



Published in final edited form as:

Am J Lifestyle Med. 2013 January 1; 7(1): . doi:10.1177/1559827612446416.

Strategies to Promote Physical Activity During Pregnancy:

A Systematic Review of Intervention Evidence

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Abstract

Physical activity during pregnancy has been associated with significant health benefits, however most women in the United States do not meet current guidelines. This systematic review evaluates evidence for interventions to improve physical activity during pregnancy in order to identify best practices and inform future research. Electronic databases (PubMed, CINAHL, SportDISCUS, Embase, ERIC, Psych Info and ISI Web of Science) were searched in July 2011 for peer-reviewed journal articles. Studies were included if they were English-language randomized control trials that measured the efficacy of an intervention targeted to pregnant women and designed to change physical activity as a primary or secondary outcome. Out of 777 studies identified through the systematic search, nine interventions were identified for inclusion by multiple reviewers. Data was abstracted using an abstraction form modeled after the "Guide to Community Preventive Services." Of the nine interventions included in the review, three reported statistically significant positive results for physical activity. While interventions included a variety of strategies and techniques, none were uniquely associated with positive outcomes. Overall this review suggests that little is known about the efficacy of interventions for physical activity during pregnancy. We provide several recommendations for future research and intervention design.

Keywords

pregnancy; exercise; physical activity; intervention; theory; review; randomized control trial

INTRODUCTION

Lack of physical activity (PA) is a problem for women across all age groups^{1,2}, but is a particular concern for women during pregnancy³⁻⁶. Moderate to vigorous PA during pregnancy has been linked to better health outcomes for mothers and their children⁷⁻¹² and can be protective against the development of chronic illness¹³⁻¹⁵. In recognition of the

importance of PA during pregnancy, the American College of Obstetricians and Gynecologists (ACOG) released guidelines in 2002 advising pregnant women to engage in at least 150 minutes of moderate intensity PA each week¹⁶. These guidelines were supported in 2008 by the United States Department of Health and Human Services “Physical Activity Guidelines for Americans”¹⁷. However, despite the significant health benefits of PA during pregnancy, only 15% of pregnant women meet the minimum national recommendations for the 150 minutes of moderate intensity aerobic activity per week³.

In light of evidence for the benefits of PA during pregnancy and the low percentage of women attaining recommended levels of PA, medical practitioners and public health professionals have been working to promote PA behavior change using a variety of strategies. Several systematic reviews have focused on PA during pregnancy as a strategy to influence other health outcomes, such as gestational weight gain, pre-eclampsia, gestational diabetes, and birth weight^{8,9,18–23}. However, we located no published systematic reviews of behavioral interventions targeting PA during pregnancy as the primary outcome. The aim of this paper was to conduct a systematic review of the literature on behavioral interventions designed to improve PA among pregnant women. The primary goals of this review were to identify effective PA promotion intervention strategies for pregnant women, help guide future intervention design, and build a common literature for professionals who work with women to promote PA during pregnancy.

METHODS

Selecting Articles for Review

Electronic databases (PubMed, CINAHL, SportDISCUS, Embase, ERIC, Psych Info and ISI Web of Science) were searched in July 2011 for peer-reviewed articles. Given that many relevant articles have been published recently, no limit terms were used in the search that could omit articles not yet indexed in PubMed. Four search filters were combined to search each database: one for interventions with pregnant populations, one for interventions focused on PA, one for interventions focused on health beliefs, and one to specify a randomized control trial design (Figure 1). Reference lists of three previous reviews of intervention literature related to PA during pregnancy were searched manually for additional references and used to test the search strategy^{8,24,25}.

Inclusion criteria—Studies were included if they were English-language randomized control trials that measured the efficacy of an intervention designed to change PA behavior in pregnant women. PA behavior could be measured as a primary or secondary outcome. Articles that were not randomized control trials and/or were specifically designed for postpartum women only were excluded, as were articles where PA behavior or intention was not measured at baseline and follow-up. Exercise training studies in which PA performance was required as the intervention strategy were also excluded, as the intention of this review was to provide an overview of strategies that encourage elective, non-mandatory, PA.

