HEALTH PSYCHOLOGY AND BEHAVIORAL MEDICINE
2025, VOL. 13, NO. 1, 2468841
https://doi.org/10.1080/21642850.2025.2468841

Taylor & Francis
Taylor & Francis Group

Physical activity during pregnancy: key beliefs to support intervention

Laurence Simard[a], Stéphanie Girard[a], Jean Lemoyne[a], Véronique Babineau[b] and Stephanie-May Ruchat[a]

[a]Department of Human Kinetics, Université du Québec à Trois-Rivières, Trois-Rivières, Canada; [b]Department of Obstetrics and Gynecology of CIUSSS de la Mauricie et du Centre-du-Québec, affiliated with the Université de Montréal, Trois-Rivières, Canada

ABSTRACT

Background: Physical activity (PA) provides maternal and fetal health benefits, but only 27.5% of Canadian pregnant women meet PA recommendations. Theory-based interventions like the theory of planned behavior (TPB) are useful in explaining what drives behavior. The first objective of this study was to validate the TPB model to predict prenatal moderate-to-vigorous physical activity (MVPA), including testing of the novel interaction between intention and perceived behavioral control (PBC). The second objective was to identify which specific beliefs predict intention toward prenatal MVPA to support intervention.

Method: We used a prospective correlational design. Healthy pregnant women completed two electronic questionnaires: at baseline, to assess TPB constructs, and one month later, to assess MVPA practice. Structural equation modeling was conducted with Latent Moderated Structural Equations. The interaction was interpreted with the pick-a-point method and the Johnson-Neyman graphical method.

Results: The sample consists of 193 women ($M_{age} = 31.2 \pm 3.6$). Results indicate that prenatal MVPA at one month was marginally predicted by intention ($\beta = 0.149$; $p < 0.10$) and PBC ($\beta = 0.322$; $p < 0.05$, MVPA $R^2 = 20\%$), but when their interaction was added to the model, MVPA R^2 increased to 44%. Specifically, the relationship between intention and MVPA is stronger when PBC is high (0.5 standard deviation over the mean). In the full model including the interaction, attitude ($\beta = 0.59$; $p < 0.001$), subjective norm ($\beta = 0.20$; $p < 0.01$) and PBC ($\beta = 0.26$; $p < 0.05$) all made a significant contribution to predicting MVPA intention ($R^2 = 88\%$). Finally, the following beliefs displayed significant indirect paths toward the intention of being physically active: behavioral beliefs: unlikely to be more tired and likely feel better mentally; normative beliefs: approval from friends and from mother/father; and control beliefs: being tired and missing social support.

ARTICLE HISTORY

Received 4 October 2024
Accepted 11 February 2025

KEYWORDS

Beliefs; intention; perceived behavioral control; physical activity; pregnancy; theory of planned behavior

CONTACT Stephanie-May Ruchat stephanie-may.ruchat@uqtr.ca Department of Human Kinetics, Université du Québec à Trois-Rivières, 3351, Boul Des Forges, Trois-Rivières QC G9A 5H7, Canada

Supplemental data for this article can be accessed online at https://doi.org/10.1080/21642850.2025.2468841

Conclusion: Interventions aiming to promote regular MVPA during pregnancy should prioritized the six significant beliefs identified to significantly predict intention toward prenatal MVPA.

Introduction

International guidelines, including those from Canada, recommend that pregnant women without complication achieve at least 150 min of moderate-intensity physical activity (MVPA) each week (Okely et al., 2021). Meta-analyses have shown that achievement of these recommendations is significatively associated with a reduced risk of developing health complications for the mother (*e.g.* gestational diabetes mellitus, hypertensive disorders, depression) (Davenport et al., 2018a; Davenport et al., 2018b) and newborn (*e.g.* macrosomia) (Davenport et al., 2018c). Despite the fact that 70% of pregnant women identify prenatal physical activity (PA) as important, beneficial and safe (Lindqvist et al., 2017), few women are meeting PA recommendations (Gjestland et al., 2013; Hayman et al., 2016; Hesketh & Evenson, 2016; Mielke et al., 2021; Srugo et al., 2023). It is therefore of critical importance to identify why pregnant women are not sufficiently active. Ajzen's theory of planned behavior (TPB) is one of the behavioral theories that have been primarily used to explain PA practice among this population (Thompson et al., 2017).

