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Physical exercise during pregnancy and its influence on maternal weight gain

El ejercicio físico durante el embarazo y su influencia en la ganancia de peso materno

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Abstract

Objective: To examine the scientific literature on the influence of exercise during pregnancy on maternal weight gain.

Method: We performed a systematic review and meta-analysis of randomized clinical trials.

Results: We analyzed 46 studies and found a positive association between regular and moderate exercise and lower maternal weight gain. The total reduction was 0.28 kg (95% CI, 0.19-0.36; I^2, 68.7%; $P_{heterogeneity}$, 0.001). The studies also showed that a lower number and percentage of pregnant women exceeded their weight gain than controls (RR, 0.85; 95% CI, 0.80-0.90; I^2, 21.7%; $P_{heterogeneity}$, 0.19).

Conclusion: Regular and moderate exercise during pregnancy reduces the risk of excessive maternal weight gain.

Key words:

Exercise.
Pregnancy.
Weight gain.

Resumen

Objetivo: examinar en la literatura científica la influencia del ejercicio físico durante el embarazo en la ganancia de peso materno.

Método: se desarrolló una revisión sistemática y metaanálisis. Se examinaron ensayos clínicos aleatorizados.

Resultados: se analizaron 46 estudios. Se observa de forma general una asociación positiva entre la práctica regular de ejercicio físico moderado y menores ganancias de peso materno, mostrando para el total de estudios una reducción media de 0,28 kg (95% IC = 0,19-0,36, I^2 = 68,7%, $P_{heterogeneidad}$ = 0,001). Asimismo, los estudios muestran una menor cantidad y porcentaje de gestantes que exceden su ganancia de peso durante el embarazo en los grupos de intervención comparados con los de control (RR = 0,85 [95% IC= 0,80-0,90], I^2 = 21,7%, $P_{heterogeneidad}$ = 0,19).

Conclusión: el ejercicio físico regular y moderado reduce el riesgo de una ganancia excesiva de peso materno.

Palabras clave:

Ejercicio.
Embarazo.
Ganancia de peso.

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INTRODUCTION

The health of a mother and her newborn depend to a large extent on pregnancy and labor. This is true both during and after pregnancy. A large body of scientific evidence supports the idea of a strong association between abnormalities during pregnancy and pre-, peri-, and postnatal complications, which affect all areas of the woman and newborn's life (1-4).

In this sense, the most common complications during pregnancy and those that generate the most risks are metabolic complications resulting from excessive maternal weight gain. These include gestational diabetes, hypertension, macrosomia, mood disorders, prolonged labor, risk of cesarean delivery, and asthma, all of which affect the future health of both mother and child in the form of postnatal depression, type II diabetes, and cardiovascular complications (5-11).

Infantile overweight and obesity give cause for concern and may result in part from the lack of control of maternal weight gain (12-14).

With reference to obesity, it is worth mentioning that whereas poor, adequate, and excessive maternal weight gain were traditionally based on limited adjusted gain (9-14 kg) (15), recommended weight gain is currently based on body mass index (BMI) at the start of pregnancy (Table I) (16).

Table I.
Recommended weight gain during pregnancy based on body mass index at the start of pregnancy (16)

Maternal body mass index	Recommended weight gain (kg)
Low weight: < 18.5 kg/m^2	12.5-18
Normal weight: 18.5-24.9 kg/m^2	11.5-16
Overweight: 25-29.9 kg/m^2	7-11.5
Obesity: > 30 kg/m^2	5-9

Data on pregnant women whose weight is higher than recommended (20-50%)(17-18) clearly show that the problem is alarming and complex. It becomes necessary—almost essential—to find and apply safe ways of preventing loss of control of maternal weight gain during pregnancy. This need is reinforced by the fact that many women become pregnant with a high BMI, thus increasing the risk at the start of pregnancy (19-20).

During the last 20 years, physical exercise has proven to have many benefits for pregnant women, with no risk of adverse effects for maternofetal well-being, provided that specific limits are observed for the type and intensity of exercise and for the positions used for load bearing (21).

Although the scientific literature is not conclusive, many studies report positive effects of moderate physical exercise on the outcome of pregnancy and, in particular, for appropriate control of maternal weight gain (22-25).