Search results and screening—After removing duplicate articles, this search identified 777 unique publications. Titles, abstracts, and full-texts of articles were then screened sequentially against inclusion criteria by E.E.P. Articles remaining in the full-text stage (n=19) were dual-reviewed for inclusion by E.E.P. and K.R.E. Eleven articles were eligible for inclusion in the review (Figure 2). Two sets of papers, Luoto et al. 2010 and 2011 and Yeo et al. 2008 and 2009, reported on the same dataset and were combined in the abstraction process^{26–29}. For simplicity, subsequent references to these interventions include only the most recent paper.

Data abstraction

Fifty-three components were abstracted from each article using a data abstraction form modeled after the “Guide to Community Preventive Services: Systematic Reviews and Evidence-Based Recommendations” developed by the Task Force on Community Preventive Services³⁰. Data was extracted by E.E.P. and was independently checked by K.R.E. and D.S.D. Inter-coder agreement was high and disagreements were resolved through consensus.

Population characteristics—Population characteristics abstracted included information on sample size, population demographics, socioeconomic status, age, parity, stage of pregnancy, and country context.

Intervention strategy characteristics—Intervention strategy characteristics abstracted included overall description of intervention techniques designed to impact PA behavior. Intervention types were first broadly categorized within one or more of the following groups: provision of information only, behavioral intervention, environmental intervention, legislation/regulation, clinical, public health or medical care system intervention, high risk target population, general target population, physical environment focus, and social environment focus. More detailed information about the intervention, including setting, particular techniques used, incentives, and timing, was then described qualitatively. Using information from the qualitative description of the intervention, techniques were further sub-categorized following Gardner et al. and Mitchie et al., into one or more of the following eight groups: information, instruction, feedback, problem-solving, reward, self-monitoring, goal-setting, and modeling^{25,31} (Table 1).

In addition to a basic intervention description, ten additional items in the abstraction form coded information on eligibility criteria, mode and setting of delivery, duration of intervention, data collection methods, setting, and schedule, feasibility and implementation, intervention components, and the theoretical basis for intervention design.

Methodological characteristics—Methodological characteristics abstracted included information on study design, power analysis, measurement of PA and other outcomes, data collection schedule, statistical analyses, and process evaluation. Presence of a power analysis was coded as either yes or no, measurement of PA was coded as one or more of the following: self-administered questionnaire, laboratory test, record review, attendance, and other, and was also assessed qualitatively. The qualitative assessment included more detailed information on the measurement tools, including evidence of the validity and reliability of the research instrument. The data collection schedule was assessed qualitatively. Presence of appropriate statistical analyses was coded as yes, no, or unknown/did not report, and then further assessed qualitatively. Presence or absence of process evaluation and other implementation information was indicated by both coded and qualitative responses to a question about feasibility issues addressed in the paper.

Outcome data—The outcome of interest was PA performance or intention. Outcome data abstracted included information on effect size, statistical significance, sample size, and attrition. The majority of outcome information was coded to indicate presence or absence and then described qualitatively to assess possible threats to validity. We considered an intervention to have an effect if there was a statistically significant ($p < 0.05$) difference between intervention and control groups and a statistically significant positive effect size reported for the intervention group between baseline and follow-up PA measurements.

Validity measures—Validity measures abstracted included information on internal validity, external validity, and statistical conclusion validity³². Specifically, the abstraction form contained 23 items that coded components relevant to validity, including selection bias, study design, sample size, inclusion criteria, power analysis, success of randomization, attrition, baseline comparisons of intervention and control groups, validity and reliability of measures, and use and reporting of statistical analyses. Measurement instruments were considered valid if the study reported having validated the measure or cited other evidence for validity.

RESULTS

Nine unique interventions were reported in the eleven studies that were included in the analysis (Table 2). All studies were randomized controlled trials where participants were randomly assigned to intervention or control groups.

Study characteristics—A total of 1506 pregnant participants were included in the nine interventions. Four of the nine interventions were conducted in the United States^{28,33–35}. Five interventions focused on high risk groups, which included women with gestational diabetes^{26,33}, obese or sedentary women^{28,36}, and women in need of substance abuse treatment³⁵. Of the studies reporting participant race (n=7), three were majority white populations^{28,36,37}, two were majority Asian populations^{33,39}, one was majority African American³⁴, and one was majority Canadian Aboriginal³⁸.

