy pregnancy.

## 2. Objectives

The current study aimed to determine the relationship between exercise and pregnancy outcomes.

## 3. Methods

This quasi-experimental randomized single-blind clinical trial was approved by the local ethics committee of Shiraz University of Medical Sciences and written informed consents were obtained from all the participants. The study participants were selected from the pregnant mothers referring to the prenatal clinics of the hospitals affiliated to Shiraz University of Medical Sciences to receive pregnancy care in 2015.

The randomization was done in the draw. Sample size was decided according to Equation 1.

$$n = \frac{(\sigma_1^2 + \sigma_2^2) \left( Z_{1-\frac{\alpha}{2}} + Z_{1-\beta} \right)^2}{d^2} \quad (1)$$

$$(\alpha = 0.05, 1-\beta = 0.8, \Delta = \text{effect size} = 0.36)$$

$$(\Delta = d / \sigma)$$

The inclusion criteria for the study were being 18-35 years old, gestational age of 20 weeks, singleton pregnancy, being primiparous, not having a history of pregnancy complications, not having a history of doing pro-

fessional sports, and normal body mass index (BMI) (19-24). However, the exclusion criteria were having underlying diseases such as hypertension, thyroid disorders, females or pregnancy disorders, diabetes, epilepsy, cardiovascular diseases, renal disorders and pulmonary diseases, having known pregnancy complications such as polyhydramnios, oligohydramnios, placenta previa, detachment, known fetal disorders, intrauterine death, cervical insufficiency, history of infertility, bleeding during pregnancy and pain, having limitations to do physical activities and not willing to participate in the study. Of course, none of the participants was excluded from the study.

Each two patients were randomly allocated to experimental or control groups (60 cases in each group). Then, subjects signed written informed consents, a physician examined them and explained the study procedure. The subjects in the intervention group were required to do aerobic exercises 30 minutes a day, three days a week for eight weeks. Aerobic exercise program started with 5 minutes of warm-up, continued with the main plan which usually lasted 20 minutes, and ended with a cool-down of 5 minutes. These exercises were strictly supervised by the instructor and the midwife. In each session, 10 types of aerobic exercises were performed, including a 5-minute warm-up, stretching exercises, and a cool-down of 5 minutes. The intensity of exercises was controlled by measuring the participants' heartbeat; accordingly, their heartbeat should not exceed 140 beats per minute (bpm) (20). Subjects in the control group received only the routine care without performing aerobic exercises.

To evaluate pregnancy outcomes, duration of pregnancy, type of delivery, 1- and 5-minute Apgar scores, and birth weight were assessed. The study variables were evaluated using a demographic information questionnaire, Apgar score and delivery information forms. In addition, duration of pregnancy was determined by the time interval between the beginning of the last menstrual cycle and delivery which is usually equal to 38 - 42 weeks. Finally, infants' birth weight was measured with no cover using infant weight scale within the first 12 hours of birth.

To assess back pain, the 10-point numeric rating scale for pain (NRS Pain) was used. This scale is a paper tape numerated from 0 to 10 representing the lowest and highest pain intensity, respectively. The validity of NRS is confirmed in various studies (20). Besides, its reliability was determined through equivalent-forms method. To do so, pain intensity of 10 mothers was measured once by the researcher and once by her assistant, which revealed a correlation coefficient of 0.91.

Finally, the data were analyzed using the SPSS statistical software (v. 18). Chi-square and T-test were used to compare the two groups.  $P < 0.05$  was considered as statistically sig-

nificant.

#### 4. Results

According to the results, the mean age of the intervention group subjects was  $23.7 \pm 4.3$  years and most of them were housewives (88.4%) and had high school diploma (58.4%). Similarly, the mean age of the control group subjects was  $24.2 \pm 3.4$  years and most of them were housewives (93.4%) and had high school diploma (56.6%). The results revealed no significant difference between the two groups regarding the demographic characteristics, including mean age ( $P = 0.562$ ), level of education ( $P = 0.280$ ), occupation ( $P = 0.529$ ), satisfaction with one's husband ( $P = 0.729$ ), income ( $P = 0.918$ ) and fetus gender ( $P = 0.258$ ) (Table 1).