While the many designs used in studies remain controversial, it is necessary to review highly reliable experimental studies such as randomized clinical trials, which enable us to draw firm conclusions and, therefore, provide wide-ranging scientific evidence.

The objective of the present study was to review the scientific literature to determine the influence of programmed physical exercise during pregnancy on maternal weight gain.

MATERIAL AND METHODS

We performed a systematic review and meta-analysis (26).

Search strategy

We used the SPORTDiscus and PubMed databases, both through Universidad Politécnica de Madrid. The search was started at the beginning of November 2017, and the last update was on February 28, 2018.

The search terms used were as follows:

- Spanish: ejercicio o ejercicio físico o actividad física o deportes y embarazo o ganancia de peso o resultados maternos.
- English: exercise OR physical activity OR sport OR fitness AND pregnancy maternal weight gain OR pregnancy outcomes AND randomized clinical trial.

Inclusion criteria

The main inclusion criterion was for the study to be a randomized clinical trial in which the intervention was some form of quantifiable physical exercise or activity. Another criterion was that the dependent variables assessed should include maternal weight gain during pregnancy assessed in terms of kilograms gained by the pregnant woman or recorded based on the number and percentage of women who exceeded the recommended weight gain.

Endpoints

The main endpoint was maternal weight gain during pregnancy; the secondary endpoint was birth weight.

Data retrieval

The data extracted and recorded for each of the studies examined (Table II) (27-73) were as follows: author(s) and year of publication, country where the study was performed, number of participants, detail of the type of exercise program, main and secondary endpoints analyzed, and cointervention (where applicable).

Statistical analysis

We used a random effects model to determine the sum total of the relative risk (RR) values (74). We established the weighted mean by giving each study a weight relative to its size or number of events contributing to the total of the study (weight), that is, the amount of information that each study provided (26).

In order to quantify the heterogeneity of the results, we used the I^2 statistic, which indicates the percentage of variability observed in the effect of the intervention (between studies) due to the heterogeneity of the studies and not as a random finding. The values considered were as follows: low, 25%; moderate, 50%; and high, 75% (75). In this sense, and in the case of considerable heterogeneity, we can divide the total number of studies into subgroups with the aim of reducing or eliminating heterogeneity (26). In our case, we decided to present the total number of studies examined in each analysis, in the understanding that this gives the study greater perspective and richness.

Evaluation of study quality (risk of bias)

We used the GRADE technique (Grading of Recommendations Assessment, Development and Evaluation)(76); moderate- and high-quality studies were included.

RESULTS

Of a total of 827 articles recovered, 684 were ruled out because they did not fulfill the inclusion criteria (Fig. 1), and 97 were ruled out in a second round owing to repetition or to the fact that despite being randomized clinical trials, their intervention did not involve a physical exercise program but data based on the woman's physical activity obtained using validated questionnaires. The final number of studies analyzed was 46 (Fig. 1).

Influence of physical exercise on maternal weight gain

The analysis included 44 studies. Physical exercise during pregnancy reduced weight by a mean of 0.28 kg (95% CI, 0.19-0.36; I^2, 68.7%; $P_{heterogeneity}$, 0.001). Figure 2 shows a forest plot corresponding to the meta-analysis of the influence of physical exercise on maternal weight gain.

A total of 16 studies were analyzed in this section. The overall effect of physical exercise was observed in the number and percentage of pregnant women who exceeded their weight gain in the intervention groups compared with the control groups in the studies examined. Thus, the total weighted RR was 0.85 (95% CI, 0.80-0.90; I^2, 21.7%; $P_{heterogeneity}$, 0.19). These results show that women who did not participate in an exercise program have a 15% greater probability of excessive weight gain than those who did.

Figure 3 shows a forest plot corresponding to the meta-analysis of the influence of physical exercise on excessive maternal weight gain.

We examined 26 studies. In general, the weight of newborns whose mothers followed a physical exercise program during pregnancy was lower than that of the control group (birth weight, -90 g; 95% CI, -20 g to -160 g; I^2, 24.9%; $P_{heterogeneity}$, 0.12). The results indicate that the mean weight of newborns whose mothers participated in an exercise program was 90 g below that of the mean weight of newborns whose mothers did not participate in an exercise program. Figure 4 shows a forest plot of the meta-analysis of the influence of physical exercise on the weight of the newborn.