The original TPB model (Ajzen, 1991) suggests that behaviors are directly explained by intention. Intention is determined by three direct determinants: attitude (ATT; a person's perception of the pros and cons of engaging in the behavior), subjective norm (SN; pressure to comply with the approval or disapproval of significant others) and perceived behavioral control (PBC; the degree of difficulty perceived in adopting the behavior). PBC is also a determinant when the performance of a behavior is not completely under volitional control. These direct determinants are explained by a set of indirect determinants, or beliefs, which are behavioral beliefs (BB; sub-constructs of ATT), normative beliefs (NB; sub-constructs of SN) and control beliefs (CB; sub-constructs of PBC). In the context of developing a TPB-based intervention to promote the adoption of a behavior, such as PA practice, it is particularly important to identify the beliefs that are likely to influence the intention to perform the behavior. Indeed, 'behavioral, normative, and control beliefs represent the information people have about a behavior, and it is ultimately on the basis of this information that they are said to make their decisions' (p. 53) (Ajzen & Manstead, 2007). The TPB model has evolved and been updated (see Figure 1), suggesting that PBC, a proxy for actual behavioral control (*i.e.* the extent to which an individual has the skills, resources, and other conditions needed to adopt a behavior), moderate the effect of intention on behavior, such that a favorable intention toward the behavior translate into the adoption of the behavior only when PBC is strong (Fishbein & Ajzen, 2010). In this respect, Hagger et al.'s meta-analysis, published in 2022, suggested that PBC can act as a moderating variable on the association between intention and behavior (Hagger et al., 2022).

Over the years, many studies conducted with pregnant women have used the original TPB model to better understand prenatal PA. Studies have shown that up to 47% of variance of prenatal PA is explained by intention and PBC (Downs & Hausenblas, 2007; Hausenblas & Downs, 2004). Studies have also shown that, on average, ATT, SN and PBC explain up to 68% of variance of intention to engage in regular prenatal PA

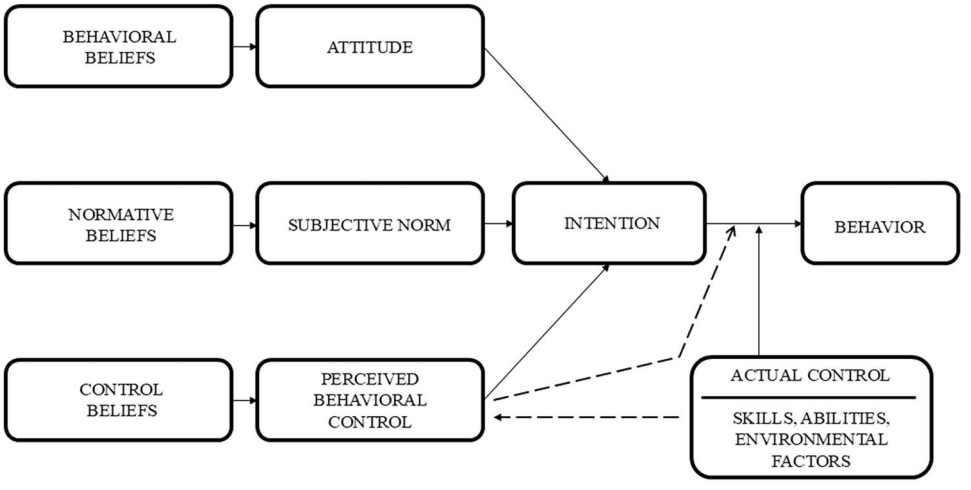

Figure 1. Schematic representation of the updated theory of planned behaviour model (Fishbein & Ajzen, 2010).

