Physical activity during pregnancy and the role of theory in promoting positive behavior change: A systematic review

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Abstract

Background: Physical activity (PA) during pregnancy provides physical and psychological benefits for mother and child. U.S. guidelines recommend ≥30 min of moderate exercise for healthy pregnant women most days of the week; however, most women do not meet these recommendations. Theory assists in identifying salient determinants of health behavior to guide health promotion interventions; however, the application of theory to examine PA among pregnant women has not been examined cohesively among multiple levels of influence (e.g., intrapersonal, interpersonal, neighborhood/environmental, and organizational/political). Subsequently, this systematic review aims to identify and evaluate the use of health behavior theory in studies that examine PA during pregnancy.

Methods: Articles published before July 2014 were obtained from PubMed and Web of Science. Inclusion criteria applied were: (1) empirically-based; (2) peer-reviewed; (3) measured factors related to PA; (4) comprised a pregnant sample; and (5) applied theory. Fourteen studies were included. Each study’s application of theory and theoretical constructs were evaluated.

Results: Various theories were utilized to explain and predict PA during pregnancy; yet, the majority of these studies only focused on intrapersonal level determinants. Five theoretical frameworks were applied across the studies—all but one at the intrapersonal level. Few determinants identified were from the interpersonal, neighborhood/environmental, or organizational/political levels.

Conclusion: This systematic review synthesized the literature on theoretical constructs related to PA during pregnancy. Interpersonal, community, and societal levels remain understudied. Future research should employ theory-driven multi-level determinants of PA to reflect the interacting factors influencing PA during this critical period in the life course.

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Keywords: Physical activity; Pregnancy; Theory

1. Introduction

Physical activity (PA) during pregnancy has been proposed to have numerous health benefits across the life course. Being physically active during pregnancy is associated with reduced risk of adverse pregnancy and birth outcomes, including pre-eclampsia, gestational diabetes, and preterm birth.1,2 PA during pregnancy can also have implications for psychological health, including overall mood and self-esteem.3 Moreover, PA can support healthy gestational weight gain,4 particularly since the amount of excessive weight gain during pregnancy is a significant predictor of postpartum weight retention.5 Therefore, having adequate levels of PA during pregnancy can have long-term, positive impacts for women’s health.

The American College of Obstetricians and Gynecologists (ACOG) has recommended that pregnant women should engage in moderate exercise for 30 min a day on most days of the week, with the exception of women with compromising health conditions (e.g., pre-eclampsia).6 Despite these recommendations, only 13.8% of pregnant women in the US are physically active.7 Furthermore, women are less likely to sustain PA as the pregnancy progresses into later trimesters8 and during the transition to parenthood.9 The salience of this issue is amplified given that pregnancy is identified as a “teachable moment” in which women are amenable to change behaviors that can benefit their health and their baby’s health.10

In order to promote PA during pregnancy, theory serves as a powerful methodological tool for health behavior change. Theory can explain or predict a phenomenon and is extensively used in health behavior research.11 Previous research on predictors of PA during pregnancy has primarily focused on demographic,
non-modifiable correlates of the behavior. Yet, there is a need to understand the potentially modifiable factors for PA during this unique period that is sensitive to change. Moreover, it is well known that health behavior is influenced by multiple factors across the socio-ecological levels. For example, intrapersonal (e.g., knowledge, attitudes, beliefs), interpersonal (e.g., social support), neighborhood/environmental (e.g., side walk availability), and organizational/political (e.g., workplace policies) factors can be interacting forces that influence PA patterns.

A firm understanding of the multi-level, theory-based factors for PA during pregnancy is critical to inform future health promotion intervention development. However, a previous systematic review examined the use of behavioral change techniques for PA interventions during pregnancy and found that out of the 14 studies included in the review, only 2 were grounded using theoretical frameworks. While behavioral change techniques (e.g., goal setting, feedback, repetition) can provide successful outcomes, the use of theory for developing interventions directly maps needs and assets to theory-based intervention components and improves generalizability of findings. Therefore, it is necessary to understand the current literature regarding the theory-based factors that influence PA during pregnancy in order to inform future intervention development. The purpose of this study was to systematically review and evaluate the use of health behavior theory in observational studies that examine PA among pregnant women.