The results showed that 76.6% of the infants in the intervention group and 70.0% of the infants in the control group were 2500 - 3500 gr at birth. The results demonstrated no significant difference between the two groups concerning weight, height and head circumference at birth.

In addition, the mean Apgar scores of most of the infants in the intervention and control groups were nine at the first and the fifth minute after birth. The results showed no significant difference between the two groups with respect to the 1-minute Apgar scores ( $P = 0.370$ ) and the 5-minute Apgar scores ( $P = 0.246$ ) (Table 2).

Considering the duration of pregnancy, the mean of gestational age was  $39.12 \pm 1.7$  and  $39.4 \pm 0.9$  in the intervention and control groups, respectively, but the difference was not statistically significant ( $P = 0.179$ ). However, a significant difference was observed between the two groups regarding the duration of active phase of delivery (from the beginning of regular uterine contractions up to the complete cervical dilation) and pain intensity at this phase ( $P = 0.022$ ). Nonetheless, no significant difference was observed between the two groups with respect to the second (from complete cervical dilation up to delivery  $P = 0.189$ ) and third phases of delivery (from delivery up to the placenta's exit  $P = 0.073$ ). Moreover, the results demonstrated a significant difference between the two groups regarding the type of delivery ( $P = 0.026$ ) (Table 3).

According to NRS, the mean score of back pain intensity in the intervention group reduced from  $5.2 \pm 1.6$  before the intervention to  $4.8 \pm 1.8$  after that, and the difference between the mean scores was statistically significant ( $P = 0.02$ ). In the control group, however, the intensity of back pain increased by progress in pregnancy; in a way that the mean intensity of back pain increased from  $5.8 \pm 2.1$  to  $6.2 \pm 2.3$  after the eighth week and the difference between the

mean scores was statistically significant ( $P = 0.005$ ). Comparison of the mean scores of back pain intensity in the two groups before and after the intervention showed that performance of a cycle of aerobic exercises led to a significant decrease of back pain intensity in the intervention group females ( $P < 0.001$ ) (Table 4).

#### 5. Discussion

##### 5.1. The Necessity of this Study

Since pregnancy is a significant and vulnerable time for pregnant females, proper education is of great importance (21). Proper fetal growth during pregnancy is important since its abnormal increase and decrease leads to abnormal child mortality and morbidity (22). Variety options such as prenatal care education can restrict pregnancy and infancy risks (23, 24).

Moreover, prenatal care education can be effective on fetal growth by providing relaxation and physical activity improvement through the rise in maternal and fetal plasma volume, cardiac output, and the increase in uteroplacental blood flow (25).

Therefore, this can lead to the improvement of neonatal criteria enhancement and maternal factors. This is what the current study is going to elaborate.

In the present study, subjects in the intervention group did regular aerobic exercises and their pregnancy outcomes, including mean duration of pregnancy, birth weight and Apgar scores were compared to those of the control group to determine the effect of exercise on pregnancy and its outcomes. The study results revealed significant differences between the two groups regarding some variables.

The findings of the current study indicated no significant relationship between doing exercises during pregnancy and the infants' weight, height, head circumference, 1- and 5-minute Apgar scores and duration of pregnancy. These results were almost similar to those of the other studies conducted on the issue. For instance, Ghodsi and Asltooghi assessed the effects of exercise on neonatal outcomes. According to the findings of their study, there was no significant statistical evidence for the positive effect of exercise training on the 1- and 5-minute Apgar scores or neonatal weight (8). Kardel and Kase also conducted a similar study to investigate the effect of average- and high-intensity exercises on fetal growth, duration of pregnancy, birth weight and Apgar scores in the females with the history of doing high-intensity exercises before pregnancy. In their study, the subjects took part in average- and high-intensity exercise programs. The results showed no significant difference between the two groups regarding pregnancy duration, infant's weight, and 1- and 5-minute Apgar

