Running head: Physical Activity and Pregnancy

Being active in pregnancy: Theory-based predictors of physical activity among pregnant women

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Suggested citation: Hamilton, K., Fleig, L., Henderson, J., & Hagger, M. S. (2018). Being active in pregnancy: theory-based predictors of physical activity among pregnant women. *Women & Health*. Advanced online publication.doi:10.1080/03630242.2018.1452835

Abstract

Although regular physical activity is recommended for pregnant women, compared to pre-pregnancy, antenatal physical activity often reduces or ceases completely. Drawing from the theory of planned behavior, self-determination theory, and theory on self-control, we aimed to test an integrative model of physical activity in a sample of pregnant women. The current study was conducted in Brisbane, Australia in 2014-2015 using a prospective-correlational design with a one-week follow-up. Participants (N=207, Time 1; $Mean_{age}$ = 30.03 years, SD_{age} = 4.49 years) completed an initial survey measuring: intrinsic motivation from self-determination theory, social cognitive constructs from the theory of planned behavior, and self-control from self-control theory; followed by a self-report measure of physical activity one-week later (n=117, Time 2). A well-fitting structural equation model accounted for 73% and 42% of the variance in intention and physical activity behavior, respectively. Perceived behavioral control and attitude, but not subjective norm, mediated the effect of intrinsic motivation on intention. Intention, perceived behavioral control, and self-control were positively associated with physical activity behavior. Future behavioral interventions aiming to promote physical activity during pregnancy, a period when physical activity levels typically decline, should consider the multiple processes advocated in the integrative model as necessary for motivated action.

Key words: Theory of planned behavior, self-determination theory, self-control, physical activity, pregnancy

Introduction

Regular physical activity (PA) has been associated with optimal pregnancy and maternal outcomes (Brown, 2002; Nascimento et al., 2012). Despite the benefits, consistent evidence has shown that compared to pre-pregnancy, antenatal PA is often reduced or ceases completely (Abbasi & van den Akker, 2015), and only 32% of Australian women meet PA guidelines during pregnancy (Wilkinson, Miller, & Watson, 2009). While some studies have shown that demographic factors (e.g., increased age, body mass index [BMI], gestational age) are negatively associated with women's PA participation in pregnancy, the findings have often been descriptive and inconclusive (Gaston & Cramp, 2011). The application of social cognitive and motivational theories to identify the factors associated with PA in pregnancy and potentially modifiable targets for behavior change interventions has therefore been advocated (Connelly et al., 2015; Currie et al., 2013; Gaston & Cramp, 2011).

Theoretical Integration and Physical Activity in Pregnancy

Building on previous research which has tended to adhere to one particular theory or approach, researchers (Arnautovska et al., 2017; Brown et al., 2018; Hagger & Chatzisarantis, 2014; Hagger et al., 2017; Hamilton, Cox, & White, 2012a; Hamilton et al., 2017a; McEachan et al., 2016; Montaño & Kasprzyk, 2008) have recently attempted to integrate and extend social cognitive models, such as the theory of planned behavior (TPB; Ajzen 1991), which has been well-validated across a range of health behaviors (McEachan et al., 2011; Rich et al., 2015), including PA (Downs & Hausenblas, 2005), with complementary theories to build more comprehensive models of human behavior.

The TPB proposes intention as the proximal antecedent of behavior, with intention conceptualized as a function of attitude (overall evaluations of the behavior), subjective norm (perceived social pressure to perform the behavior), and perceived behavioral control (perceived capacity to carry out the behavior), with perceived behavioral control further

hypothesized to be a direct predictor of behavior. While TPB constructs have been associated with health behaviors in multiple populations (Epton et al., 2015; French & Cooke, 2011; Hamilton et al., 2017b; Hamilton et al., 2016; Hamilton et al., 2012b; Vayro & Hamilton, 2016), the origins of these constructs have not been comprehensively identified. Theories that focus on the quality of motivation, such as self-determination theory (SDT; Deci & Ryan, 1985, 2002), may complement the TPB to provide a better understanding of the processes underpinning TPB constructs (Hagger & Chatzisarantis, 2009; Hagger et al., 2016).