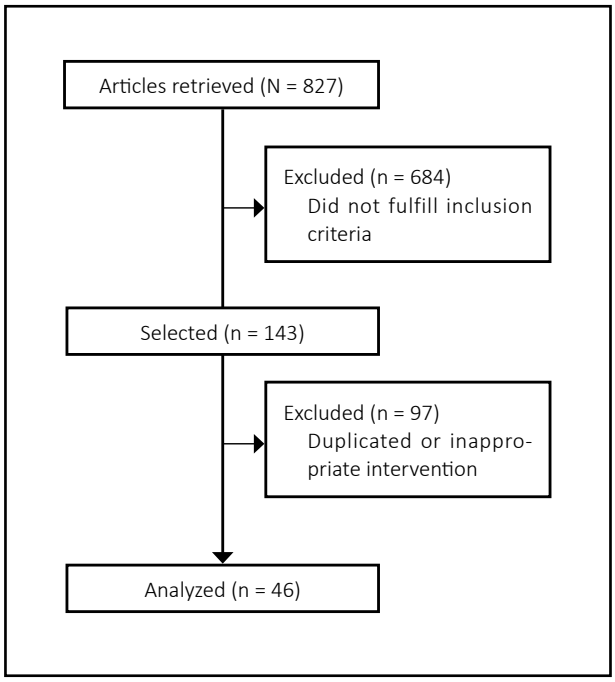

Figure 1. Flow chart for the studies analyzed.

DISCUSSION

The aim of the present study was to determine the influence of physical exercise during pregnancy on maternal weight gain. The results are highly relevant and applicable in clinical practice, given the large number of women who want a physically active pregnancy.

Table II.
Table 2: Characteristics of the studies examined

Ref	Author	Year	Country	N	IG	GC	Intervention. Physical exercise program							Main variables analyzed	Secondary variables analyzed	Co-intervention
							Freq	Intens	Dur	Type	Superv. classes	Duration	Adh.			
27	Garnaes et al.	2018	Norway	91	36	34	3 d/wk	12-15 Esc. Borg	60'	Aerobic + strength	Ind.	20 wk	42 sessions	Postpartum retention	Maternal weight and glucose	No
28	Nobles et al.	2018	USA	241	118	123	Diaria	ND	ND	Walking	Ind. home	12 wk	NA	MWG	Maternal and fetal parameters	No
29	Da Silva et al.	2017	Brazil	594	155	320	3 d/wk	12 - 14 Esc. Borg	60'	Aerobic	Superv. group	> 16 wk	NA	Newborn variables	Maternal variables	No
30	Wang et al.	2017	China	300	112	114	3 d/wk	12-14 Esc. Borg	30'	Aerobic bicycle	Ind. superv.	30 wk	NA	GD	Maternal and fetal parameters	No
31	Bacchi et al.	2017	Argentina	140	49	62	3 d/wk	12-14 Esc. Borg	50-60'	Water program	Superv. group	30 wk	> 85%	MWG	Newborn variables	No
32	Barakat et al.	2016	Spain	840	382	383	3 d/wk	12-14 Esc. Borg	50-55'	Aerobic + strength + flexibility	Superv. group	30 wk	< 70%	GH	Maternal and fetal parameters	No

33	Sagedal et al.	2016	Norway	606	296	295	3 d/wk	12-14 Borg	60'	Aerobic + strength + flexibility	Superv. group	38 sessions	Mean of 14	MWG	Maternal and fetal parameters	Nutritional assessment
34	Garnaes et al.	2016	Norway	91	38	36	3 d/wk	12-15 Borg	60'	Aerobic + strength + flexibility	Group + Ind.	20 wk	NA	MWG and GD	Maternal and fetal parameters	No
35	Perales et al.	2016	Spain	241	83	53	3 d/wk	60% MHR	55-60'	Varied program	Superv. group	30 wk	> 85%	Maternal and fetal variables	Maternal and fetal parameters	No
36	Herring et al.	2016	USA	66	27	29	Daily	NA	NA	Walking	Ind. home	NA	NA	MWG	Maternal and fetal parameters	Personal assessment
37	Seneviratne et al.	2015	New Zealand	NA	37	37	3-5 d/wk	40-59% VO2 peak	15-30'	Aerobic bicycle	Ind. home	67 sessions	NA	Newborn variables	Maternal and fetal parameters	No
38	Perales et al.	2015	Spain	95	38	25	3 d/wk	55-60% HR	55-60'	Varied program	Superv. group	30 wk	> 85%	Cardiac variables	Maternal and fetal parameters	No
39	Perales et al.	2014	Spain	239	83	83	3 d/wk	55-60 MHR	55-60'	Varied program	Superv. group	30 wk	NA	MWG	Maternal variables	No
40	Barakat et al.	2014	Spain	320	138	152	2 d/wk	60-75 % MHR	55-60'	Varied program	Superv. group	30 wk	>85%	Gestational age	Maternal and fetal parameters	No