Out of all the studies reviewed only two focused on PA as the primary intervention target^{37,38}. Other primary targets included gestational weight gain^{33,34,36,39}, gestational diabetes mellitus^{26,38}, and pre-eclampsia²⁸. All studies measured PA using self-report questionnaires. Four studies included additional measures of PA, including pedometers^{28,38}, heart rate monitors²⁸, and daily exercise logs or diaries^{26,33,38,39}.

All studies randomized participants into at least two groups. Most control groups were usual care controls^{26,34–39}. In one study the control group received printed materials about GDM and newsletters about health and infant safety³³. Another study had two control groups, one usual care and one that received a brochure about diet³⁷. In one study the control group received the same number of counseling sessions as the intervention group, but did not receive PA content in the sessions³⁵. One study had two intervention groups in addition to a control group, one that received counseling and a brochure, and one that received a brochure only³⁶. Finally, one study compared the effects of two different interventions, randomizing participants into either walking or stretching programs²⁸.

Intervention Strategies and Techniques—The majority of the interventions were delivered primarily or entirely in a clinical setting^{26,33–34, 36,37,39}. Other settings included a university exercise lab²⁸, home^{28,33,38}, gym³⁸, and a community-based substance abuse treatment facility³⁵. Four interventions were delivered in more than one setting^{26,28,33,38}. Interventions were delivered by exercise specialists^{26,28,38}, trained nutritionists^{33,36}, trained nurses^{26,39}, computers³⁴, motivational interviewing specialists³⁵, and academic researchers³⁷. Duration of interventions ranged from one week³⁷ to one year³⁹.

Four of the interventions were based on one or more health behavior theories or models: including the transtheoretical model or “stages of change”^{26,33–34}, the social cognitive theory³³, protection motivation theory³⁷, and social support²⁶. All interventions citing the transtheoretical model used the theory to tailor content to an individual participant’s readiness to change. For all other theories, constructs were used as a basis for general intervention content.

The interventions offered a variety of strategies and techniques intended to promote PA. General strategies included PA counseling by telephone³³, via computer-based “video doctor”³⁴, and/or in person^{26,33,35,36,39}, brochures^{26,36,37}, PA self-monitoring diaries^{26,33,39}, VHS or DVD exercise instruction³⁸, and individual²⁸ or group^{28,38} exercise instruction. Specific techniques included information^{26,28,33–39}, goal-setting^{26,33,37,39}, feedback^{26,28,33–35,38,39}, instruction^{26,28,38}, modeling^{28,38}, rewards²⁸, problem-solving^{33,36,39}, and self-monitoring^{26,33,38,39}.

Validity of findings—While three of the nine interventions indicated positive, statistically significant effects on PA outcomes, studies varied in the degree to which validity of their findings could be established.

Of six the studies showing no effect, only three presented evidence for most items assessing validity criteria^{27,28,36}, and none met the full criteria. Specifically, none of the six studies were powered on PA behavior, two had no power calculation included in the article^{33,35}, one had a small sample size ($n < 100$)²⁸, two reported high attrition during the intervention (20% and 35%, respectively)^{33,36}, two reported evidence of differential attrition between intervention and control groups^{33,34}, two did not report a test for significant differences between groups at baseline^{34–35}, one found significant differences between groups on smoking and income at baseline, but did not control for them in the analysis³⁴, and all but one²⁸ used self-report questionnaires to measure PA, with only three reporting that the measure had been validated with pregnant populations^{26,33,36}.

Of the three studies showing significant effects, all presented stronger evidence for validity than studies showing no effect, but none met the full criteria. Specifically, none of the studies were powered on PA behavior, two had small samples sizes ($n < 100$)^{37,38}, two reported high attrition (29% and 24%, respectively)^{37,39}, and all used self-report questionnaires to measure PA, with only one reporting that the measure had been validated with pregnant populations³⁸.

Overall effectiveness—Of the ten interventions included in the review, only three reported statistically significant differences between the intervention and control groups^{37,38,39}. One additional study reported a statistically significant difference between baseline and follow-up for the intervention group, but did not find significant differences between the intervention and control groups, both of which improved in PA performance³⁴. This suggests improvements in PA were due to a secular trend that affected both groups and should not be attributed to the intervention.