SDT is a theory of motivation which focuses on the quality rather than quantity of motivation. Central to the theory is the distinction between self-determined or autonomous and non-self-determined or controlled forms of motivation. Intrinsic motivation is considered the prototypical form of autonomous motivation, involving behavior that is performed in the absence of external contingencies and out of inherent choice and interest. Intrinsic motivation has been associated with adherence to health behaviors, including PA (Teixeira et al., 2012). In contrast, controlled forms of motivation represent engaging in behaviors out of obligation or for external contingencies, such as rewards or deadlines. Such contingencies are motivating, but only as long as the external contingencies are present; once removed, the behavior is likely to desist. A meta-analysis examining the integration of the TPB and SDT in health behavior indicated that autonomous forms of motivation from the SDT were related to health behavior directly as well as indirectly through the TPB constructs (Hagger & Chatzisarantis, 2009). These findings corroborate more recent studies on PA among general adult populations (Hagger & Chatzisarantis, 2014) and targeted at-risk groups for physical inactivity, such as parents of young children (Hamilton et al., 2012a).

The higher demands placed on women during pregnancy, in addition to the physical (e.g., fatigue, increased body weight) and psychological (e.g., altered moods) effects of pregnancy, may result in any good intentions to engage in regular PA that do not always

translate into actual participation behavior. Recent research has shown that the translation of intention into behavior is related to a person's self-regulatory skills (Junger & Van Kampen, 2010; Reyes Fernández et al., 2016; Zhou et al., 2015). Thus, having the necessary self-control, considered a quintessential feature of self-regulatory behavior (de Ridder et al., 2012; Hofmann & Kotabe, 2012; Tangney, Baumeister, & Boone, 2004), to engage in desirable health behaviors, such as PA, during pregnancy may also be important to consider.

Self-control is conceptualized as an individual difference which enables individuals to direct their actions toward approaching desirable and inhibiting undesirable behavioral tendencies (de Ridder et al., 2012). Individuals with high self-control are likely to be more effective in structuring their long-term goals and recognizing and predicting costs and consequences of action (Gottfredson & Hirschi, 1990). Self-control is proposed to be associated with behavior through two routes: directly and indirectly mediated by intentions (Hagger, 2013, 2014; Hankonen, Kinnunen, Absetz, & Jallinoja, 2014). The direct path reflects capacity to inhibit impulse-driven non-intentional responses while the indirect pathway reflects strategic alignment of behavioral intentions to attain long-term goals. Self-control may also lead individuals to be more effective in fulfilling their intentions by directing their attention to relevant cues to action (Hagger, 2013, 2014). As a consequence, self-control may moderate the intention-behavior relationship.

The Current Study and Hypotheses

Drawing from the TPB, SDT, and theory on self-control, the aim of the current study was to test an integrative model of PA in a sample of pregnant women. The hypothesized model, developed in line with the existing empirical and theoretical evidence, is depicted in Figure 1. First, in line with SDT (Deci & Ryan, 1985; Hagger & Chatzisarantis, 2009), intrinsic motivation was hypothesized to serve as distally related to the social cognitive antecedents of behavior from the TPB: attitude, subjective norm, and perceived behavioral

control (H_1). Consistent with the TPB (Ajzen, 1991; McEachan et al., 2011), attitude, subjective norm, and perceived behavioral control were proposed to be associated with intention (H_2). Indirect associations of intrinsic motivation from SDT with intention through attitude, subjective norm, and perceived behavioral control were expected (H_3). In addition, intention and perceived behavioral control were proposed as factors directly associated with behavior (H_4). We also proposed a direct relationship between intrinsic motivation and behavior (H_5). Finally, in accord with theory on self-control (Hagger, 2013, 2014), it was proposed that self-control would have a direct relation to intention (H_6) and behavior (H_7), and moderate the intention-behavior relationship (H_8). The mediation of the relationship between self-control and behavior via intention was also tested (H_9).

Method

Participants and Procedure

Participants were pregnant women (N = 207) aged 18 years and older and recruited in Australia, with the majority residing in the states of Queensland and New South Wales (n = 171, 66%) between October 2014 and March 2015. Women were eligible to participate if they had not been diagnosed with a medical condition preventing them from engaging in PA in the antenatal period. Participants were recruited via face-to-face contact at mother/baby groups and general practice surgeries, along with advertisements at antenatal classes, childcare centers, and on social media. These recruitment sites were selected to optimize sample size, given the higher proportion of pregnant women in these settings. However, due to the different recruitment methods, it was not possible to compute participation rates, although most of those approached face-to-face participated in the study. As an incentive, participants were informed of the opportunity to enter a prize draw to win one of three double movie vouchers (each valued at AUD50). Ethical approval for the study protocol was granted by the University Human Research Ethics Committee.