41	Cordero et al.	2014	Spain	342	101	156	3 d/wk	60% MHR	50-60'	Varied program	Superv. group	25-30 wk	NA	GD	MWG	No
42	Ronnberg et al	2014	Switzerland	445	192	182	NA	NA	NA	Varied exercise	Ind. home	NA	NA	MWG	Maternal variables	No
43	Hui et al.*	2014	Canada	113	30	27	3-5 d/wk	Mod	30-45'	Aerobic + strength + flexibility	Superv. group+ Ind. home	10-16 wk	3 d/wk	MWG and GD	Maternal and fetal parameters	Nutritional assessment
44	Hawkins et al.	2014	USA	68	33	35	Daily	NA	35'	Walking with a pedometer	Ind. home	24 wk	NA	MWG and insulin	Maternal and fetal parameters	Nutritional assessment
45	Barakat et al.	2013	Spain	510	210	218	3 d/wk	8-20 Borg	50-60'	Aerobic + strength + flexibility	Superv. group	30 wk	>85%	GD	MWG	No
46	Ruiz et al.	2013	Spain	926	481	481	3 d/wk	12-14 Borg	50-60'	Aerobic + strength + flexibility	Superv. group	30 wk	>85%	MWG	Newborn variables	No
47	Renault et al.	2013	Denmark	425	130	134	Daily	NA	NA	Walking with a pedometer	Ind. home	NA	NA	MWG	Newborn variables	Dietary intervention
48	Harrison et al.*	2013	Australia	228	106	97	4 sessions	NA	NA	Walking with a pedometer and questionnaire	Ind. home	NA	NA	MWG and GD	Maternal and fetal parameters	Nutritional assessment

49	Oostdam et al.	2012	Holland	121	52	53	2 d/wk	NA	60'	Aerobic + strength	Ind. superv.	NA	NA	Blood glucose and MWG	Newborn variables	No
50	Price et al.	2012	USA	91	31	31	4 d/wk	12-14 Borg	45-60'	Aerobic	Ind. superv.	20 wk	NA	Cardiorespiratory parameters	Maternal and fetal parameters	No
51	Ruchat et al.*	2012	Canada	73	23	45	3-4 d/wk	30-70% MHRHR	50'	Walking program	Ind. superv. + home	21 wk	NA	MWG	Newborn variables	Dietary intervention
52	Cordero et al.	2012	Spain	80	25	30	3 d/wk	12-14 Esc. +Borg	45-60'	Aerobic + strength + flexibility	Superv. group	28 wk	> 85%	GD	Maternal and fetal parameters	No
53	Barakat et al. (a)	2012	Spain	100	40	43	3 d/wk	70 % MHR	35-45'	Aerobic + water program	Superv. group	85 sessions	>85%	MWG and GD	Maternal variables	No
54	Barakat et al. (b)	2012	Spain	320	138	152	3 d/wk	70% MHR	40-45'	Aerobic + strength + flexibility	Superv. group	30-33 wk	>85%	Newborn variables	Maternal variables	No
55	Haakstad et al.	2011	Norway	105	52	53	3-5 d/wk	12-14 Borg	60'	Aerobic + strength	Superv. group	12 wk	<80%	MWG	Weight variables	No
56	Barakat et al.	2011	Spain	80	34	33	3 d/wk	70 % MHR	35-45'	Aerobic + strength + flexibility	Superv. group	30 wk	>85%	Quality of life	MWG	No

