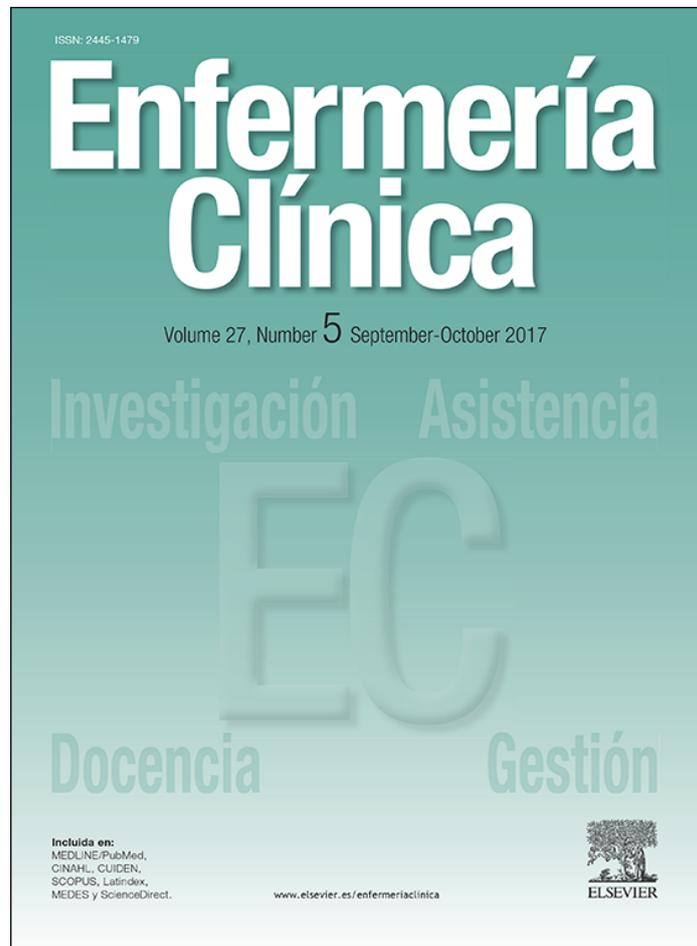


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## ORIGINAL ARTICLE

## Effectiveness of a physical activity programme based on the Pilates method in pregnancy and labour<sup>☆</sup>



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### KEYWORDS

Physical activity;  
Pregnancy;  
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### Abstract

**Objective:** To assess the effectiveness and safety of a physical activity programme based on use of the Pilates method, over eight weeks in pregnant women, on functional parameters, such as weight, blood pressure, strength, flexibility and spinal curvature, and on labour parameters, such as, type of delivery, episiotomy, analgesia and newborn weight.

**Method:** A randomised clinical trial was carried out on pregnant women, applying a programme of physical activity using the Pilates method, designed specifically for this population. A sample consisting of a total of 105 pregnant women was divided into two groups: intervention group (n = 50) (32.87 ± 4.46 years old) and control group (n = 55) (31.52 ± 4.95 years old). The intervention group followed a physical activity programme based on the Pilates method, for 2 weekly sessions, whereas the control group did not follow the programme.

**Results:** Significant improvements ( $p < 0.05$ ) in blood pressure, hand grip strength, hamstring flexibility and spinal curvature, in addition to improvements during labour, decreasing the number of Caesareans and obstructed labour, episiotomies, analgesia and the weight of the newborns were found at the end of the intervention.

**Conclusion:** A physical activity programme of 8 weeks based on the Pilates method improves functional parameters in pregnant women and benefits delivery.

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**PALABRAS CLAVE**

Actividad física;  
Embarazo;  
Entrenamiento;  
Seguridad

**Efectividad de un programa de actividad física mediante el método Pilates en el embarazo y en el proceso del parto****Resumen**

**Objetivo:** Valorar la eficacia y seguridad de un programa de actividad física por medio del método Pilates de ocho semanas de duración en mujeres gestantes sobre parámetros funcionales, como el peso, la tensión arterial, fuerza, flexibilidad, curvatura de la columna y parámetros en el parto, como tipo de parto, episiotomía, analgesia y peso del recién nacido.