The study used a prospective design with a one-week follow-up. At Time 1 (T1), participants completed an initial questionnaire either face-to-face (n = 48; 23%) or online (n = 159; 77%) to assess TPB constructs (attitude, subjective norm, perceived behavioral control, and intention) as well as measures of intrinsic motivation from SDT and self-control. Data on demographics were also collected. At Time 2 (T2), participants completed a follow-up questionnaire either over the phone (n = 14; 12%) or online (n = 103; 88%) that assessed their self-reported PA behavior in the previous week. To ensure informed consent, an information sheet was provided to participants containing all required information on the nature of the research and outlining confidentiality. Informed consent was gained through the completion of the T1 questionnaire, and consent to contact participants for the T2 follow-up was given through the provision of contact details. Providing written consent was deemed not necessary by the University Human Research Ethics Committee. Data across each time points were able to be de-identified and matched using a unique code identifier created by the participant.

Measures

Demographic variables. Participants self reported responses to a series of demographic characteristics that were expected to be related to PA in pregnant women based on previous research (Gaston & Cramp, 2011) and, therefore, used as covariates in subsequent analyses: age (in years), self-reported weight and height to calculate BMI in kg/m^2, and gestational age (in weeks; embryonic age plus 2 weeks, which approximately corresponds to the duration since the last menstrual period began).

Behavior. The target behavior or outcome, was performing the *"recommended level of moderate-intensity physical activity over the next week"*, following the Australian's Physical Activity and Sedentary Behavior Guidelines for Adults (Department of Health, 2014), which recommend accumulating 150-300 minutes (2.5 to 5 hours) of moderate-intensity PA each week. Moderate-intensity was operationalized as "physical activity which

takes effort, but where you are still able to talk while doing such activity". To improve understanding of moderate-intensity PA, examples of activities were presented (e.g., brisk walking, recreational swimming, household tasks, such as cleaning windows or raking leaves). PA behavior was assessed by self-report using two 7-point scales: "In the previous week, on how many days did you perform physical activity following the recommended guidelines" and "In the previous week, how often did you perform physical activity following the recommended guidelines"; scored *never* (1) to *very often* (7). The responses to these two items were summed and averaged to provide a single score, with a score range in the current study of 1-7. The two items were significantly correlated ($r = 0.89$, $p < 0.001$).

Social cognitive variables. We used previously-validated measures of the social cognitive variables used in multiple studies and based on published guidelines (Ajzen, 2006). The measures were adapted to refer to the target behavior and follow-up period (one week) relevant to the current study. Attitude was assessed by two 7-point items on a semantic differential scale: "For me to perform the *recommended level of moderate intensity physical activity over the next week* would be …", *unpleasant* (1) to *pleasant* (7) and "For me to perform the *recommended level of moderate intensity physical activity over the next week* would be …", *undesirable* (1) to *desirable* (7). The responses to these two items were summed and averaged to provide a single score, with a score range in the current study of 1-7. The two items were significantly correlated ($r = 0.71$, $p < 0.001$).

Subjective norm was measured by three items: "Most people who are important to me would approve of me performing the *recommended level of moderate intensity physical activity over the next week*", "Those people who are important to me think I should perform the *recommended level of moderate intensity physical activity over the next week"*, and "Most people like me would perform the *recommended level of physical activity in the next week"*; scored *strongly disagree* (1) to *strongly agree* (7). These three items were summed and

averaged to provide a single score, with a score range in the current study of 2-7. The scale scores in the current study were internally consistent ($\alpha = 0.93$).

Two items assessed perceived behavioral control: "It would be easy for me to perform the *recommended level of physical activity in the next week*" and "I am confident that I could perform the *recommended level of physical activity in the next week*"; scored *strongly disagree* (1) to *strongly agree* (7). These two items were summed and averaged to provide a single score, with a score range in the current study of 1-7. The two items were significantly correlated ($r = 0.83$, $p < .001$).

Two items assessed intention to perform the target behavior: "I expect that I will perform the *recommended level of physical activity in the next week*" and "I plan to perform the *recommended level of physical activity in the next week*"; scored *strongly disagree* (1) to *strongly agree* (7). These two items were summed and averaged to provide a single score, with a score range in the current study of 1-7. The two items were significantly correlated ($r = 0.96$, $p < 0.001$).