57	Hui et al.	2011	Canadá	224	88	102	3-5 d/wk	NA	30-45'	Aerobic + strength + flexibility	Superv. group	10 wk	NA	MWG	GD	Dietary intervention
58	Nascimento et al.	2011	Brazil	82	39	41	NA	Mod	40'	Aerobic	Superv. group + Ind. home	NA	NA	GD	Blood pressure and newborn variables	No
59	Hopkins et al	2011	New Zealand	84	47	37	5 d/wk	65% MHR	40'	Aerobic	Ind. home	NA	NA	Newborn variables	MWG	No
60	Vinter et al.	2011	Denmark	360	150	154	1 d/wk	NA	50 '	1 day class in the gym + pedometer	Superv. group + Ind. home	NA	NA	MWG	Maternal and fetal parameters	Dietary intervention
61	Korpi-Hyövälti et al.	2011	Finland	60	27	27	Daily	12-14 Borg	30-45'	6 sessions with physiotherapist + home	Ind. home + superv. ind.	NA	NA	MWG and GD	Newborn variables	Nutritional assessment
62	Luoto et al.	2011	Finland	399	219	180	800 MET	NA	NA	Increased physical activity	Ind. home	25-30 wk	NA	GD	Maternal and fetal parameters	Nutritional assessment
63	Barakat et al.	2009	Spain	160	72	70	3 d/wk	12-14 Borg	30-45'	Aerobic + strength + flexibility	Superv. group	26 wk	>85%	Newborn variables	MWG	No
64	Calvacante et al.	2009	Brazil	71	34	37	3 d/wk	70% MHR	50'	Water program	Superv. group	25 sessions	NA	Newborn variables	MWG	No

65	Huang et. Al	2009	Taiwan	240	61	64	3 d/wk	NA	NA	Advice on physical activity	Ind. home	20 wk	NA	Postpartum weight retention	MWG	Nutritional assessment
66	Ong et al.	2009	Australia	12	6	6	3 d/wk	50-70% HR	45'	Exercise bicycle	Ind. superv.	10 wk	NA	Maternal glucose	Maternal and fetal parameters	No
67	Sedaghati et al.	2007	Iran	90	40	50	3 d/wk	55-65% HT	60'	Exercise bicycle	Ind. superv.	8 wk	NA	Back pain	Maternal and fetal parameters	No
68	Hui et al.	2006	Canada	52	24	24	3-5 d/ wk	NA	45'	1 Superv. group + home	Superv. group + Ind. home	NA	NA	Study viability	MWG	Dietary intervention
69	Barakat et al.	2006	Spain	142	72	70	3 d/wk	12-14 Escala Borg	45-60'	Aerobic + strength + flexibility	Superv. group	20 wk	NA	MWG, birth weight	Maternal and fetal parameters	No
70	Garshasbi & Faghih	2004	Iran	212	107	105	3 d/wk	< 140 BPM	60'	Aerobic	Superv. ind	12 wk	<94	Back pain	MWG	No
71	Polley et al.*	2002	USA	120	30	31	NA	NA	NA	Recommendation for walking	Ind. home	NA	NA	MWG	Maternal and fetal parameters	Nutritional assessment
72	Marquez-Sterling et al.	2000	USA	20	9	6	3 d/wk	120-156 MHR	60'	Aerobic	Ind. superv.	15 wk	NA	Lactate	MWG	No

Abbreviations: Adh, adherence; Borg, Borg Scale; Freq, frequency; Dur, duration; MET, multiples of resting metabolic equivalents; MHR, maternal heart rate; MWG, maternal weight gain; CG, control group; GD, gestational diabetes; GH, gestational hypertension; IG, intervention group; Ind, individual; Intens, intensity; NA, not available; Rf, reference; Superv, supervised.