2. Materials and methods

Methods of this systematic review were specified prior to commencement in a study protocol. The protocol referenced Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines and recommendations for integrative reviews (i.e., reviews of quantitative and qualitative research). Articles were systematically selected from a search of PubMed and Web of Science databases, during a date range of database inception until July 2014. Search terms were organized into general categories of pregnancy (e.g., pregnancy, gestation, pregnant women), PA (e.g., leisure-time activity, physical activity, exercise, fitness, motor activity), and theory (e.g., theory, conceptual framework). The search strategy in each database used the Boolean term of “AND” for inclusion of each general category, and the Boolean term of “OR” for inclusion of each search term within the category.

Inclusion criteria applied were: (1) empirically-based; (2) published in a peer-reviewed journal; (3) measured factors related to PA during pregnancy; (4) comprised a pregnant sample; and (5) used a health behavior theory. Studies were excluded if they tested an intervention since this review focused on observational designs only, and not experimentally impacted theoretical determinants. Additionally, studies were excluded if only a published abstract was available since not enough data were available for abstraction.

Fig. 1 presents the search process for this systematic review. The primary search of the literature identified 326 articles. After removing 67 duplicates, 259 articles remained. Articles were then screened based on titles and relevance to the research topic; this removed 190 articles. Next, articles were assessed based on the abstract to determine the relevance to the research topic; this resulted in 25 articles remaining. Three additional articles were added to the search strategy from hand-searching reference lists from the remaining articles. Twenty-eight full-text articles were examined to determine eligibility based on inclusion and exclusion criteria. Four articles were excluded for not providing details of an empirical study (i.e., only a published abstract was available), 4 articles were excluded for not including pregnant participants, 4 articles were excluded for testing or describing an intervention, and 2 articles were excluded for not measuring theory-based constructs for PA.

Each article had the following information abstracted for review: publication year, authors, article title, journal title,
research questions and purpose, hypotheses, theory used, study design, sample description, trimester, sample size, methodology, measurement of PA behavior, instrument(s) used, analysis, and key findings related to theoretical constructs. Data were abstracted by the first author of the manuscript.

The primary purpose of this article was to conduct a qualitative synthesis of the theory-based constructs associated with PA during pregnancy. All theoretical constructs and findings from each article were abstracted and grouped by the levels of the Socio-ecological Model (i.e., intrapersonal, interpersonal, neighborhood/environmental, and organizational/policy). This allowed for identification of themes at varying levels of impact. According to PRISMA guidelines, it is recommended that reviews conduct a quality assessment of the methodology of included studies. However, given that this review integrates both qualitative and quantitative observational methodologies, this prohibits a single, standardized evaluation tool for quality assessment.

3. Results

Fourteen articles were included in this systematic review that examined theoretical determinants of PA during pregnancy. However, 4 of the included articles comprised 1 longitudinal study using 1 theoretical framework; therefore, this was reported as 1 empirical study. Articles included in the review were published between 2003 and 2014, despite searching for articles prior to these dates. Table 1 presents study methodological characteristics for each article. Studies included several countries of origin, including the US, UK, Australia, Canada, Portugal, and South Africa. Three studies selected participants based upon pre-pregnancy weight category in order to elicit determinants among overweight and obese pregnant women. There was also variability in study inclusion criteria for which trimester women were sampled.

This review included studies that utilized both qualitative and quantitative methodologies to collect data on factors related to PA during pregnancy. Surveys were the most frequently utilized data gathering tool; however, qualitative techniques such as focus groups, open-ended interview questions, and semi-structured interviews were also employed. The majority of studies had a measure of intensity or frequency of PA during pregnancy, yet a few studies did not measure this.

Other studies relied on validated instruments, such as the Leisure-Time Exercise Questionnaire, the Maternal Exercise Activity Questionnaire, or the Pregnancy Physical Activity Questionnaire. The remaining studies assessed moderate or vigorous PAs conducted days per week. All behavior measurements were based on self-report of activity, except in 1 study. Santos et al. objectively measured pregnant women’s compliance with recommended guidelines for PA using an accelerometer over a 7-day period.