(Downs & Hausenblas, 2003; Downs & Hausenblas, 2007; Guelfi et al., 2015 Hausenblas & Downs, 2004). The exploration of PA beliefs has also been an objective of some studies (Downs et al., 2015; Downs & Ulbrecht, 2006; Guelfi et al., 2015; Hausenblas et al., 2011; Muzigaba et al., 2014; Tinius et al., 2020; Weir et al., 2010). From these studies, the most cited behavioral beliefs are a decreased fatigue following PA, a better weight control, an increase of back pain, a better mental health, and a better preparation for delivery. The importance given on the spouse and the close family constitute the most frequently mentioned normative beliefs (Downs et al., 2007; Hausenblas et al., 2011; Muzigaba et al., 2014; Tinius et al., 2020). Lastly, the most cited control beliefs are tiredness, pain, discomforts and lack of time and motivation (Downs et al., 2015 Downs & Hausenblas, 2007; Hausenblas et al., 2011; Muzigaba et al., 2014; Tinius et al., 2020). To our knowledge, no study has examined beliefs associated with regular practice of MVPA among healthy French-speaking pregnant women living in the province of Quebec (Canada). Moreover, no study has explored the moderating effect of PBC on the association between intention and prenatal PA among pregnant women. Filling these gaps is important to better support French-speaking pregnant women living in Quebec toward an active pregnancy. The first objective of this study was to test the TPB model to predict prenatal MVPA, while considering the novel interaction between PBC and intention. The second objective was to identify which specific beliefs predict intention toward prenatal MVPA through direct determinants (ATT, SN, and PBC).

Materials and methods

Design and procedures

This is a correlational prospective study that was conducted online. Participants were recruited between February and May 2022 via various recruitment strategies to limit recruitment bias, including advertisement in social media (Facebook), and installation

of posters in various sites attended by pregnant women (*e.g.* medical clinics, hospital, community centers). Inclusion criteria were being ≥ 18 years old, being between the 8th and 33rd week of pregnancy, carrying a single fetus (since twin or higher order pregnancy is a relative contraindication to MVPA), having a healthy pregnancy (*i.e.* not diagnosed with pregnancy complications) and having no contraindications to exercise or movement restrictions (Mottola et al., 2019). To calculate sample size, we proceeded in two steps. As we conducted multiple regression (Faul et al., 2007), we first considered the required sample size for such analyses by using G*Power software. Assuming a statistical power of 0.80, an alpha value of 0.05 and an expected 'average' effect for intention modeling (f2 (Cohen, 1988) of 0.15) (Cohen, 1988), a sample size of 120 participants was required. Then, considering that we conducted path analyses, we also took account of the 'N:' ratio (participants relative to number of parameters). In the present study, the N;q ratio (N;q = 7.4) was judged acceptable which suggest that we attained minimum sample size to get sufficient statistical power (Jackson, 2003; Kline, 2016).

Data collection

Data were collected at recruitment (baseline) and one-month later using electronic questionnaires. Baseline questionnaire collected information about sociodemographic characteristics (*e.g.* age, pre-pregnancy body weight, height, ethnicity, education level), level of PA over the past month, and the TPB psychosocial constructs. The one-month follow-up questionnaire collected information about PA level over the past month.

Prenatal PA level

Prenatal PA level at baseline and at the one-month follow-up was assessed using the French version of the International Physical Activity Questionnaire [IPAQ] – Short form (Gauthier et al., 2009) and PA scores were calculated using standard protocols as recommended (Craig et al., 2003). The IPAQ is a self-reported questionnaire that asks about the time spent being physically active in the last seven days. Questions are asked about vigorous-intensity PA, moderate-intensity PA and walking. The French version of the IPAQ has good psychometric properties among adults aged between 18 and 64: the value of test-retest reliability intraclass correlation coefficient for leisure time was 0.86 (0.74–0.93) and a Pearson correlation of 0.60 ($p < 0.05$) with the Yamax Digi-Walker SW-200 pedometer was observed for convergent validity (Gauthier et al., 2009). It also has good psychometric properties among pregnant women: test-retest reliability intraclass correlation coefficient for MPA, VPA and MVPA ranged from 0.81 to 0.84 (95% CI 0.69, 0.90) and a Pearson correlation ranged from 0.08 to 0.39 with the SenseWear Armband monitor (Sanda et al., 2017). In the context of our study, questions were asked about PA practiced over the past month.