**Studies where the analysis of results is divided according to one of the characteristics of the sample.*

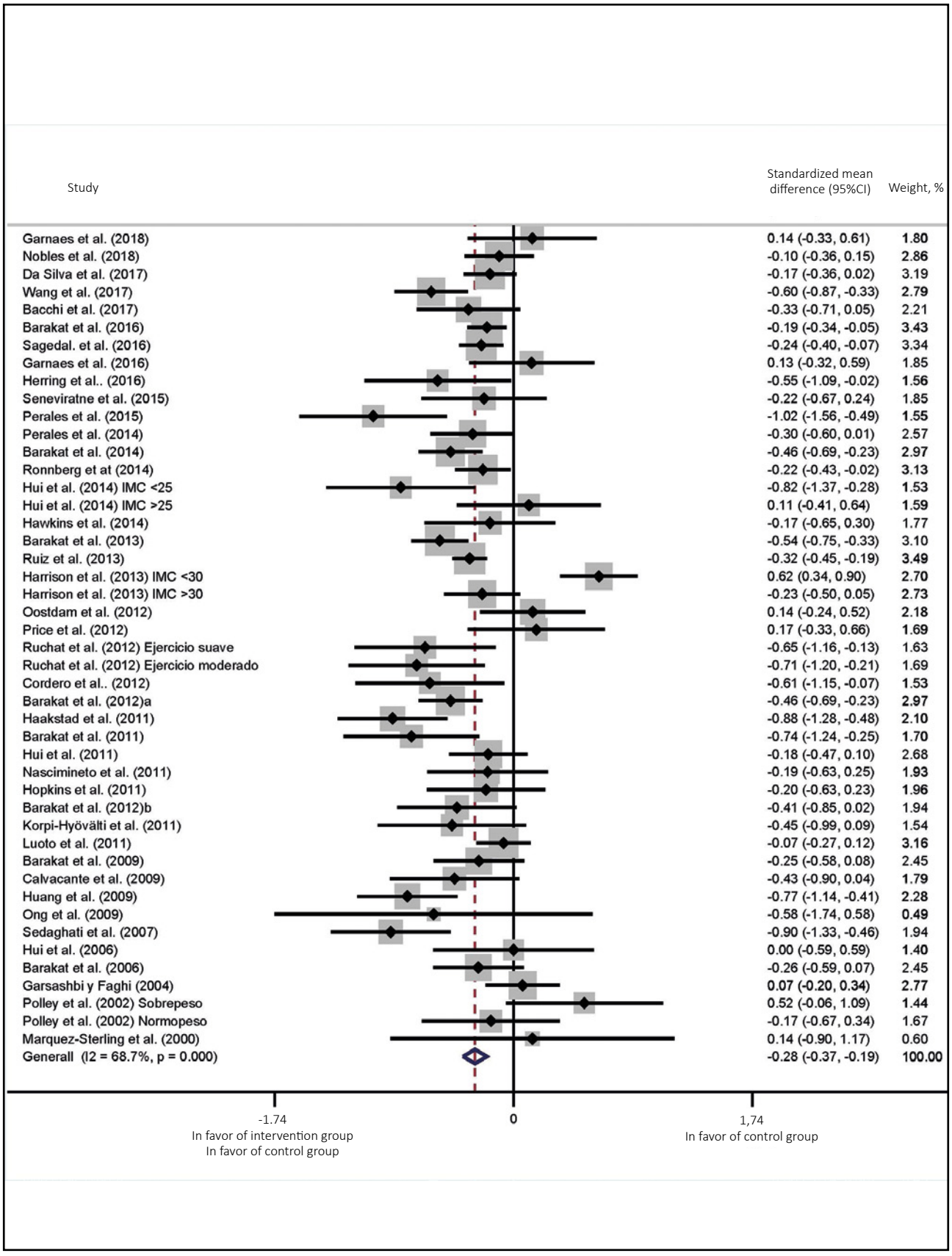

Figure 2. Meta-analysis of the effect of programmed physical exercise during pregnancy on maternal weight gain.