The three studies reporting significant intervention effects had a variety of methods of PA measurement and a range of effect sizes for intervention groups between baseline and follow-up. Gaston (2009) and Hui (2006) measured PA in minutes per week and reported relatively small effect sizes: 8.6 metabolic equivalent (MET) min/wk³⁷ and 0.77 min/wk³⁸, respectively. Huang (2011) measured PA on a 4-point scale (1=never, 2=sometimes, 3=often, 4=rarely) and reported a 2.45-point increase in average PA scores³⁹.

The duration of effective interventions ranged from one week³⁷ to one year³⁹ and varied in dose from one session lasting less than one hour³⁷ to six 30-minute sessions³⁹. Only one intervention was theory-based, using protection motivation theory³⁷. Intervention strategies included brochures^{37,39}, PA counseling as part of regular prenatal care visits³⁹, and group exercise instruction in-person and on VHS or DVD³⁸. Specific intervention techniques in the studies demonstrating positive effects included information^{37–39}, goal setting^{37,39}, problem-solving³⁹, feedback^{38,39}, self-monitoring^{38,39}, instruction³⁸, and modeling³⁸.

DISCUSSION

The purpose of this systematic review was to report evidence for behavioral intervention strategies to encourage PA behavior during pregnancy from randomized controlled trials. Nine unique interventions were assessed. Overall our findings suggest that little is known about the efficacy of interventions for PA during pregnancy. Three interventions reported having a positive effect on PA during pregnancy, and interventions employed a variety of strategies and specific program techniques for behavior change (Figure 3 and Figure 4). The most commonly used strategy was PA counseling, with and without take-home brochures (featured in six interventions). The most common intervention techniques were provision of information on PA during pregnancy (nine interventions) and feedback on PA performance (seven interventions). However, we found no unique strategies or techniques consistently associated with positive outcomes.

In addition to the similarity of intervention strategies in effective and ineffective interventions, elements of study design limited our ability to assess the validity of findings. Interventions that did not report an effect either had no power calculation^{33,35} or were not powered on PA outcomes^{26,28,34,36}, suggesting they might not have adequate statistical power to detect changes in PA. This could have contributed to Type II error, or failing to find an effect when it was present. Of the three studies reporting significant results, only one³⁹ achieved the required sample size as indicated by a power calculation. The small sample sizes may have decreased the effectiveness of the randomization process. Ineffective randomization could contribute to Type I error, or finding an effect that was actually due to bias. Possible types of bias in terms of threats to internal validity included differential attrition and selection, which could be assessed if differences between groups were measured at baseline. One study³⁵ did not report testing for baseline differences between intervention and control groups, but all other studies tested for and did not find significant differences between groups. This suggests that threats to internal validity were minimized in most studies by effective randomization. Only three studies^{26,33,38} reported using a PA measurement questionnaire that had evidence for validity among pregnant women. This suggests that the measures pose a threat to statistical conclusion validity.

In terms of external validity, while the interventions overall included diverse samples, none of the three effective studies focused on high risk populations. Of the interventions in this review, only four were delivered in the United States^{28,33-35}. Because policies impacting access to prenatal care, usual care procedures, and norms of PA vary between countries, it is not possible to generalize most studies to the United States context.

RECOMMENDATIONS

Due to limitations of study designs, the outcomes of several intervention trials included in this review are uncertain. Absence of major differences in content and delivery of effective interventions compared to ineffective interventions further underscores a lack of understanding of “what works”. Below we offer some suggestions for future research.

- Design interventions to include strategies suggested by formative research with pregnant women⁴¹⁻⁴⁴.
- Expand intervention targets beyond pregnant women to include other “key players”, such as medical providers, family members, and social networks⁴⁵⁻⁴⁷.
- Consider the social ecological framework by expanding intervention focus beyond the individual level to target interpersonal, community, and population/policy levels⁴⁸.

- Design interventions using health behavior theories and models demonstrated to be relevant to pregnant populations, such as the transtheoretical model^{49–52}, social cognitive theory^{49,52–54}, social support^{49,55}, theory of planned behavior^{4,56,57}, social ecological model^{4,45,52}, the life course framework^{1,58,59}, and the health belief model⁴⁵.
- Strengthen study designs by using power calculations based on PA effect size estimates, inflating sample size requirements to take into account attrition rates, and measuring and accounting for baseline differences between groups.
- Increase generalizability of evidence to minority and high-risk populations by including these groups in the intervention.
- Improve retention rates during the study by limiting participant burden in data collection and by providing incentives of interest to pregnant women⁶⁰.
- Improve assessment of PA by using a combination of self-report and objective assessments that have evidence for validity and reliability among pregnant women.
- Conduct studies that are replicable.
- Consider partnerships with local businesses, insurance providers, or non-profits to provide vouchers, prizes, or other types of compensation and widen the sphere of community involvement.