Psychosocial construct measures

The psychosocial constructs assessed were the variables of the TPB. As recommended by Ajzen & Fishbein (Ajzen & Fishbein, 1980), psychosocial variables were defined in terms of *action* (participate regularly), *target* (MVPA), *context* (during my pregnancy), and *time* (over the past month). In order to standardize the definition of regular PA for all participants, the following definition was presented: 'Practicing physical activity regularly means:

accumulating at least 150 min (2.5 h) of physical activity per week (*e.g.* five sessions of 30 min or three sessions of 50 min) at moderate or vigorous intensity' (Mottola et al., 2019).

Participants completed the self-reported baseline questionnaire asking them to assess the variables on a 7-point Likert-type scale (1-7); the variables were intention (3 items), ATT (6 items), SN (2 items), PBC (4 items), BB (8 items), NB (4 items) and CB (8 items). Two BB were recoded as they were reversed (*If I practiced regularly one or more physical activities in my free times over the next month, I would be more tired/have pregnancy-related discomforts and pains;* unlikely = 7; likely = 1). For these beliefs, as suggested by Gagné and Godin (Gagné & Godin, 2000), only expectancy components were included, rather than expectancy-value combinations. Salient modal beliefs were chosen from an elicitation study previously conducted by our research team in accordance with the methodology recommended by Ajzen & Fishbein (Ajzen & Fishbein, 1980). Briefly, the identification of salient beliefs was done on an individual basis, *i.e.* with each participant, in a free-response pencil-and-paper or an online questionnaire format. Ten French-speaking pregnant women living in the province of Quebec (Canada) were included. For instance, for the BB, participants were asked: 'What would be the benefits/disadvantages to you of doing at least 150 min of moderate- to vigorous-intensity physical activity each week during the current pregnancy trimester?'. Online Supplementary Table 1 describes each of the psychosocial variables. Finally, the self-administered questionnaire was submitted to a test-retest procedure over a two-week period to an independent group of 36 pregnant women. Cronbach's alpha coefficients to estimate the internal consistency of the scales used are reported in Online Supplementary Table 1. Although there is no universally agreed-upon level for Cronbach's alpha coefficients, a minimum score of 0.70 has been recommended (Tavakol & Dennick, 2011). Regarding the test-retest, all intraclass correlation coefficients exceeded the threshold value of 0.50 for acceptable reliability (Bobak et al., 2018).

Statistical methods

Descriptive statistics (mean, standard deviation and percentage) for each variable were calculated. Unpaired Student t-test for continuous variables and chi-squared test for dichotomous variables were used to compare baseline characteristics between women who were included in the study and those who were excluded. Zero-order correlation coefficients among TPB variables, and one-month MVPA were calculated. Prior to using structural equation modeling for main analyses, assumptions of multivariate normality was carried out by calculating the Mardia coefficient, which is used to verify normality postulates in the context of multivariate analyses (Mardia, 1980; Raykov & Marcoulides, 2006). Preliminary analyses reveal violation of multivariate normality ($M_{\text{kurtosis}} = 49.62$, $p < 0.001$; $M_{\text{skewness}} = 10.04$, $p < 0.001$), which suggest selecting the maximum likelihood modeling procedure with robust estimates as the analytic procedure (Yuan & Bentler, 2007). Models were estimated using Mplus software (version 8).