**Table 1.** Distribution of the Pregnant Females in the Study Groups Based on Demographic Indexes

Index		Intervention Group	Control Group	Statistical Test
Level of education, No. (%)	Middle school	14 (23.3)	20 (33.4)	Chi-square, Df = 2, P = 0.280
	High school and diploma	35 (58.4)	34 (56.6)	
	Academic	11 (18.3)	6 (10.0)	
Housing status, No. (%)	Private house	14 (23.4)	18 (30.0)	Chi-square, Df = 1, P = 0.08
	Tenant	46 (76.6)	42 (70.0)	
Satisfaction with husband, No. (%)	Yes	55 (91.6)	56 (93.4)	Chi-square, Df = 1, P = 0.729
	No	5 (8.4)	4 (6.6)	
Fetus gender, No. (%)	Boy	30 (50.0)	26 (43.4)	Chi-square, Df = 2, P = 0.258
	Girl	21 (35.0)	29 (48.3)	
	Unknown ( not identify with sonography)	9 (15.0)	5 (8.3)	
Average income, No. (%)	Below 7 million Rials	33 (55.0)	34 (56.6)	Chi-square, Df = 2, P = 0.918
	Above 7 million Rials	27 (45.0)	26 (43.4)	
Occupation, No. (%)	Employed	7 (11.6)	4 (6.6)	Chi-square, Df = 1, P = 0.529
	Homemaker	53 (88.4)	56 (93.4)	
Age, (Mean $\pm$ SD)		23.7 $\pm$ 4.3	24.2 $\pm$ 3.4	T-test, Df = 118, P = 562

**Table 2.** Comparison of the Infants' Growth Indexes in the Two Groups

Index	Study Groups				Independent T-test Results
	Intervention Group		Control Group		
	Mean	SD	Mean	SD	
Birth weight (gr)	3185.5	453.0	3175.0	391.7	P = 0.447
Birth height (cm)	51.1	2.1	51.3	2.1	P = 0.496
Birth head circumference (cm)	34.3	1.5	34.1	1.6	P = 0.095
1-minute Apgar score	9.3	0.3	9.0	0.1	P = 0.370
5-minute Apgar score	9.2	1.3	10.2	1.6	P = 0.246

Abbreviation: SD, standard deviation.

scores (26). In the same line, Barakat et al. found no significant relationship between doing exercises and duration of pregnancy (27). Also, Hickman concluded that doing physical activities during pregnancy had no impacts on fetal growth and other pregnancy outcomes. Overall, although doing exercise might not be effective in pregnancy, it has no negative effects on the mother or the fetus (28). Duncombe et al. also reported no difference between the mothers who had done exercises and those of the control group regarding their infants' birth weight (29).

In contrast to the present study's results, some studies indicated a significant relationship between doing exercises during pregnancy and the infants' weight, height, head circumference, and 1- and 5-minute Apgar scores.

Zand and Zamani performed a research on the effect of exercise on the mother and pregnancy outcomes in healthy females with low-risk pregnancy and reported a significant difference in the infants' Apgar scores (30). In addition, Hopkins et al. reported no decrease in the infants' birth weight due to performance of physical activities. They concluded that exercise did not decrease the infants' birth weight, and it had desirable effects on other pregnancy outcomes (10). The difference between their study and the present one might be due to the difference in race, economic status, social status, exercise interventions, location and duration of interventions or time of beginning the interventions in pregnancy.