CONCLUSION

Despite the significant health benefits of PA during pregnancy, most women in the United States do not meet PA minimums set by current guidelines³. In recognition of the public health importance of PA behavior during pregnancy^{3,5,6}, interventions to improve PA in this population have been designed and evaluated. In our review of those interventions, few had significant impact on PA behavior or intention and methodological weaknesses decreased the validity of study results. The findings of this systematic review underscore the need for further research to effectively design and evaluate interventions to promote PA during pregnancy. The recommendations provided here are intended to help guide practitioners and researchers considering intervention strategies to impact this important public health issue.

Acknowledgments

The authors wish to thank Kathleen A. McGraw at the University of North Carolina at Chapel Hill Health Sciences Library for her helpful assistance in assembling the search terms for this review and the anonymous reviewers for their feedback. Kelly Evenson was funded by the National Institutes of Health (NIH) / National Cancer Institute (#CA109804-01). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

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(Pregnancy[MeSH] OR pregnancy[tw] OR
maternity[tw])

AND (exercise[MeSH] OR exercis*[tw] OR motor
activity[MeSH] OR physical activity[tw])

AND (motivat*[tw] OR health education[mesh] OR
health education [tw] OR intervention*[tw] OR
program*[tw] OR counsel*[tw])

AND (clinical trial[MeSH] OR clinical trial*[tw]
OR randomi*[tw] OR evaluat*[tw] OR meta-
analysis[tw])

Figure 1.
Search Terms and Strategy*
*MeSH=Medical Subject Headings; tw=text word

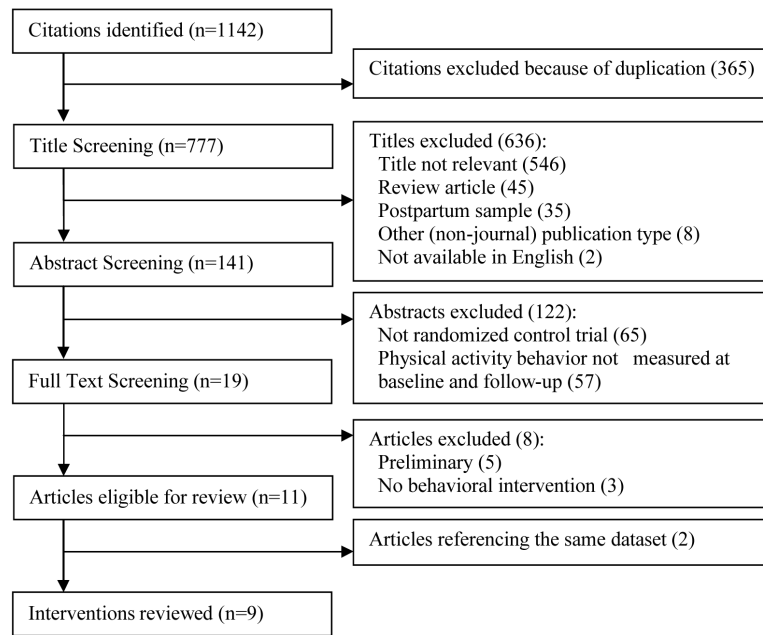


Figure 2.
Article Selection Process

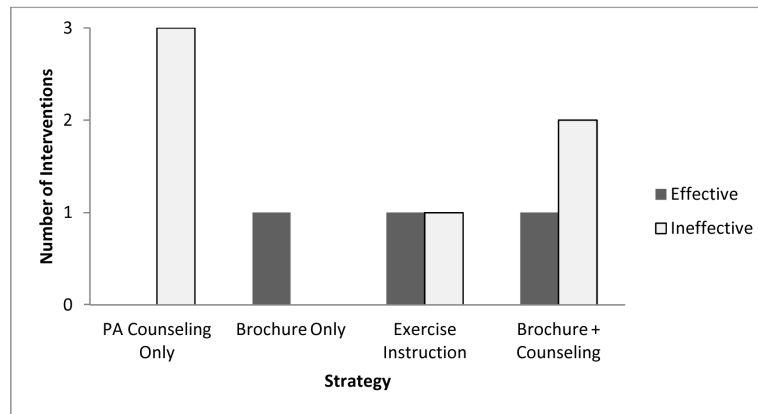


Figure 3.
Effective and Ineffective Intervention strategies*

*Intervention strategies were considered effective if the study reported a statistically significant ($p < 0.05$) difference between intervention and control groups and a statistically significant positive effect size reported for the intervention group between baseline and follow-up PA measurements.