3.1. Theories

The majority of studies utilized intrapersonal level theories to identify factors associated with PA during pregnancy (Table 2). Intrapersonal level theories applied to PA during pregnancy included the Theory of Planned Behavior, the Health Belief Model, Organismic Integration Theory, and the Self-Efficacy construct from the Social Cognitive Model. While 3 studies applied the Socio-ecological Model, the findings were primarily focused on intrapersonal determinants, rather than higher-levels of influence.

3.2. Factors by Socio-ecological Model level

3.2.1. Intrapersonal

The majority of health behavior theories were derived from the intrapersonal level, and thus a substantial portion of the factors in this review was identified at this level. Many studies identified the perceived benefits and barriers to PA. Perceived benefits included improved health, feeling better/good, postpartum weight loss, and improved health for the baby. However, the major focus in these studies was on barriers to PA. Pregnant women were more likely to have pregnancy-specific barriers compared to a non-pregnant sample. Overall, intrapersonal barriers were dichotomized into 2 categories: health related and non-health related. Examples of health related barriers include physical limitations, health conditions, tiredness, and pain. Non-health related barriers were related to psychosocial attitudes toward PA, specifically lack of motivation or lack of self-confidence. Compounding these barriers was the reported lack of time to engage in PA. Additionally, women reported a lack of knowledge regarding what types of activity they should be engaged in during pregnancy. Perceived barriers may also change as a woman progresses in her pregnancy. Furthermore, relative to other behavioral changes that can impact gestational weight gain, exercise was referred to as more difficult to change compared to diet.

Intention to perform PA was a significant predictor across all trimesters with the exception of predicting behavior within Trimester 1. However, intention was a relatively weak predictor longitudinally in pregnancy. In these studies utilizing the Theory of Planned Behavior, attitudes about PA were also measured (e.g., useful, pleasant, enjoyable); however, it was not a significant predictor of behavior. Rather attitudes for PA were only significant predictors for intention for behavior in 3 studies.

Self-efficacy was a significant construct for PA during pregnancy. Pregnant women viewed exercise as under their control, planning to be active, and being able to exercise even on busy days. An additional study examined self-efficacy as a separate construct: barrier self-efficacy (i.e., confidence in overcoming barriers to exercise) and exercise self-efficacy (i.e., confidence in the ability to exercise). Cramp and Bray reported that exercise self-efficacy is a more proximal predictor of PA; however, if substantial barriers exist then barrier self-efficacy is a more dominant predictor.