**Método:** Se realizó un ensayo clínico aleatorizado sobre gestantes, consistente en la aplicación de un programa de actividad física mediante el método Pilates, diseñado específicamente para esta población. Se agrupó una muestra compuesta por un total de 105 mujeres gestantes, las cuales estaban divididas en grupo intervención ( $n = 50$ ) ( $32,87 \pm 4,46$  años) y grupo control ( $n = 55$ ) ( $31,52 \pm 4,95$  años). El grupo intervención asistió a un programa de actividad física por medio del método Pilates, durante 2 sesiones semanales, mientras que el grupo control no realizó el programa.

**Resultados:** Tras finalizar la intervención se observaron mejoras significativas ( $p < 0,05$ ) en la tensión arterial, fuerza de prensión manual, flexibilidad isquiosural y curvatura de la columna y además mejoras en el proceso del parto, disminuyendo el número de cesáreas y de partos distócicos, de episiotomías, de analgesia y del peso del recién nacido.

**Conclusión:** Un programa de actividad física 8 semanas por medio del método Pilates mejora parámetros funcionales en las gestantes y podría beneficiar la finalización del parto.

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**What is known?**

There is some controversy about the type and volume of physical exercise pregnant women should do during pregnancy, labour and after birth.

**What does this article contribute?**

The effectiveness of a physical programme based on the Pilates method designed for pregnant women and its beneficial outcome during pregnancy and labour.

**Introduction**

Regular practice of moderate physical exercise has positive effects on a healthy pregnancy, with benefits during pregnancy, labour and after birth.<sup>1-5</sup>

During labour, the benefits are reflected in the strengthening of muscles of the area involved, which reduces the pain and the effort needed to give birth. Pelvic movements also help to make ligaments more flexible, helping to increase the diameter of the opening of the cervix and facilitating a natural birth with no need for unnecessary caesarean sections or instrumental deliveries.<sup>6-8</sup>

Regarding the recommended physical activity, several sources emphasise light to moderate exercise (walking,

riding a bike or running). Despite this, in the last few years the recommendation for exercises which require greater physical effort have gained in relevance.<sup>9-12</sup> Different authors consulted do however agree on the duration of exercise (between 45 and 60 min) and frequency (2-3 times per week).<sup>13-15</sup>

There is also agreement regarding the most suitable time to start an exercise routine: that of the 20th week of pregnancy, with exercises of moderate intensity.<sup>16</sup> Well directed physical activity therefore does not entail any risk to the mother and baby, and the future mother does not gain too much weight during pregnancy, reducing the possible appearance of high blood pressure and gestational diabetes.<sup>17</sup>

At present, the Pilates method is gaining significance as a possible type of activity and growing in strength for this group.<sup>18</sup> The aim of this method is to achieve muscle harmony through the strengthening of the weakest muscles and the elasticity of hypertrophied muscles resulting in the person having greater control over their body, greater strength and elasticity but without damaging their back or joints.<sup>19</sup> A Pilates programme during pregnancy requires adapting exercise to the new situation and changes in the body, and may begin in any stage of pregnancy regardless of the fact the women have never previously trained in this method.<sup>20</sup>

Despite a search of the literature, no relevant information was found where the positive effects of the Pilates method had been analysed in this patient group.<sup>21</sup> The aim of this article is therefore to assess the efficacy of a physical exercise programme using the Pilates method for eight weeks on the physical condition of pregnant women during pregnancy and once labour had been completed.

## Method

*Design.* A randomised clinical trial on pregnant women was conducted, which was consistent in the application of a physical exercise programme using the Pilates method, specifically designed for this patient group. This was conducted during the period from April 2016 to July 2016 in the area Maternal Hospital Quirón Campo de Gibraltar.

A simple randomisation process was carried out for inclusion into the two groups using a list of random numbers.

*Sample.* The sample included a total of 105 pregnant women, who were split into an intervention group ( $n=50$ ) ( $32.87 \pm 4.46$  years) and a control group ( $n=55$ ) ( $31.52 \pm 4.95$  years). All the women had voluntary access from the prenatal clinic to participate in the study, and were informed of the procedures, risks and benefits of the study. They signed a written consent form at the beginning of the study which was in keeping with the Declaration of Helsinki, the Spanish law on the clinical research, Royal Decree 1090/2015 and law 41/2002 on patient autonomy and rights and duties in matters of clinical information and documentation. Law 15/1999 on data protection (LODP) for treatment of personal data obtained was adhered to.