Model estimation – To address the first objective, we estimated three structural models. Given the limited sample and the high number of parameters estimated, beliefs were not included in these models. Model 1 (M1) replicates the TPB model (ATT, SN, PBC → intention → behavior) to predict one-month prenatal MVPA follow-up. In model 2 (M2), we added the direct path between PBC and MVPA (see

Figure 2) and, in Model 3 (M3), we added the interaction between PBC and intention to predict prenatal MVPA (see Figure 3) using the Latent moderated structural equations (LMS) procedure (Marsh et al., 2012).

To address the second objective, we first tested the TPB model with the contribution of beliefs to predict intention through direct determinants (beliefs → direct determinants → intention). In this model, we tested all indirect paths for each type of beliefs (treated as composite scores) on all direct determinants. Once significant paths were observed, we tested three smaller models (one for each set of beliefs) to identify which specific beliefs predicted intention through direct determinants (BB → ATT → INT; NB → SN → INT; CB → PBC → INT).

Model interpretation – Model interpretation is based on the most common fit indices (Barbeau et al., 2019). The chi-square statistic (χ^2) indicates the level of model fit. To estimate the quality of the indices, we used the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). Estimation errors were estimated using the Rooted Mean Square Error of Approximation (RMSEA) and the Standardized rooted mean square residual (SRMR). To interpret the indices, we followed the suggestions of Hu and Bentler (Hu & Bentler, 1999): 1- a non-significant value of χ^2 (*goodness-of-fit*); 2- CFI et TLI > 0.950; 3- RMSEA and SRMR < 0.07. To interpret the fit of the model with the interaction variable, we used the log-likelihood ratio test (Klein & Moosbrugger, 2000) because fit indices are not provided when using the XWITH command to create the interaction variable with the LMS method (Wang & Wang, 2012). The interpretation of the interaction was done using two strategies: pick-a-point and Johnson-Neyman graphical method (Johnson & Fay, 1950; Rogosa, 1980). The first allows to visualize the interaction and the latter indicates for which value of the moderator the interaction is significant (*i.e.* it provides zones of significance). For more details about these methods, see Girard et al. (2020).

Ethics statement

Participation was voluntary, and written informed consent was obtained from all participants. This study was approved by the Local Research Ethics Committees: Université du Québec à Trois-Rivières (CER-22-285-10.01) and CIUSSS de la Mauricie et du Centre-du-Québec (MP-29-2022-564, 827).

Results

Participants

A total of 256 pregnant women were recruited and completed the baseline questionnaire. Among them, 204 completed the one-month follow-up questionnaire (attrition rate = 20.3%). In the one-month follow-up questionnaire, 11 women reported weekly MVPA > 450 min (weekly MVPA between 480 and 1100 min), which is 3–7 times more than the recommended 150 min of MVPA during pregnancy. Careful examinations of PA data collected from these women led us to believe that they were unreliable. These women were therefore excluded from the sample. Thus, a total of 193 women were included in the analyses. Baseline sociodemographic characteristics of women who completed the study and those who were lost to follow-up or excluded were similar (data not shown).

Demographic characteristics

Characteristics of the participants are presented in Table 1. Women were in their thirties; most were nulliparous, and the majority had a pre-pregnancy body mass index < 25 kg/m^2. Most of them were Caucasian and held a university degree. Among participants, less than half achieved the Canadian PA guidelines at baseline.

Correlation matrix

As shown in Online Supplementary Table 2, the zero-order correlation matrix shows that the correlation coefficients (r) between intention and behavior and between PBC and behavior is 0.35 and 0.42 (all p's < 0.01), respectively. Similarly, correlation coefficients between intention and the direct determinants indicates that intention is positively correlated with ATT ($r = 0.75$), SN ($r = 0.53$), and PBC ($r = 0.68$) (all p's < 0.01). In terms of the indirect determinants, significant correlations are observed between BB and ATT ($r = 0.60$), NB and SN ($r = 0.54$) as well as between CB and PBC ($r = 0.68$) (all p's < 0.01). Finally, intention is positively correlated with BB ($r = 0.43$), NB ($r = 0.28$), and CB ($r = 0.60$) (all p's < 0.01).