Finally, identified regulation was a significant predictor when applying the Organismic Integration Theory. This construct is a source of extrinsic motivation and represents a person’s outcome expectations related to the behavior.
| Study                                      | Country   | n  | Trimester | Sample    | Study design               | Theory                                      | Theoretical constructs                                 |
|-------------------------------------------|-----------|----|-----------|-----------|---------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Cramp and Bray, 2009^25                   | Canada    | 160| 2, 3      | Mean age 31| Longitudinal              | Self-efficacy construct from Social Cognitive Theory | Exercise self-efficacy                                |
|                                           | USA       | 1306| 2         | Median age 30| Cross-sectional subset of longitudinal study | Health Belief Model/Theory of Planned Behavior | Perceived benefits                                 |
| Evenson and Bradley, 2010^26              | USA       | 1535^6 | 2, 3     | Median age 30^6 | Median age 26^6 | Mixed-methods: cohort^6/focus groups^6 | Socio-ecological Model | Intrapersonal Interpersonal Neighborhood/environment Organization Policy |
| Evenson et al., 2009^10                   | Canada    | 75  | 1–3       | Age range 19–40| Cross-sectional           | Organismic Integration Theory               | External regulation | Introjected regulation Identified regulation Intrinsic regulation |
| Gaston et al., 2013^22                    | Canada    | 25  | 1–3       | Mean age 26; overweight or obese| Interviews | Socio-ecological Model | Intrapersonal Interpersonal Organizational Community Public policy |
| Goodrich et al., 2013^12                  | USA       | 67  | 1–3       | Mean age 28 | Longitudinal              | Theory of Planned Behavior                  | Behavioral beliefs | Control beliefs Normative beliefs |
| Hausenblas et al., 2011^26                | USA       | 34  | 1–3       | Mean age 26 | Focus groups              | Theory of Planned Behavior                  | Behavioral beliefs/attitudes Control beliefs/perceived Behavioral control Normative beliefs/subjective Norms |
| Muzigaba et al., 2013^31                  | South Africa | 123 | 1, 2     | Mean age 30; no leisure time activity| Cohort | Socio-ecological Model | Intrapersonal Interpersonal Neighborhood/environment Organization Policy |
| Santos et al., 2014^49                    | Portugal  | 464^1 | 1^1       | Age range 30–40; overweight or obese| Mixed-methods: survey^1; interviews^1 | Health Belief Model | Perceived susceptibility (of excess GWG) Perceived severity (of excess GWG) Perceived benefits Perceived barriers Cues to action Self-efficacy |
| Sui et al., 2012^23                       | Australia | 104 | 1         | Age range 20–37; BMI greater than 25 at first trimester| Interviews | Theory of Planned Behavior | Behavior beliefs/attitudes Control beliefs Normative beliefs |
| Weir et al., 2010^44                      | UK        | 89  | 2         | Mean age 30 | Longitudinal              | Theory of Planned Behavior                  | Subjective norm | Perceived behavioral control Intention |

^1 Quantitative sample of the study.
^2 Qualitative sample of the study.
Abbreviations: BMI = body mass index; GWG = gestational weight gain.
Table 2
Summary of theoretically-informed findings stratified by theoretical framework from studies selected for the systematic review of theory-based determinants of PA during pregnancy.