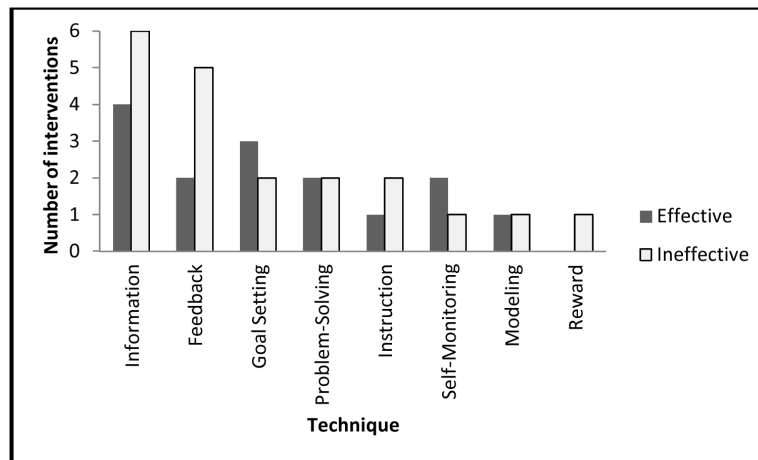


Figure 4.
Effective and Ineffective Intervention Techniques*

* Intervention techniques were considered effective if the study reported a statistically significant ($p < 0.05$) difference between intervention and control groups and a statistically significant positive effect size reported for the intervention group between baseline and follow-up PA measurements.

Table 1Definition of Intervention Techniques, Adapted from Mitchie et al.²⁶

Component	Definition
Information	Provides information on the consequences of a behavior in general
Instruction	Tells the person how to perform a behavior either verbally or in writing
Feedback	Provides a person with data about his or her own recorded behavior
Problem-Solving	Prompts the person to think of potential barriers and identify ways of overcoming them
Reward	Provides rewards contingent on effort or progress towards behavior
Self-Monitoring	Asks the person to keep a record of specified behavior(s) as a method of changing behavior
Goal-Setting	Encourages the person to make a behavioral resolution
Modeling	Shows the person how to perform a behavior