Intrinsic motivation. Intrinsic motivation was measured using an adapted version of Ryan and Connell's (1989) measure. Participants were presented with a common stem: "The reason I would perform the *recommended level of physical activity over the next week*…" followed by two reasons relating to autonomous motives on a 7-point scale: "Because I personally believe it is the best thing for my health…" and "Because I personally believe it is the best thing for the health of my baby…"; scored *not at all true* (1) to *extremely true* (7). These three items were summed and averaged to provide a single score, with a score range in the current study of 3-7. The items were correlated significantly ($r = 0.71$, $p < .001$).

Self-control. General self-control was measured using the Brief Self Control measure (Tangney, Baumeister, & Boone, 2004) (e.g., "I am good at resisting temptation"; scored *not at all* (1) to *very much* (5). The items were summed and averaged to provide a single score,

with a score range in the current study of 2-5. The measure has demonstrated good psychometric properties ($\alpha = 0.83$ and 0.85 in the two validation samples, and test-retest reliability was 0.87) (Tangney et al., 2004). The scale scores in the current study were internally consistent ($\alpha = 0.76$).

Data Analysis

The proposed model (Figure 1) was estimated using structural equation modelling using Mplus 7. The hypothesized model comprised seven latent variables: intrinsic motivation, attitude, subjective norm, perceived behavioral control, intention, self-control, and PA. All latent variables were indicated by the questionnaire items pertaining to each construct. As the self-control scale comprised a large number of items, item parcelling was applied using random allocation of items to four parcels (Little et al., 2002). We also examined correlations between demographic variables, age, BMI, and gestational age, and PA behavior. Given that increased age, BMI, and gestational age have been shown to affect women's PA participation negatively in pregnancy (Gaston & Cramp, 2011) and were also revealed as significant bivariate correlations with PA, we included these demographic factors as covariates on PA in the model. Model fit was assessed based on a combination of fit indices: the comparative fit index (CFI) and the Tucker-Lewis-Index (TLI), which should approach or exceed 0.95 for good fit; the root-mean-square error of approximation (RMSEA), which should be less than 0.05 for good fit (Hu & Bentler, 1999). Missing data (< 5%) were imputed using the full information maximum likelihood (FIML) algorithm (Enders & Bandalos, 2001). Indirect effects were estimated using 95% bias-corrected bootstrap confidence intervals (CI) with 5,000 replications.

Results

Attrition Analysis

Data at the one-week follow-up were missing for 90 participants, resulting in a final sample of 117 participants (Table 1). Attrition analyses showed no significant differences in PA, age, BMI, gestation age, and levels on the manifest (averaged) social cognitive variables (intention, perceived behavioral control, self-control) measured at the first time point between participants who dropped out of the study and those who completed the follow-up assessment ($p > 0.05$). Further analyses, however, indicated significant differences in attitude ($t(205) = 2.14$, $p = 0.03$, $d = 0.31$), intrinsic motivation ($t(205) = 2.25$, $p = 0.03$, $d = 0.31$), and subjective norm ($t(205) = 2.55$, $p = 0.01$, $d = 0.32$). Participants who remained in the study reported higher levels of attitude, intrinsic motivation, and subjective norm compared to participants who dropped out of the study.

Structural Equation Model

The structural equation model had a good model fit with the data ($\chi^2(145) = 205.50$; RMSEA = 0.06, CFI = 0.95, TLI = 0.95). In addition, factor loadings for the manifest indicators of each latent variable were within acceptable ranges, supporting the construct validity of the measures adopted. The covariates of age, BMI, and gestational age were retained in the final structural equation model (Table 2). Intrinsic motivation was statistically significantly directly related to attitude, subjective norm, and perceived behavioral control, as hypothesized (H_1; Figure 1). Attitude and perceived behavioral control, but not subjective norm, were statistically significantly and positively associated with intention (H_2). The indirect relations of intrinsic motivation to PA intention through attitude ($\beta = 0.22$, $p = 0.01$; 95% CI [-0.02, 0.43]) and perceived behavioral control ($\beta = 0.18$, $p = 0.01$; 95% CI [-0.02, 0.32]) reached level of significance, but not the indirect relation of intrinsic motivation to intention through subjective norm ($\beta = -0.01$, $p = 0.81$; 95% CI [-0.07, 0.05]) (H_3). As hypothesized (H_4), intention and perceived behavioral control showed statistically significant

and positive associations with behavior. Contrary to assumptions (H_5), intrinsic motivation was not statistically significantly directly related to behavior.