Objective 1

Table 2 presents model fit indices for the three models tested. All models provide an acceptable fit. The log-likelihood ratio test is significant, indicating that model 3 (with the interaction) have a better fit than model 2. The effect size of the interaction is 0.33, which represents a large size effect (Girard et al., 2020).

Table 1. Baseline characteristics of the participants ($n = 193$).

Variables	Mean ± SD or n (%)
Age (years)	31.2 ± 3.6
Pre pregnancy BMI (kg/m^2)	24.3 ± 4.6
Pre pregnancy BMI categories (kg/m^2)	
< 25.0	127 (65.8)
25–29.9	46 (23.8)
> 30.0	20 (10.4)
Education level	
University degree	155 (80.3)
Non-University degree	38 (19.7)
Ethnicity	
Caucasian	188 (97.4)
Others	5 (2.6)
Gestational age (week/days)	20 (7) / 2.9 (2)
State of pregnancy	
First trimester (≤ 14 weeks)	56 (29)
Second trimester (15-28 weeks)	108 (56)
Third trimester (≥ 29 weeks)	29 (15)
Parity	
0	144 (74.6)
1	39 (20.2)
≥ 2	10 (5.2)
Physical activity levels*	
MVPA (min/week)	145.9 ± 101
≥ 150 min/week of MVPA	82 (44.8)
< 150 min/week of MVPA	101 (55.2)

Note. BMI = Body mass index; MVPA = Moderate-to-vigorous intensity physical activity. *Data available for 183 participants.

Table 2. Fit indices.

Model	χ^2 (df)	CFI	TLI	RMSEA	SRMR	H0 value	Free parameters	R^2 INT	R^2 MVPA
M1	140.213*(78)	0.956	0.941	0.066	0.062	−4139.61	57	87%	19%
M2	138.44*(77)	0.957	0.941	0.066	0.061	−4138.11	58	87%	20%
M3	–	–	–	–	–	−4387.68	59	88%	44%

Note. *$p < 0.05$.

Figure 2 presents standardized estimates for the structural model 2 (original model of the TPB), which explains 20% of the variance of prenatal MVPA. All direct determinants predict the intention toward MVPA ($R^2 = 87\%$) while MVPA was positively predicted by PBC, but not intention.

Figure 3 presents standardized estimates for the final structural model (model 3 including the intention x PBC interaction), which explains 44% of the variance of prenatal MVPA. All direct determinants predict the intention toward MVPA ($R^2 = 88\%$), and the interaction between PBC and intention positively predicted MVPA. Specifically, the relationship between intention and MVPA is stronger when PBC is high (0.5 standard-deviation over the mean) (See Figures 4 and 5). As for the interaction illustrated in Figure 4, it indicates that the positive relationship between intention and MVPA is stronger when PBC is high. Specifically, the interpretation of the Johnson-Neyman plot depicted in Figure 5 specifies that the interaction is significant only when PBC is 0.5 standard deviation over the mean.

Objective 2

The structural model including beliefs as composite scores indicates acceptable fit indices ($\chi^2 = 236.55_{(113)}$; $p = 0.000$; CFI = 0.931; TLI = 0.908; RMSEA = 0.078; SRMR = 0.067). Then, three specific models were tested to identify which specific beliefs predicted the