| Theory Model | Author/year | Major findings |
|--------------|-------------|----------------|
| Health Belief Model | Evenson and Bradley, 2010 | Women who reported exercising during their first and second trimester were more likely to report the perceived benefits of exercise and PA during pregnancy compared to those who reported no exercise during either trimester (OR ≥ 2.0, p < 0.05) |
| Organismic Integration Theory | Gaston et al., 2013 | Identified regulation (β = 0.37, p < 0.05) significantly predicted exercise behavior; external regulation, introjected regulation, and intrinsic regulation were not significant; model explained 20% of the variance |
| Self-Efficacy from Social Cognitive Theory | Cramp and Bray, 2009 | (1) Barrier self-efficacy (β = 0.26, NS) and exercise self-efficacy (β = 0.32, p < 0.05) at 18 weeks gestation explained 26% of variance for behavior at 24 weeks gestation; (2) Barrier self-efficacy (β = 0.40, p < 0.05) and exercise self-efficacy (β = 0.21, NS) at 24 weeks gestation explained 32% of variance for behavior at 30 weeks gestation; (3) Barrier self-efficacy (β = 0.25, NS) and exercise self-efficacy (β = 0.41, p < 0.05) at 30 weeks gestation explained 37% of variance for behavior at 36 weeks gestation |
| Theory of Planned Behavior | Downs and Hausenblas, 2001 | Intention (β = 0.58, p < 0.05) and perceived behavioral control (β = 0.17, NS) explained 47% of the variance for behavior; attitude (β = 0.29, p < 0.05), perceived behavioral control (β = 0.28, p < 0.05), and subjective norm (β = 0.13, NS) explained 37% of the variance for intention |
| | Hausenblas and Downs, 2004 | Intention (β = 0.17, NS) and perceived behavioral control (β = 0.37, p < 0.05) explained 25% of the variance for behavior; attitude (β = 0.57, p < 0.05), perceived behavioral control (β = 0.06, NS), and subjective norm (β = 0.28, p < 0.05) explained 68% of the variance for intention |
| | Downs and Hausenblas, 2007 | Intention (β = 0.39, p < 0.05) and perceived behavioral control (β = 0.23, NS) explained 28% of the variance for behavior; attitude (β = 0.13, NS), perceived behavioral control (β = 0.07, NS), and subjective norm (β = 0.51, p < 0.05) explained 31% of the variance for intention |
| | Hausenblas et al., 2008 | Intention (β = 0.49, p < 0.05) accounted for 16% of the variance for behavior; all other variables not significant (cross-sectional data); intention (β = 0.58, p < 0.05) accounted for 6% of the variance for behavior; all other variables not significant (longitudinal data); attitude (β = 0.35, p < 0.05, R² = 0.09), perceived behavioral control (β = 0.35, p < 0.05, R² = 0.10), and pre-pregnancy exercise behavior (β = 0.02, p < 0.05, R² = 0.11) predicted intention (cross-sectional data); no significant predictors for predicting intention (longitudinal data) |
| | Hausenblas et al., 2011 | Compared to a non-pregnant sample, pregnant women reported pregnant-specific behavioral and control beliefs that impacted PA during 3-month intervals; pregnant-specific beliefs were most salient for control beliefs of “make it difficult” (e.g., morning sickness, larger size/weight, soreness/pain) and behavioral “disadvantages” (e.g., decreased PA during pregnancy, premature labor, increased size/weight); pregnant women were more likely to list healthcare providers as persons who approve PA under “normative beliefs” |
| | Muzigaba et al., 2013 | Behavioral beliefs/attitudes: importance of being healthy, perceived advantages (e.g., weight, health, labor), perceived disadvantages (e.g., fear of hurting self/baby); control beliefs/perceived behavioral control: physical pain, large body size, lack of energy, lack of facilities/gym, lack of time, neighborhood safety, lack of education or PA sessions for pregnant women, self-motivation, self-confidence, family support, staying in shape, general health; normative beliefs/subjective norms: midwife or medical doctor advise to be active; members of family advise to rest |
| | Weir et al., 2010 | Behavioral beliefs/attitudes: aware of the importance of “being physically active” in pregnancy, but awareness not always enough to change behavior; felt healthy eating was more important than being physically active; perceived benefits related to pregnant woman not baby, but perceived risks related to baby; control beliefs: personal health problems were most common internal barrier, as well as lack of self-confidence and motivation; work, time, childcare, feeling safe in neighborhood, weather, and cost were external barriers; normative beliefs: did not have enough information or support for PA during pregnancy; reported the midwife as most appropriate source for information; received conflicting advice from family and health professionals; reported barriers: too tired, lack of time, physical limitations, work, weather, lack of motivation, lack of support, injury/contraindications, childcare | (continued on next page)
3.2.2. Interpersonal

There was a paucity of interpersonal theories applied to PA during pregnancy; however, interpersonal factors did emerge. While normative beliefs or subjective norms are derived from an intrapersonal level, for the purposes of this review it is examined at the interpersonal level as it is describing persons identified as valuable for informational and motivational support to PA during pregnancy. Healthcare providers were viewed as important sources of support for PA during pregnancy.23,28,31 However, provider advice was reported as conflicting with information from family members that advised women to rest during pregnancy.24,31 Many studies identified the benefit of family and friends support, as well as childcare.22,23,25,30 Furthermore, 2 studies reported the need for pregnancy-specific exercise companionship.29,31 Despite the salience of identifying sources of social support for PA during pregnancy, subjective norms had limited predictive value on PA intention during pregnancy.18,21

3.2.3. Neighborhood/environmental

There is a dearth of theory-based factors from a neighborhood or environmental perspective. The studies that examined neighborhood and environmental factors were qualitative or descriptive in design; as a result, there were no reported measures of how these factors impacted PA levels. Weather was a commonly reported barrier to PA.23–25,30 For example, women reported that changes in the season or the temperature being too hot or too cold made it difficult to exercise outside.23,30 Neighborhood characteristics were also reported as barriers, including safety concerns and distance/access to facilities.22–24,29,31 Potential facilitators for PA were described by women as the existence of PA education programs for pregnant women in their community, specifically group exercise programs.31