Self-control was statistically significantly and positively associated with behavior (H_7); so, this hypothesis was supported. Self-control was not directly associated with intention (H_6) and self-control did not moderate (H_8; $ß$ = -0.08; p =0.72; 95% CI [-0.28, 0.52]) or mediate (H_9; β = -0.01, p =0.68; 95% CI [-0.09, 0.07]) the intention-behavior relationship, so these hypotheses were rejected. Overall, the model accounted for 73% and 42% of the variance in intention and PA behavior, respectively. Zero-order correlations indicated that age, BMI, and gestational age were statistically significantly and negatively associated with PA behavior; however, in the final model only intention, self-control, and perceived behavioral control were statistically significantly and positively related to PA. These results indicate that the social cognitive factors were the most prominent factors related to PA and overrode any associations of age, BMI, or gestational age.

Discussion

The current findings provide confirmation of the multiple pathways by which psychological constructs were related to PA behavior of pregnant women. Specifically, the association of a distal motivational factor (intrinsic motivation) with intention was mediated by belief-based constructs (attitudes, perceived behavioral control), and that intention and perceived behavioral control were directly associated with PA behavior. These findings are in line with our hypotheses and consistent with the motivational and social cognitive components that comprise SDT and TPB, respectively, as well as empirical evidence supporting the integration of the two psychological theories (Hagger & Chatzisarantis, 2009).

The mechanism underpinning this association was based on the function of intrinsic motivation in stimulating future action. Consistent with SDT, experiencing activities as intrinsically motivated is likely to lead individuals to engage in the behavior in future as it is

intrinsically gratifying and associated with adaptive outcomes, including enjoyment and positive affect. As a consequence, individuals will strategically align their cognition and beliefs with their motives. In doing so, they leverage the deliberative processes that underpin action to make participation in the behavior more likely. Pregnant women who experience PA as intrinsically motivating and enjoyable will, therefore, be more likely to report positive attitudes and perceived control and intend to participate in PA in future.

Contrary to hypotheses, subjective norm had no significant relation to intention. This finding is consistent with earlier theoretical explanations of integrating the TPB and SDT. Such a mediation path was not originally hypothesized, based on the reasoning that subjective norm is defined as reflecting *controlling*, rather than *autonomous*, beliefs (Hagger & Chatzisarantis, 2009). The current findings provide support for this original theorizing and corroborate previous research indicating that the association of subjective norm with PA intention is smaller than that of attitude and perceived behavioral control (Downs & Hausenblas, 2005). Further, lack of an association of subjective norm with intention could be due to an increased tendency of pregnant women to make decisions based on their personal beliefs, rather than their beliefs about others. The myriad of information and general advice provided to pregnant women from various sources has been shown to produce confusion (Connelly et al., 2015) and may therefore result in a decreased reliance on others' approval. Consistent with this observation, research has shown that self-efficacy beliefs are often reported as the most salient factors associated with PA in pregnancy (Gaston & Cramp, 2011).

In addition, the current findings indicated that self-control processes accounted for significant variance in behavior, independent of the motivational and social cognitive components. However, self-control did not moderate or mediate the intention-behavior relation as hypothesized in theory on self-control and previous research (Hagger, 2013, 2014; Hankonen et al., 2014). Theoretical explanations (Tangney et al., 2004) and empirical

evidence (de Ridder, 2015) have supported a direct relation of self-control to behavior. Pregnant women are likely faced with additional demands on their time as well as the increased physical demands as a result of their pregnancy. Those with high levels of self-control are likely to have sufficient self-regulatory skills and resources to exert the necessary effort to participate in regular PA, which suggests that they are potentially more effective in resisting alternative immediately gratifying actions, such as sitting down and watching television, in favor of engaging in effortful activities likely to lead to health benefits, such as participating in PA. The direct relation of self-control to behavior, and the absence of an intention-mediated path, is likely to reflect this capacity to resist impulses that is independent of deliberative processing (Hofmann & Kotabe, 2012). The lack of an interactive effect implies that self-control may be less important when it comes to more deliberative modes of acting; enactment of intentions appears not to depend on self-control levels in this population.