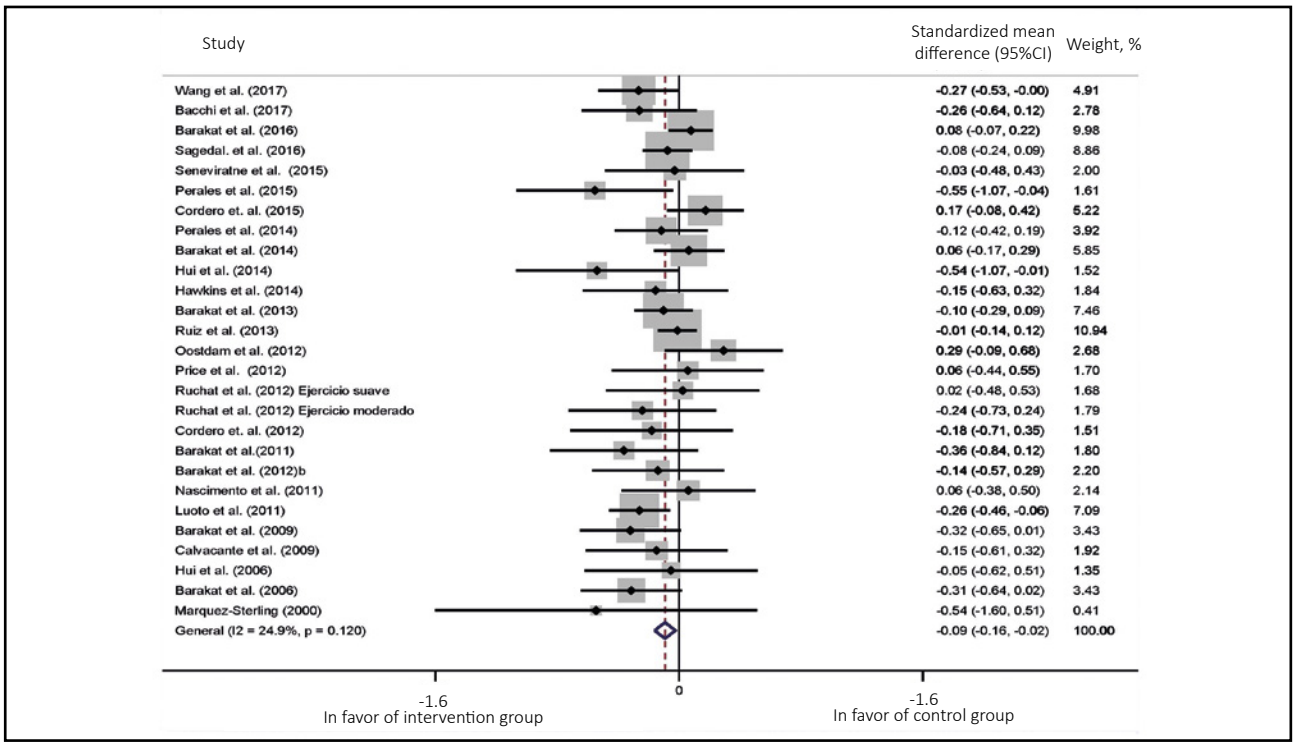

Figure 3. Meta-analysis of the effect of a physical exercise program during pregnancy on excessive maternal weight gain.