Inclusion criteria to form part of the sample were: (a) being of age; (b) being in the second trimester of pregnancy; (c) that the pregnancy was not multiple; (d) not having any contraindication of a medical nature nor any pathologies) not taking any medication which could have affected the programme; (f) not taking part in other physical exercise programmes; (g) not having any contraindication or lesion which would impede undertaking physical exercise.

Prior to the distribution of each group, authorisation from the Ethical Committee of the Hospital Quirón Campo de Gibraltar was requested.

## Data collection

All patients were given appointments and interviewed to obtain socio-demographic data such as age, weeks of pregnancy, number of children and habits relating to physical activity prior to pregnancy, during pregnancy and time dedicated to physical activity.

## Assessment of their physical condition

Improvements in the physical state of the pregnant woman were evaluated at the start of the programme and after 8 weeks, using:<sup>22</sup>

- (a) Anthropometric evaluation: height, weight and body mass index.
- (b) Blood pressure measurement.
- (c) Evaluation of grip strength of each hand with a dynamometer.
- (d) Evaluation of ischial flexibility of each leg using a goniometer.
- (e) Quantification of the dorsal spine curvature using an inclinometer.

## Dependent variables

Weight.  
Blood pressure.  
Strength.  
Flexibility.  
Dorsal spine curvature.  
Birthing process.

Once the programme had been finalised, an evaluation of the following variables was made on the effectiveness of the programme on labour in the intervention group and the control group:

Type of birth (normal birth, instrumental delivery and caesarean section).  
If an episiotomy was carried out (yes or no).  
If epidural analgesia was used (yes or no).  
The baby's birth weight in grams.

## Intervention

Intervention was carried out through an eight-week programme of physical exercise using the Pilates method, with two group sessions per week lasting 40–45 min. This programme was supervised and designed by professionals in this area and following the recommendations of different authors.

Women began their Pilates programme in week 26–28 of pregnancy and terminated it in week 34–36. It was considered necessary to attend at least 90% of the sessions (14–16 sessions) divided throughout the eight weeks minimum (from week 26 to week 34). During the programme, there were groups of 10–12 pregnant women to ensure the right atmosphere for the exercise.

The Pilates programme sessions were conducted using fitball balls, elastic bands, magic hoops and small balls, initially working on the correct postural position whilst resting and during movement, to provide strength and flexibility from the upper limbs to the lower limbs, from standing to sitting and lying positions with 3–5 repetitions for each exercise.

The structure of each session comprised: verification of posture, warm-up phase (5–8 min), aerobic and toning phase (25–30 min), flexibility phase (5–10 min) which helped the women to relax their muscles and elongate them and the last final phase of returning to a calm state (5–10 min) where relaxation techniques were conducted.

The control group followed standard clinical practice and this did not include any guided physical activity.

## Statistical analysis

Descriptive statistics were carried out to discover the different variables related to daily habits. Characteristics were compared between both groups at the start of the study using the Student's *t*-test or the Chi-square test for related samples, according to whether variables were discreet or continuous. Kolmogorov–Smirnov analysis was made which confirmed the normality of sample distribution (*Z*, between 0.64 and 0.92;  $p > 0.05$ ).

**Table 1** Sample characteristics. Development in the Hospital Quirón Campo de Gibraltar in Cádiz, (Spain) from April to June 2016.

		Intervention Group		Control Group	
		Frequency	Percentage	Frequency	Percentage
Week of pregnancy	24	1	2	1	1.8
	25	1	2	1	1.8
	26	24	48	14	25.5
	27	3	6	12	21.8
	28	13	26	22	40
	29	7	14	5	9.1
	30	1	2	0	0
Number of children	0	34	68	43	78.2
	1	14	28	11	20
	2	2	4	1	1.8
Physical exercise during pregnancy before the programme	Swimming	6	12	8	14.5
	Walking	40	80	26	47.3
	Gym for mothers	0	0	1	1.8
	Aquatic activities	0	0	11	20
	Yoga	0	0	9	16.4
	Other	3	6	0	0
Daily volume (minutes) of PE before pregnancy	0	5	10	14	25.5
	30	2	4	2	3.6
	60	33	66	24	43.6
	90	2	4	5	9.1
	120	7	14	8	14.4
	180	1	2	2	3.6

PE: physical exercise.