The current results also have potential ramifications for improving the PA of pregnant women. Given that multiple motivational and social cognitive factors are key influences related to behavior in this context, future interventions and campaigns should target these range of factors to promote PA behavior in pregnant women. Specifically, interventions at the individual and community levels should recognize the importance of changing personal beliefs with respect to PA in this context as pregnant women may be especially amenable to making health improving changes (Jepson, Harris, Platt, & Tannahill, 2010). Our findings can be translated into practice by linking the factors related to PA in this population with matched behavior change methods that have been shown to change these factors (Kok et al., 2016). This will lead to the development of behavior change interventions that may be optimally effective in changing behavior (see Michie, van Stralen, & West, 2011).

Based on current findings, some specific behavioral strategies could be considered in this context. First, pregnant women could be prompted to make choices and set intrinsic goals

for performing PA to instil a sense of intrinsic value and interest toward PA, thus promoting intrinsic motivation. Second, strategies to increase women's attitudes (e.g., providing information targeting salient beliefs and adopting gain-framed messages; Gallagher & Updegraff, 2012) and perceptions of control (e.g., prompting successful behavior practice and providing feedback; Ashford, Edmunds, & David, 2010) might be important to consider in improving PA intentions, the strongest determinant of behavior. Third, prompting pregnant women to adopt self-regulatory strategies such as monitoring of behavior (e.g., recognizing situations in which they might lapse from a healthy behavior), developing implementation plans and identifying cues to action, and engaging in tasks which may train or promote capacity to inhibit responses (Allom, Mullan, & Hagger, 2016; Friese, Frankenbach, Job, & Loschelder, 2016) may facilitate greater self-control capacity with respect to PA.

Strengths and Limitations

The current study was the first of which we are aware to apply a comprehensive integrative theoretical model to the area of PA in pregnant women. Although, in general, the tenants of the model were supported, future research that attempts to manipulate theoretical constructs and measures their influence on behavior change is essential in supporting the model for this behavior in this at-risk target group. The current prospective research does, however, highlight important multiple pathways to behavioral engagement, which can be used as a basis for interventions that may be efficacious in eliciting behavior change.

Results should also be considered in light of some limitations. First, although measures were undertaken to prevent participant drop out (e.g., offers of incentives, a brief follow-up measure), the attrition rate was 40% from the main study to the follow-up sample. Thus, the possibility of unmeasured retention biases must be considered. Second, despite using recruitment methods frequently adopted in research using correlational designs, the sample consisted predominately of Caucasian women, limiting generalizability of the findings

to other cultural, racial, and ethnic groups. However, research has demonstrated that patterns of effects among constructs of the TPB generalize across national and cultural groups in the context of PA (Hagger et al., 2007). Third, although participants who completed measures at baseline and follow-up did not differ from those who dropped out by demographic variables, some evidence of selection bias was apparent in that mean levels of social psychological variables (attitude, intrinsic motivation, and subjective norms) were higher for those completing both time points and those that dropped out. Fourth, although effect sizes for the differences were small, we must acknowledge that current findings may have been affected by the tendency of participants with higher motivation to remain in the study, making the findings less generalizable.

Furthermore, the measurement of PA was via self report and assessed over a one-week time period; thus, the current results may reflect some reporting error and cannot be applied to questions about maintaining PA behavior over a more extended period, which may be more important and relevant for positive pregnancy and health outcomes. Although self-reports are a frequently used practice in research on PA and have been shown to be reliable and valid for assessing PA (Hamilton, White, & Cuddihy, 2012; Milton et al., 2010), to investigate changes in naturally occurring PA over time, baseline measures of behavior as well as longer follow-ups and objective measures of PA would be advisable. In addition, some of the measures adopted exhibited slightly lower psychometric properties, as have been found in previous research (e.g., self-control, Tangney et al., 2004). The lower reliabilities should be considered when making comparisons between the findings from the current study using these measures and research in other contexts adopting similar measures. However, the concerns may be mitigated somewhat by the use of a latent variable approach in our analysis. This allowed us explicitly to model measurement error and, as a consequence, the constructs and associated parameter estimates can be considered relatively error-free (Huba & Harlow, 1987).

The current findings have high value as they provide the first proof-of-concept evidence in support of the integrated model for PA in pregnant women albeit over a relatively short behavioral follow-up period. Although our data highlight the potential relevance of the different pathways to action derived from the integrated model to long-term explanation of variance in PA, future studies with longer behavioral follow-up are needed to verify this potential. In addition, research that includes multiple measures of PA at follow-up is needed to evaluate the effectiveness of the integrated model in accounting for variance in PA across the life course of pregnancy, from prenatal to antenatal through to postnatal. While this study investigated an important health behavior for pregnant women, future research might benefit from a continued examination of this integrative model to determine its utility to other key health-related behaviors that are also shown to be important in pregnancy (e.g., smoking, alcohol use, healthy eating practices, sedentary behavior).