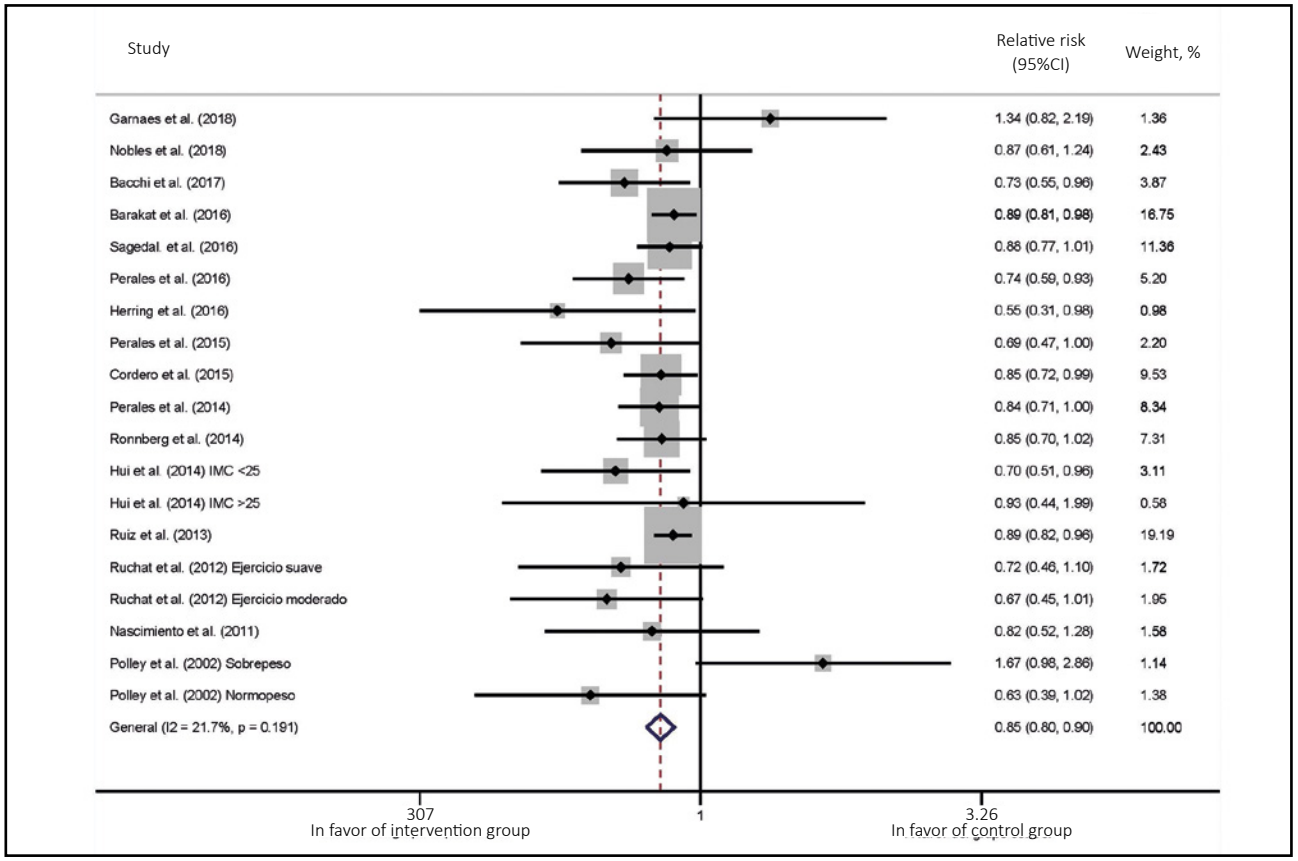

Figure 4: Meta-analysis of the effect of a physical exercise program during pregnancy on newborn weight.

Overall, our results show a positive association between physical exercise during pregnancy and better control of maternal weight gain. This can be seen both in the total weight gained (in kg), a factor for which many studies report lower gains in the intervention group (Fig. 2), and in the number of women whose gain exceeds recommendations, a factor for which most studies also report lower percentages of pregnant women (with excessive gains) in physical exercise groups than in control groups (Fig. 3).

Of particular interest is the study of 962 healthy pregnant women by Ruiz et al in 2013 (46), where this tendency was clearly observed in pregnant women who were normal weight before pregnancy; in those with overweight or obesity, on the other hand, the tendency was attenuated, possibly indicating a lower potential effect of physical exercise in obese persons.

A relevant aspect in the studies analyzed was the type of intervention used. This is undoubtedly a key element with respect to adherence to a program and, at the same time, a criterion of the quality of the clinical trial performed. In this sense, while 19 studies (29,31,33,35,38-40,42,46,47,49,52,55,61,63-66,69) presented a group intervention based on a controlled physical exercise program supervised by a professional, 27 had an individual program that was supervised or simply based on recommended physical activities that the woman performs autonomously (27,28,30,34,36,37,41,43-45,48,50,51,53,54,56-60,62,67,68,70-73); this difference may diminish the validity and reliability of the "physical exercise" variable.

The literature contains studies similar to the present one carried out in a similar setting by means of systematic reviews (alone) or meta-analyses (77-83).

The conclusions of these studies generally tend to interpret physical exercise as a valid approach to controlling excessive weight gain during pregnancy (77-81), although other studies do not reach the same conclusion, thus revealing this topic to be somewhat controversial.

Of note among the former is a recent meta-analysis of 65 clinical trials including 11,444 pregnant women. The authors concluded that a program for diet, exercise, or both together could reduce the risk of excessive maternal weight gain during pregnancy (81).

However, the review by Nascimento et al (81) (2011) of 10 randomized clinical trials shows that only 3 trials report a positive association between physical exercise and better control of maternal weight gain (82).

Along the same lines, a recent systematic review found few evaluable effects of interventions with physical exercise during pregnancy in the control of maternal weight gain (82). The authors stated that this was due in part to low adherence in the studies analyzed.

As for the present study, the data obtained make it possible to conclude that the use of physical exercise throughout pregnancy reduces the risk of excessive maternal weight gain. Therefore, exercise can be considered to be a valid approach for ensuring adequate control of weight in healthy pregnant women.

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