The effectiveness of the programme was valued using the analysis of the variance of an ANOVA factor of repeated measurements and the calculation of the confidence Interval of difference. Statistical significance was established at 95%. The statistical programme SPSS 20.0 for Windows (SPSS: an IMB Company, Amarouk, NY) was used with licence from the University of Granada.

## Results

The pregnant women of the intervention and control group began the study from week 24 to week 30, with the concentration of most women between week 26 and 28. Most of the pregnant women were first time mothers (48% in the intervention group compared with 78.2% in the control group). With regards to physical activity the women had done before the programme during their pregnancy "walking" stands out in 80% of the intervention group and in 47.3% in the control group and to a lesser extent and percentage other activities, as well as no type of activity in around 12% of the intervention group and 14.5% in the control group.<sup>21</sup> Lastly, we highlighted the volume of activity they did prior to initiating the programme, which was around 60 min, 66% in the group intervention and 43.6% in the control group although there were several exceptional cases of 90 min and 120 min between the intervention and control group. The results may be appreciated in detail in [Table 1](#).

[Tables 2 and 3](#) show the pre-and post intervention variables in the group. The results after a programme of 8 weeks of physical activity show a significant improvement ( $p < 0.001$ ) in the grip strength values, ischial flexibility and spine curvature.

[Table 4](#) shows how a statistically significant improvement is noted ( $p < 0.001$ ) in evaluation of the birthing process, after completing the Pilates programme. This includes normal delivery, no episiotomy, less epidural analgesia and lower weight babies, compared with the control group.

## Discussion

The aim of this study was to find out the effectiveness of a physical exercise programme for 8 weeks, using the Pilates method on functional parameters in the pregnant woman during pregnancy and labour.<sup>23</sup>

The results obtained confirm that with this intervention an improved statistical significance is appreciated in weight, blood pressure, flexibility, curvature of the spine and the birthing process, in aspects such as type of birth, episiotomy, analgesia and new-born birth weight. No adverse events were noted during or after the physical activity sessions.

We found an array of recommendations in the literature on the inclusion of pregnant women in different physical exercise programmes aimed at avoiding an increase in weight above 30 kg/m<sup>2</sup>, as this could lead them to suffer from obesity and the morbidity this would entail.<sup>24</sup> The

**Table 2** Results of physical and functional parameters before and after the physical exercise programme through Pilates (8 weeks). Developed in the Hospital Quirón Campo de Gibraltar in Cadiz (Spain) from April to June 2016.

	Intervention Group (n = 50)			Control Group (n = 55)			Between Groups <i>p</i>
	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	<i>p</i>	Pre Mean ± SD	Post Mean ± SD	<i>p</i>	
Mass (kg)	76.58 ± 12.14	78.12 ± 11.46	0.001	72.82 ± 14.12	78.39 ± 13.80	0.000	0.043
Height (cm)	1.63 ± 0.12	1.63 ± 0.10	n.s.	1.64 ± 0.05	1.64 ± 0.04	n.s.	n.s.
BMI (kg/m <sup>2</sup> )	28.79 ± 4.27	29.38 ± 4.09	0.001	26.78 ± 5.04	28.80 ± 4.95	0.000	0.001
Systolic blood pressure	108.72 ± 10.37	104.36 ± 7.33	0.001	107.18 ± 10.08	115.10 ± 7.38	0.000	0.001
Diastolic blood pressure	65.63 ± 7.33	61.45 ± 5.82	0.001	65.16 ± 6.34	71.70 ± 14.12	0.000	0.001
Right grip strength (kg)	25.54 ± 5.59	26.84 ± 5.41	0.001	24.43 ± 4.85	21.48 ± 4.17	0.000	0.001
Left grip strength (kg)	24.81 ± 5.36	26.19 ± 5.24	0.001	22.85 ± 5.68	20.40 ± 4.98	0.000	0.001
Ischial flexibility in right leg (°)	71.45 ± 3.80	83.54 ± 2.29	0.001	72.30 ± 3.93	68.50 ± 2.90	0.000	0.001
Ischial flexibility in left leg (°)	71.72 ± 2.92	83.27 ± 2.39	0.001	71.70 ± 3.99	68.70 ± 2.99	0.000	0.001
Dorsal kyphosis (°)	27.65 ± 5.17	24.36 ± 3.37	0.001	26.36 ± 3.57	28.12 ± 2.75	0.000	0.001
Lumbar lordosis (°)	40.80 ± 4.33	35.41 ± 1.25	0.001	39.20 ± 3.95	42.08 ± 1.39	0.000	0.001

SD: standard deviation.