The findings of the current study revealed a positive

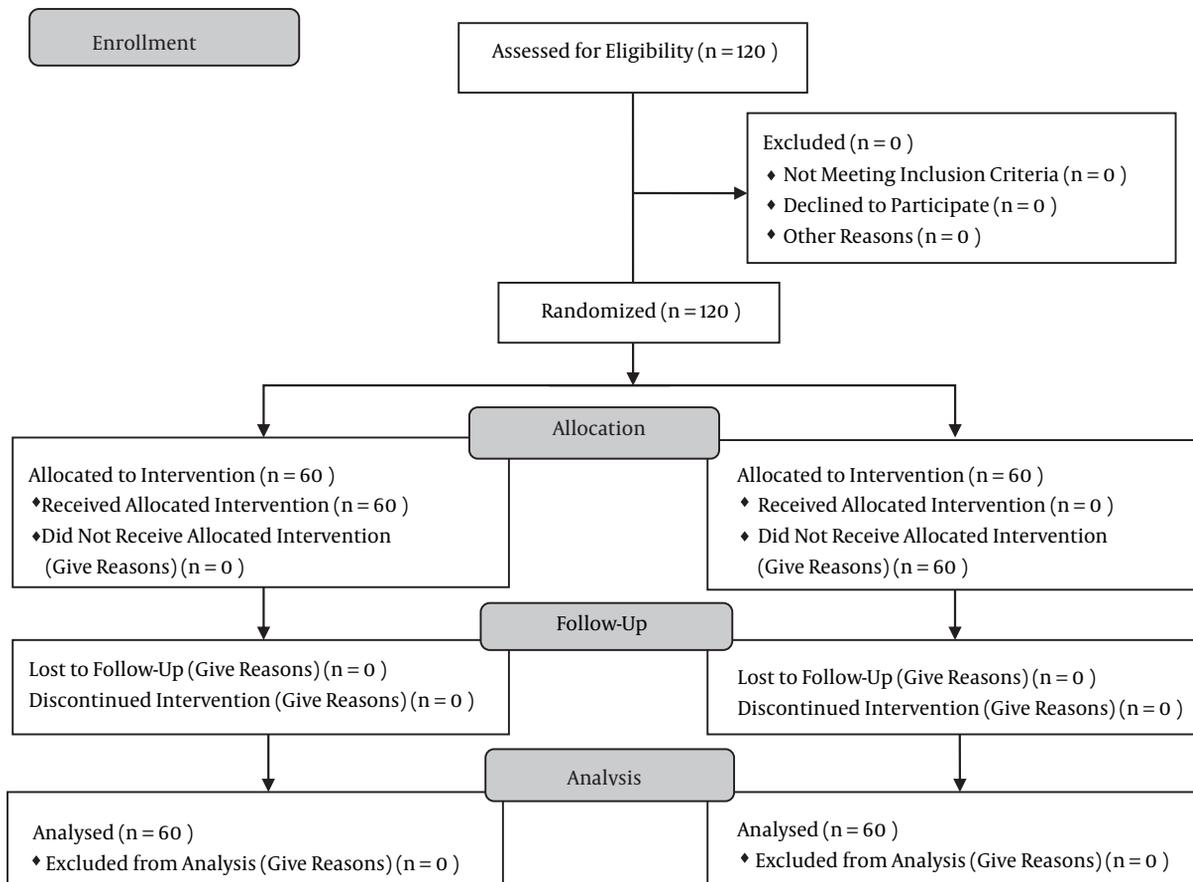


Figure 1. Consort Flow Diagram

correlation between doing exercises during pregnancy and length of the first stage of labor and pain intensity at this stage. In other words, duration and pain intensity of the first stage of labor were lower in the females who had taken part in exercise interventions compared to the control group. On the other hand, the rate of cesarean delivery was higher in the control group. The study results also showed a significant increase in the rate of cesarean delivery in the control group, indicating that physical activity during pregnancy was accompanied by lower rate of cesarean section. These results were consistent with those of a large number of studies conducted on the relationship between doing exercises and pregnancy outcomes.

Prather stated that exercise during pregnancy decreased the risk of diabetes, increased self-confidence and reduced pain in mothers. Also, it could shorten the length of the active phase of labor by reducing the stress (31).

In agreement with the results of the current study, Kamali demonstrated a significant improvement in the in-

tensity of back pain after pelvic tilt exercise in the sitting position for eight weeks. Besides, this intervention had no adverse effects on the pregnancy outcomes (32). In general, exercise therapy is one of the most common methods to treat back pain (33). Patients receive exercise therapy alone or along with other treatment methods. Various studies disclosed that the individuals who did exercise regularly had less back pain (33-37). Evidence also showed that interventions such as physical therapy, acupuncture, acupressure, massage and exercise could reduce back pain (38).