4. Discussion

This systematic review synthesized the results of 14 empirical articles that applied theoretical frameworks to examine PA during pregnancy across multiple levels of influence. The
majority of the studies focused on factors at the intrapersonal level due to the selection of theoretical frameworks. The only exception was the use of the Socio-ecological Model itself as a guiding framework in 3 studies. Therefore, studies excluded more distal factors that may limit or facilitate PA, and thus there is a need to further examine the interpersonal, community, organizational, and political influences that impact the more proximal intrapersonal factors of PA behavior. Considering distal level factors is consistent with the Institute of Medicine report that indicates the significant impact of the built environment in facilitating or prohibiting PA, as well as other PA reviews among adults emphasizing the importance of multilevel frameworks.

The majority of factors identified at the intrapersonal level were barrier focused. These barriers were related to health issues while being pregnant, as well as non-health related issues, such as motivation or confidence. Unique barriers reported during pregnancy should be the focus of health education components to find accommodations for exercise that address these specific issues. Moreover, integrating these findings on barriers with those regarding self-efficacy to overcome the barriers to exercise may improve intervention development. Additionally, developing health messages that align with the perceived benefits of PA during pregnancy, such as improved health for baby or postpartum weight loss, may also support behavior change.

At the interpersonal level, findings related to family support corroborate previous correlational data that report marriage as a positive, significant predictor for PA during pregnancy. The multi-faceted layers of social support may impact women attempting to engage in PA during pregnancy. For example, instrumental support may assist women in overcoming barriers to childcare or work-related conflicts. Informational and appraisal support are required to inform women of the benefits of PA during pregnancy and how it can impact maternal and child health.

Additionally, healthcare providers were identified as important sources for information regarding PA. Healthcare providers have an important role, which includes clarifying the benefits and emphasizing the importance of PA during pregnancy. This is especially important as pregnant women may receive conflicting information from family members and healthcare providers; both considered trusted sources of health information. While previous research has indicated that healthcare providers often have positive beliefs regarding PA during pregnancy, not all providers reported disseminating current ACOG recommendations for this behavior to their patients. Thus, there is a need to further engage these providers to communicate and advise women with regard to the current national PA guidelines in a clear and patient-centered manner.

Higher levels of influence received less attention in the theory-based literature; however, these levels are not without recognition. The tunnel-vision of the literature on intrapersonal level factors related to PA during pregnancy may be attributed to the assumption that organizational, environmental and policy level factors are the same for adults regardless of gravidity. The effect of environmental variables on PA have been studied in the adult population; however, there is a need to further evaluate these factors in a pregnant population since these women may face unique challenges and barriers due to changing physiology and social circumstances. As mentioned by Muzigaba et al., women desired exercise group classes specific for pregnant women offered in their communities in order to learn about PA that is appropriate and safe for pregnancy. Additionally, given some of the unique barriers pregnant women with children may face, such as childcare issues, facilities offering these types of services may be warranted. Moreover, it is necessary to consider these higher levels of influence since the degree to which these various environmental and policy factors make it difficult to carry out PA may contribute to a woman’s perceived behavioral control.

Additionally, this systematic review revealed that there is variability in which theory-based factors were significant at each trimester. For example, in the series of papers presented by Hausenblas and Downs using the same sample of women at different time points, constructs from the Theory of Planned Behavior, specifically intention and perceived behavioral control, alternated in significance for different trimesters. Therefore, certain behavioral constructs may be more influential during different stages of pregnancy, which is important to recognize when designing future health promotion interventions for this target population.

This systematic review has revealed overlap in some theoretical constructs. For example, barrier self-efficacy and perceived behavioral control can intersect, both reflect the underlying phenomenon of personal agency. Interestingly, both of these constructs were only significant predictors during the early phases of pregnancy. This highlights the need to consolidate and synthesize the theory-based literature for any health behavior in order to identify these types of overlap in underlying constructs that may use different labels or language.