**Table 3** Summary of the changes which occurred pre-intervention and post-intervention of the programme. Developed in the Hospital Quirón Campo de Gibraltar de Cádiz (Spain) from April to June 2016.

	Intervention Group (n = 50)	Control Group (n = 55)
Mass (kg)	↑	↑
Height (cm)	=	=
BMI (kg/m <sup>2</sup> )	↑	↑
Systolic blood pressure	↓	↑
Diastolic blood pressure	↓	↑
Right grip strength (kg)	↑	↓
Left grip strength (kg)	↑	↓
Ischial flexibility in right leg (°)	↑	↓
Ischial flexibility in left leg (°)	↑	↓
Dorsal kyphosis (°)	↓	↑
Lumbar lordosis (°)	↓	↑

Pilates method is recommended in this population group due to its intensity and low physical load. Intervention therefore contributes to an improvement in this respect.

Scientific associations advise on maintaining blood pressure values within normal limits during pregnancy as it is already a major cause of maternal and foetal morbidity and mortality.<sup>25</sup> No negative alterations were appreciated in the intervention group with regards to blood pressure behaviour.

The benefits of the Pilates method in the adult non pregnant population have been widely analysed, with benefits being found in strength, flexibility and improvements in lumbar hyperlordosis.<sup>29,30</sup> However, the results for the pregnant women group of our 8 week programme were proven and gave origin to a significant improvement in

parameters such as grip strength, ischial flexibility and dorsal lumbar curvature, despite there being modifications from pregnancy which lead to a reduction in grip strength, shortening of the ischium and lumbar hyperlordosis from the change in the centre of gravity and weight increase.<sup>22,26-28</sup>

With regards to how the Pilates method affected labour it is of note that the most significant contribution of this study were the programme's benefits in the birthing process.

The literature confirmed the reduction in the number of caesarean sections and difficult births in pregnant women who had completed a physical exercise programme. In fact, it has been seen in the work of Barakat et al.<sup>32</sup> that there was a greater rate of normal deliveries and in our study this rate was even higher.<sup>31</sup> The outcome of our training programme is evidence of this. Several references are made to the strengthening of the pelvic muscles and its flexibility, which helps to reduce the number of episiotomies in births.<sup>22</sup> The physical exercise activity we designed dedicates one section to pelvic floor exercises with statistically significant results (*p* < 0.001) regarding the reduction in the number of episiotomies.

The data obtained from the literature confirm the beneficial effects of the Pilates method in better pain control during birth.<sup>33,34</sup> With support from our study we observed a reduction in the use of epidural analgesia.

Finally, new-born birthweight fell as the pregnant woman's weight fell, and was within normal parameters which confirms that this programme offered no risks for the newborn.<sup>35</sup>

One strength of this study is the programme design which has contributed beneficially to improvements in functional parameters and in the birthing process and which may help future programmes of this type to be more effective in the future. Its main limitation is the small number of pregnant women who wish to continuously follow the physical activity programme and the small number of participants. This may have led to bias in the findings, and would be resolved by

**Table 4** Obstetric parameters of finalisation of the birthing process. Developed in the Hospital Quirón Campo de Gibraltar in Cadiz (Spain) from April to June 2016.

		Intervention Group n = 50		Control Group n = 50		Difference
		Frequency	Percentage	Frequency	Percentage	
Type of birth	Normal	45	90	23	42	$p = 0.001$
	Complicated	0	0	8	16	
	Caesarean section	5	10	23	42	
Episiotomy	No	49	98	27	49.09	$p = 0.001$
	Yes	1	2	28	50.90	
Analgesia	Yes	24	48	40	72.72	$p = 0.001$
	No	26	52	15	27.27	
Baby's weight (g)		3361.23 ± 361.89		3417.60 ± 473.54		$p = 0.05$

increasing the number of participants. We do not know if this is representative of the population group and this greatly compromises the external validity of the study.

To conclude, the practice of an exercise programme using the Pilates method supervised by a professional expert, obtains major improvements in the pregnant woman's physical condition, such as blood pressure, flexibility, spine curvature, and the parameters in birth, with more normal births, fewer episiotomies, less analgesic usage and lower new-born birthweight.

## Conflict of interests

The authors have no conflict of interests to declare.

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