Table 2

Interventions included in review, N=9

Reference	Sample characteristics	PA Measure	Theory*	Intervention Summary	Findings
Ferrara et al. ³³ <i>Intervention</i> <i>Target: Gestational Weight Gain, PA</i> <i>Country: USA</i>	n=163 <i>Population:</i> Pregnant women with GDM <u>Intervention Group</u> n=72 Age:21–30+, 78% > 30 Race:49% Asian, 20% White, 20% Latina, 11% Other <u>Control Group</u> n=91 Age:21–30+, 75% > 30 Race:55% Asian, 20% White, 20% Latina, 5% Other	7-day PA recall	TTM;SCT	<i>Description:</i> Intervention in three phases: prenatal, postpartum, and maintenance. In the prenatal and postpartum phase the experimental group received in-person and telephone counseling; control group received printed materials about GDM and newsletters about health and infant safety. In the maintenance phase the experimental group received telephone counseling and the control group received nothing. Women in the experimental group were given self-monitoring diaries for PA and diet. <i>Recommended PA:</i> 150 min/wk MPA <i>Setting:</i> Clinic/Home <i>Delivered by:</i> Trained dietitians <i>Number of sessions:</i> 3 in-person, ~ 15 phone <i>Duration of sessions:</i> ~1 hr in-person, ~32 min phone <i>Duration of intervention:</i> 12 months	<i>Summary:</i> No significant differences between intervention and comparison groups
Gaston and Prapavessis ³⁷ <i>Intervention</i> <i>Target: PA, PMT factors, PA intention</i> <i>Country: Canada</i>	n=70 <i>Population:</i> Pregnant women <u>Intervention Group</u> n=22 Age:19–38 Race:78% White, 22% Other <u>Control Group 1</u> n=27 Age:15–40 Race:76% White, 24% Other <u>Control Group 2</u> n=21 Age:15–36 Race:78% White, 22% Other	Godin Leisure-Time Exercise questionnaire score (7-day recall of times/wk PA MET-min 30)	PMT	<i>Description:</i> Women were randomly assigned to three groups: Intervention group received an educational brochure on exercise during pregnancy designed using Protection Motivation Theory, the attention control group received a brochure about diet, and the usual care control group received no intervention. <i>Recommended PA:</i> 30-min of MVPA/4×/wk <i>Setting:</i> Clinic <i>Delivered by:</i> Academic researcher <i>Number of sessions:</i> 1 <i>Duration:</i> Not reported <i>Duration of intervention:</i> 1 week	<i>Summary:</i> Significant increase in PA in intervention group compared to both attention control and usual care control groups. <i>Effect Size:</i> +8.6 MET-min/wk, p < .05
Guelinckx et al. ³⁶ <i>Intervention</i> <i>Target: Gestational Weight Gain, diet/nutrition, PA</i> <i>Country: Belgium</i>	n=122 <i>Population:</i> Obese pregnant women <u>Intervention Group1</u> n=37 Age: 24–32 Race: 100% White <u>Intervention Group2</u> n=42 Age: 25–33	Baecke questionnaire score	No theory described	<i>Description:</i> Women were randomized into three groups: usual care, passive intervention, or active intervention. The passive group received a brochure on nutrition and on PA to limit pregnancy-related weight gain. The active group	<i>Summary:</i> No significant differences between intervention and comparison groups

Reference	Sample characteristics	PA Measure	Theory*	Intervention Summary	Findings
	Race: 100% White <u>Control Group</u> n=43 Age: 25–34 Race: 100% White			received the brochure and group counseling. Sessions included information on diet and PA with techniques for behavior change. <i>Recommended PA:</i> Not specified <i>Setting:</i> Clinic <i>Delivered by:</i> Trained nutritionist <i>Number of sessions:</i> 3 <i>Duration:</i> 1 hr <i>Duration of intervention:</i> ~ 6 months	
Huang et al. ³⁹ <i>Intervention</i> Target: Gestational Weight Gain, PA Country: China (Taiwan)	n=189 <i>Population:</i> Taiwanese women <u>Intervention Group</u> n=61 Age: 27–37 Race: 100% Asian <u>Control Group</u> n=64 Age: 27–37 Race: 100% Asian	Health-Promoting Lifestyle Profile (HPLP), Chinese version: cumulative score from 5-item PA measure on a 4-point scale	No theory described	<i>Description:</i> The prenatal intervention included PA counseling as part of regularly scheduled clinic visits and a brochure on PA. Participants designed an individualized PA education plan and kept records of self-monitored PA. Women whose weight exceeded recommended levels were given an additional assessment of current PA, problem-solving, and goal setting. The control group received routine care, which included received a leaflet about exercise during pregnancy. PA was measured at baseline at again 6 months postpartum. <i>Recommended PA:</i> Not reported <i>Setting:</i> Clinic <i>Delivered by:</i> Trained nurse <i>Number of sessions:</i> 6 <i>Duration:</i> ~ 30 min <i>Duration of Intervention:</i> ~ 12 months	<i>Summary:</i> Significant increase in PA score in intervention group compared to control. <i>Effect Size:</i> +2.45 points, p<.05
Jackson et al. ³⁴ <i>Intervention</i> Target: PA, diet/nutrition, Gestational Weight Gain, knowledge of Gestational Weight Gain Country: USA	n=287 <i>Population:</i> Pregnant women <u>Intervention Group</u> n=134 Age: Not Reported Race: 24% African American, 16% Asian, 12% White <u>Control Group</u> n=153 Age: Not Reported Race: 23% African American, 13% Asian, 13% White	PA min/wk: score from 2 items as part of a 41 item scale	TTM	<i>Description:</i> Intervention group received a Video Doctor counseling session, including in-depth behavioral risk assessment, tailored counseling messages, and printed output for both the patient and clinician. An actor-portrayed Video Doctor provided information on exercise, nutrition and weight gain using Motivational Interviewing. Usual care control. <i>Recommended PA:</i> 30 min/day most days of the week <i>Setting:</i> Clinic <i>Delivered by:</i> Computer <i>Number of sessions:</i> 2 <i>Duration:</i> ~15 min	<i>Summary:</i> Significant increase in PA in intervention group, but no significant differences between intervention and control group. <i>Effect Size:</i> +28 min/wk, p<0.05