There was an overall paucity of diversity in the samples among the studies included that were conducted in the USA. The majority of studies focused on homogenous samples of primarily Caucasian women; few had diverse participants, such as African Americans. Previous epidemiological studies have identified racial/ethnic differences in the level of PA during pregnancy. In addition, the diversity of the samples with regards to other socio-demographics needs to be further explored. For example, previous research has found differences in PA levels by marital status, education, health status, and household income. Moreover, there was a lack of heterogeneity for body size (i.e., normal weight, overweight, and obese) prior to pregnancy with the exception of 3 studies. Similarly, pre-pregnancy body size impacts the level of PA, and potentially the determinants of PA during pregnancy. Future research should examine theory-based predictors of PA among diverse samples of participants and consider potential mediating variables, such as pre-pregnancy body size.

Several limitations should be acknowledged. This review only included published, peer-review literature; therefore it may be subject to potential publication bias. Additionally, the review was limited to a qualitative synthesize only since the included
studies lacked consistency in terms of the PA and determinants measures used, limiting the ability to compare measures of effect across studies. This field of investigation would benefit from standardized procedures to assess PA in the pregnant population. Finally, this review did not include an evaluation of the quality of the studies. This is a limitation of reviews that integrate both qualitative and quantitative methodologies, which prohibits a single, standardized quality assessment across studies. However, the authors argue that it is necessary to consider rigorous, qualitative methodologies in systematic reviews of the literature, as this adds to the scope of the findings related to the research topic. In this review, the examination of the theory-based literature for PA during pregnancy was enriched by including qualitative study designs.

Although health promotion interventions have targeted PA during pregnancy in order to promote adequate gestational weight gain, limited improvements have been observed.43 Furthermore, there has been a dearth of theory used to inform intervention design and those that were theory-informed had minimal effects for PA during pregnancy to prevent excessive gestational weight gain.44 Nonetheless, evidence has shown that using theory to design interventions can lead to improved effects compared to those without theory.11 For instance, studies applying theoretical constructs to improve PA levels in adult, non-pregnant populations have been successful.45 Intervention mapping is a potential tool for future research to integrate the findings on the salient theoretical determinants that impact PA during pregnancy in this review to promote PA behavior change during pregnancy through the development of theory-based and evidence-informed interventions.46

Additionally, development of multi-level interventions are the most effective in changing behaviors compared to those that only target individual level determinants.11 Thus, the lack of improvement in outcomes related to PA during pregnancy in previous research may be the result of minimal applications of health behavior theory at multiple levels of influence to the intervention design. For example, pregnant women interact with healthcare providers throughout their pregnancy and are regarded as a trusted source of information. Therefore, these agents should be targeted as well in the delivery of health interventions for pregnant women.10 Additional research on the knowledge, attitudes, and beliefs regarding provider adherence to ACOG guidelines for PA during pregnancy recommendations to pregnant patients is warranted.

Finally, this systematic review identified areas in the literature that require additional research. First, this review included findings from relatively homogenous samples. Future research should be dedicated to elucidating theory-based predictors of PA within the context of unique cultures or demographic factors. The epidemiological research indicates that rates of PA during pregnancy vary by demographic factors, such as race/ethnicity, education status, and income.7,39,40 These findings may reveal distinctive factors that would contribute to improving PA during pregnancy. Secondly, the factors identified in this systematic review at the intrapersonal level were primarily deficit or barrier focused. While it is necessary to understand what prohibits PA during pregnancy, additional research is required to elucidate the facilitators or assets to PA during this unique period. These facilitators may contribute to improved uptake of future PA interventions targeted toward this population.

5. Conclusion

Theoretical constructs are useful tools for examining PA, especially in a unique population, such as pregnant women. Future work should implement multi-level, theory-based determinants of health behavior into health promotion interventions aimed at increasing PA during this period, which is notably amenable to behavior change. Ultimately, improving levels of PA during pregnancy has the potential to have positive health outcomes for women across the life course.

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Authors’ contributions

ELT conceived of the study and conducted the systematic review process; CAV and EMD also conceived of the study, and participated in its design and coordination. All authors drafted the manuscript, read and approved the final version of the manuscript, and agreed with the order of presentation of authors.

Competing interests

The authors declare that they have no competing interests.

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