On the contrary, Shim et al. investigated the effect of exercise program on reduction of pain, disability and anxiety in pregnant females with back pain and indicated no significant difference between the groups after six weeks of intervention (39). This difference might be due to the nature, type, intensity and repetition of exercise activities in different subjects and time points in delivery.

**Table 3.** Comparison of Labor Stages and Mothers' Pain Scores in the Two Groups

Group	Intervention Group	Control Group	Independent T-test Results
Duration of pregnancy (week of gestation)	39.12 ± 1.7	39.47 ± 0.9	P = 0.179
First stage (up to complete dilation, hour)	4.2 ± 1.4	4.8 ± 0.9	P = 0.022
Second stage (exit of fetus, minute)	48.9 ± 11.9	51.6 ± 10.0	P = 0.189
Third stage (exit of placenta, minute)	5.58 ± 2.3	6.52 ± 3.2	P = 0.073
Mother's pain score in the active phase of labor	6.85 ± 1.3	7.45 ± 1.7	P = 0.034
Type of delivery			P = 0.026
Cesarean section, No. (%)	19 (31.6)	31 (51.6)	
Natural delivery, No. (%)	41 (68.4)	29 (48.4)	

### 5.2. Study limitations

The results of the study were consistent with most other studies. However, the efficacy of other studies was not the same as the current one which can be contributed to the differences in the content, place, duration and the starting time of studying in pregnancy.

Study restrictions can be due to small sample size and short duration of the intervention (eight weeks) since this eight-week exercise program was not enough to reduce back pain and other changes.

Moreover, it should be confessed that applying questionnaire, subjective assessments of exercise effects, ergonomic advice, lack of objective criteria, applying diagram to determine back pain, and lack of physical exam for individual patients can be noted as the weak points of the study.

### 5.3. Suggestions

All in all, results of the study suggest that evaluating exercise and observing ergonomic principles can effectively reduce back pain and its related disabilities in pregnant females; therefore, doing regular exercise and considering ergonomic principles are advised in pregnancy.

Further studies with larger sample sizes are suggested to support the results of the study, also simultaneous application of subjective and objective assessments in the interventions as well as assessing the impact of these practices on the prevention of direct and indirect costs of back pain is recommended.

It is recommended that prenatal clinics advise the pregnant females without motion restriction to have an active life and walk as much as possible to avoid immobilization.

As a result, proper exercise implementation does not only cause fetus and maternal damage or harm but it also provides an easier delivery with healthier birth.

### 5.4. Conclusion

Considering the results of the present study, appropriate aerobic exercises had no negative effects on the mother or her fetus. Thus, it is recommended to incorporate programs into pregnancy care training to improve physical activity in the pregnant females. The current study findings also revealed that doing physical activities as a simple, effective, safe and non-invasive treatment method seemed essential to improve pregnancy outcomes. Hence, pregnant females are recommended to exercise regularly and pay more attention to health principles.

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### Footnotes

**Authors' Contribution:** Monireh Toosi: design, literature search, definition of intellectual content, data acquisition, experimental studies and manuscript preparation; Marzieh Akbarzadeh: concepts design, literature search, definition of intellectual content, manuscript preparation, review and corresponding.

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**Table 4.** Comparison of the NRS of Back Pain in the Two Groups Before and After the Intervention

Group	Before the Intervention, Mean $\pm$ SD	After the Intervention, Mean $\pm$ SD	Paired T-test Results	Confidence Interval
Intervention	5.2 $\pm$ 1.6	4.8 $\pm$ 1.8	P = 0.02	(L -0.58, U -0.05)
Control	5.8 $\pm$ 2.1	6.2 $\pm$ 2.3	P = 0.005	(L -0.13, U -0.72)
<b>Independent T-test results</b>	P = 0.06	P < 0.001		

Abbreviation: NRS, numeric rating scale; SD, standard deviation

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