Reference	Sample characteristics	PA Measure	Theory*	Intervention Summary	Findings
Kropp et al. ³⁵ <i>Intervention</i> <i>Target: Prenatal care attendance, diet/nutrition, PA</i> <i>Country: USA</i>	n=152 <i>Population:</i> Pregnant women in need of substance abuse treatment <i>Age:</i> 26 (mean) <i>Race:</i> Not reported Number assigned to intervention and control groups not reported	Number of days/week 20 min of MPA achieved: RA administered interview	No theory described	<i>Duration of Intervention:</i> 1 month <i>Description:</i> Participants were randomly assigned to treatment with motivational enhancement therapy for pregnant substance users (MET-PS) or control treatment as usual. The MET-PS groups received counseling that included discussion of substance abuse and personalized feedback about engagement in behaviors for a healthy pregnancy, including PA. The control group received the same number of counseling sessions. Counseling sessions were recorded to discern differences between messages received by treatment and control groups. <i>Recommended PA:</i> 20 min/day MVPA <i>Setting:</i> Community-based substance abuse treatment program <i>Delivered by:</i> MET technician <i>Number of sessions:</i> 3 <i>Duration:</i> 1–2 hrs <i>Duration of Intervention:</i> 1 month	<i>Summary:</i> No significant differences between intervention and comparison groups
Luoto et al. ^{26,27} <i>Intervention</i> <i>Target: Gestational Diabetes, Gestational Weight Gain, diet/nutrition, PA, quality of life</i> <i>Country: Finland</i>	n=399 <i>Population:</i> Women at high risk for GDM <u>Intervention Group</u> n=219 <i>Age:</i> 26–34 <i>Race:</i> Not reported <u>Control Group</u> n=180 <i>Age:</i> 25–35 <i>Race:</i> Not reported	MET min/wk: Leisure Time Physical Activity Questionnaire	Stages of Change; Social Support	<i>Description:</i> Intervention group received PA counseling at regular prenatal care visits and booklet about PA during pregnancy. Counseling tailored to individual needs using a personalized card with weekly action plan and review of weekly exercise logs. Optional participation in five monthly group meetings, including group exercise. <i>Recommended PA:</i> 800 MET-min/wk <i>Setting:</i> Clinic and off-site <i>Delivered by:</i> Nurse (Counseling), Physiotherapist (Group meetings) <i>Number of sessions:</i> 5 <i>Duration:</i> 15–30 min <i>Duration of Intervention:</i> ~6 months	<i>Summary:</i> No significant differences between intervention and comparison groups
Yeo et al. ^{28,29} <i>Intervention</i> <i>Target: Weight, heart rate, blood pressure, PA</i> <i>Country: USA</i>	n=79 <i>Population:</i> Sedentary Pregnant Women <u>Walking Intervention</u> n=41 <i>Age:</i> 19–35 <i>Race:</i> 81% White	PA sessions/wk; PA min/session; Steps/day; PA intensity measured by heart rate	No theory described	<i>Description:</i> Participants assigned to one of two interventions: 40 minutes of moderate intensity walking or video-guided stretching five times a week. All participants	<i>Summary:</i> No significant differences between intervention and comparison groups

Reference	Sample characteristics	PA Measure	Theory*	Intervention Summary	Findings
	<u>Stretching Intervention</u> n=38 Age:20–35 Race: 76% White			individually received PA training and supervision for their designated exercise. Free on-site childcare was provided and participants received a \$10 gift card per visit. <i>Recommended PA:</i> 40 min/5x/wk <i>Setting:</i> University Exercise Lab, Home <i>Delivered by:</i> Exercise specialists <i>Number of sessions:</i> ~ 22 <i>Duration:</i> ~ 40 min <i>Duration of Intervention:</i> ~5 months	

* TTM=Transtheoretical Model, SCT=Social Cognitive Theory, PMT=Protection Motivation Theory, TPB=Theory of Planned Behavior