Conclusion

The current study tested an integrative model incorporating three psychological theories (TPB, SDT, and self-control theory) applied to PA in pregnant women, a group that is at risk of low levels of PA. Overall, the majority of the core associations among the motivational and social cognitive factors proposed in the model were supported. Future research should investigate possible moderation and mediation effects to determine which processes predominate in determining action and manipulate the theoretical constructs and measure their influences on behavior change to support the tenets of the model. Future research should also undertake longer term longitudinal investigations to address questions about PA maintenance during pregnancy. Despite the correlational design of the current study, the findings do suggest important potential routes to behavioral performance that researchers can use to ensure the design of future PA interventions for pregnant women that are efficacious in eliciting behavior change. Future interventions aimed at improving the PA

of pregnant women should therefore consider the multiple processes advocated in the integrative model as necessary for motivated action.

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Table 1

Physical activity and pregnancy: Demographic data and descriptive statistics for study variables across time points

Variable	Time 1	Time 2
Participants, n	207	117
Age in years, *Mean* (*SD*)	30.03(4.49)	30.53 (4.42)
Gestational age in weeks, *Mean* (*SD*)	25.02 (8.70)	24.32 (8.81)
BMI in kg/m^2, *Mean* (*SD*)	27.49 (5.74)	27.34 (5.63)[a]
Employment status *n* (%)		
currently unemployed/home duties	57 (27.5%)	29 (24.8%)
currently employed full-time	81 (39.1%)	49 (41.9%)
part-time/casual employed	69 (33.4%)	39 (33.3%)
Ethnicity *n*(%)[b]		
Caucasian	196 (95.6%)	111 (96.5%)
Indigenous/Torres Strait Islander	2 (1.0%)	1 (0.9%)
Other	7 (3.4%)	3 (2.6%)
Annual household income *n* (%)		
AU$0-$18,200 (US$0-$13946)	12 (5.8%)	3 (2.6%)
AU$18201- $37,000 (US$13947- $28352)	9 (4.3%)	6 (5.1%)
AU$37001- $80,000 (US$28353 - $61302)	58 (28.0%)	32 (27.3%)
AU$80,001- $180,000 (US$61303 - $137930)	102 (49.3%)	62 (53.0%)
AU$180,000+ (US$137931+)	26 (12.6%)	14 (12.0%)
Education level attained *n* (%)		
Junior school	12 (5.8%)	4 (3.4%)
Senior school	28 (13.5%)	13 (11.1%)
TAFE (technical and further education) /diploma	50 (24.2%)	28 (23.9%)
University undergraduate degree	73 (35.2%)	42 (36.0%)
University postgraduate degree	44 (21.3%)	30 (25.6%)
Psychological variables, *Mean* (*SD*)		
Attitude	5.43 (1.53)	5.63 (1.40)
Subjective norm	5.82 (1.35)	6.03 (1.10)
Perceived behavioral control	4.96 (1.70)	5.12 (1.71)
Intention	5.15 (1.78)	5.39 (1.61)
Intrinsic motivation	5.92 (1.13)	6.07 (0.90)
Self-control	3.48 (0.52)	3.52 (0.50)
Behavior	3.89 (1.86)	4.02 (1.75)

Note. Age expressed in years; Gestation age expressed in weeks; BMI expressed as weight (kg)/height (m)^2; Psychological variables measured on 1 to 7 scale; [a]One participant did not report their BMI; [b]Two participants did not report their ethnicity; Time 1 = baseline data, Time 2 = follow-up data.

Table 2

Physical activity and pregnancy: Estimated means (M), standard deviations (SD), and intercorrelations of latent variables (N=117)

	1	2	3	4	5	6	7	8	9	10
1. Intrinsic motivation T1	1.00									
2. Attitude T1	0.54**	1.00								
3. Subjective norm T1	0.35*	0.41*	1.00							
4. PBC T1	0.37*	0.68**	0.42*	1.00						
5. Intention T1	0.47**	0.78**	0.39*	0.78**	1.00					
6. Self-control T1	0.45*	0.24*	0.16*	0.17*	0.19*	1.00				
7. PA behavior T2	0.23*	0.49*	0.26*	0.57*	0.59*	0.27*	1.00			
8. Age	-0.03	-0.02	-0.01	-0.01	-0.01	-0.07	-0.17*	1.00		
9. BMI	-0.13*	-0.07	-0.05	-0.05	-0.06	-0.16*	-0.12*	0.10	1.00	
10. Gestational age	0.01	0.02	0.01	0.03	0.01	0.08	-0.12*	-0.01	0.12*	1.00
Factor loadings for manifest indicators within construct	0.91; 0.77	0.95; 0.70	0.77; 0.90; 0.94	0.95; 0.91	0.98; 0.97	0.60; 0.63; 0.50; 0.67	0.91; 0.96	–	–	–
M[a]	6.07	5.63	6.03	5.12	5.39	3.51	4.01	30.53	27.34	24.32
SD[a]	0.90	1.30	1.10	1.71	1.61	0.51	1.74	4.42	5.63	8.81
Alpha[a]	0.71[b]	0.71[b]	0.93	0.83[b]	0.96[b]	0.76	0.89[b]	–	–	–

Note. Age expressed in years; Gestation age expressed in weeks; BMI expressed as weight (kg)/height $(m)^2$; Psychological variables measured on 1 to 7 scale; PBC = perceived behavioral control; [a]Manifest scale means, standard deviations, and internal consistency; [b]Pearson correlation (two items only); T1 = baseline data, T2 = follow-up data. *$p < 0.05$; **$p < 0.01$.

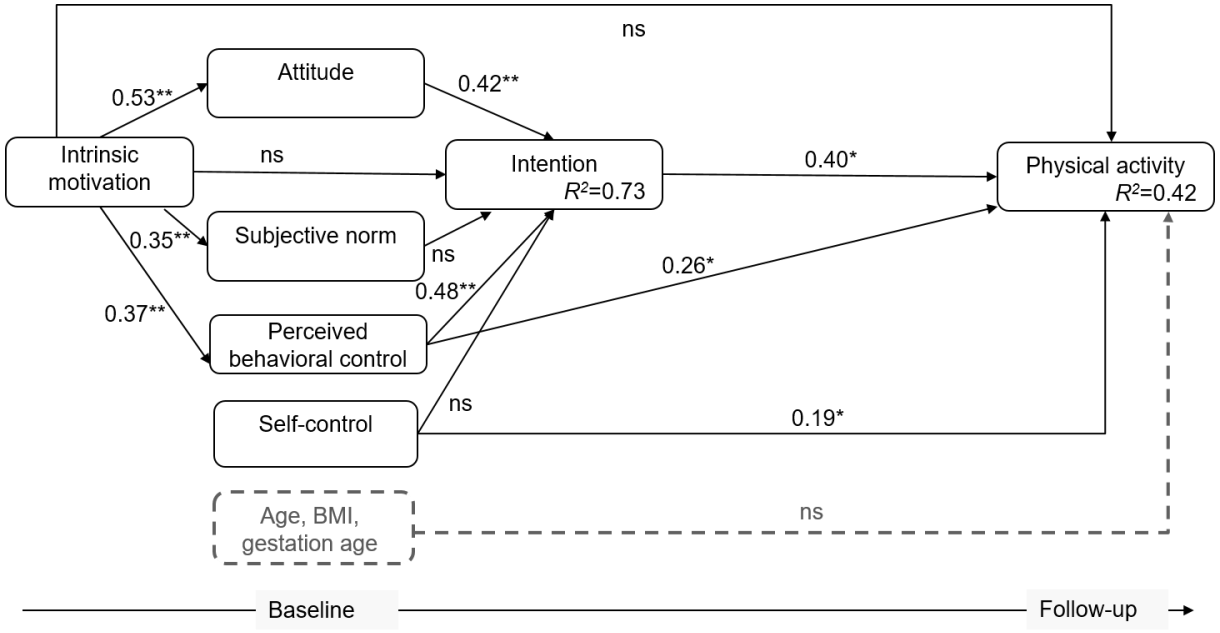

Figure 1. Structural model for predicting PA in pregnant women (N = 117). Fully standardised beta coefficients are reported. Of the covariates entered (i.e., age, BMI, gestation age), none emerged as having significant associations ($p > 0.05$) over and above the social-cognitive variables in the tested model. BMI = Body-mass index. Significance levels were *$p < 0.05$, **$p < 0.01$.