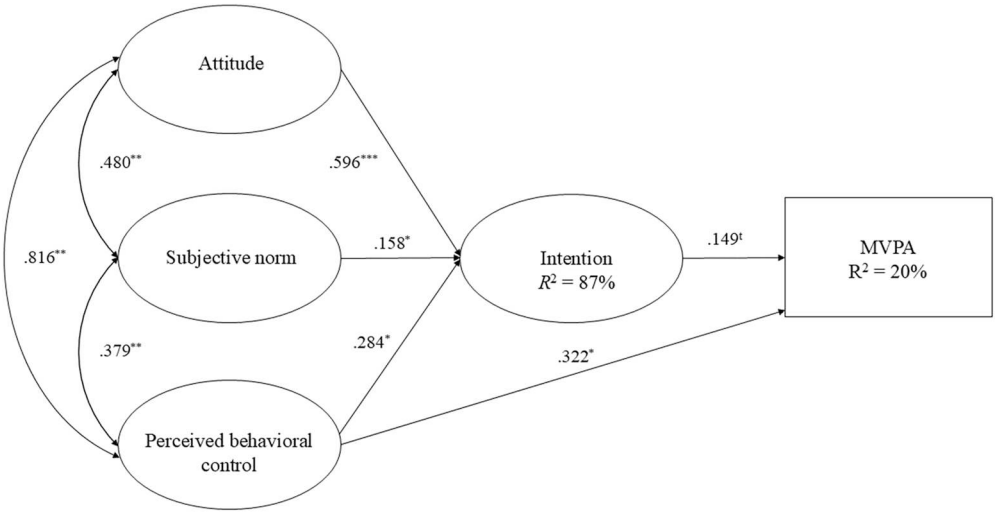

Figure 2. Structural model 2. *Note.* $^t p < 0.10$; $^* p < 0.05$; $^{**} p < 0.01$; $^{***} p < 0.001$; R^2 = explained variance

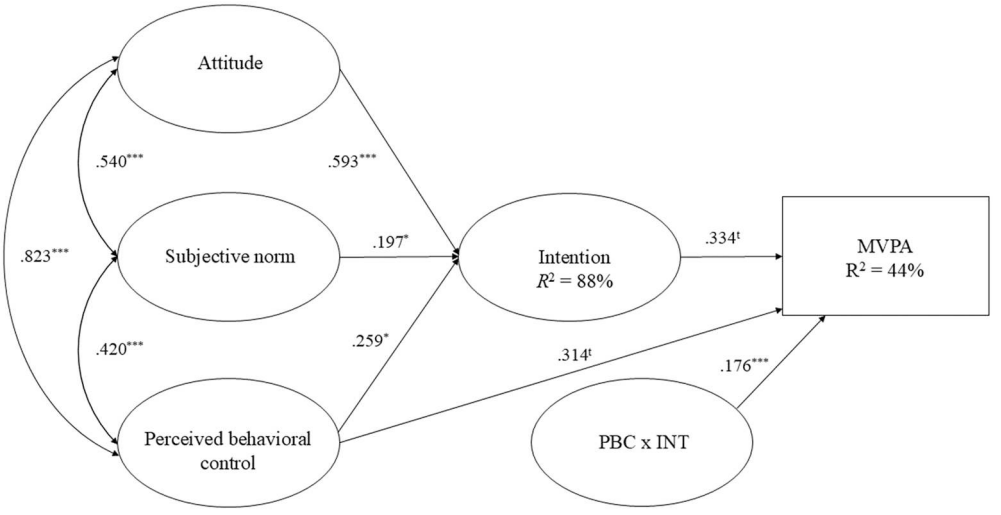

Figure 3. Structural model with the interaction (model 3). *Note*. $^{t}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; R^2 = explained variance.

intention toward prenatal MVPA. Table 3 presents all beliefs that were included in the baseline questionnaire.

For the BB model, the results indicate acceptable fit indices ($\chi^2 = 11.20_{(7)}$; $p = 0.13$; CFI = 0.979; TLI = 0.956; RMSEA = 0 0.057). Beliefs 2 ('unlikely to be more tired') ($p = 0.001$) and 6 ('likely feel better mentally') ($p < 0.001$) show significant effects on intention toward prenatal MVPA. For the NB model, the results indicate excellent fit indices ($\chi^2 = 6.40_{(4)}$; = 0.17; CFI = 0.971; TLI = 0.936; RMSEA = 0.056). Beliefs 3 ('approval

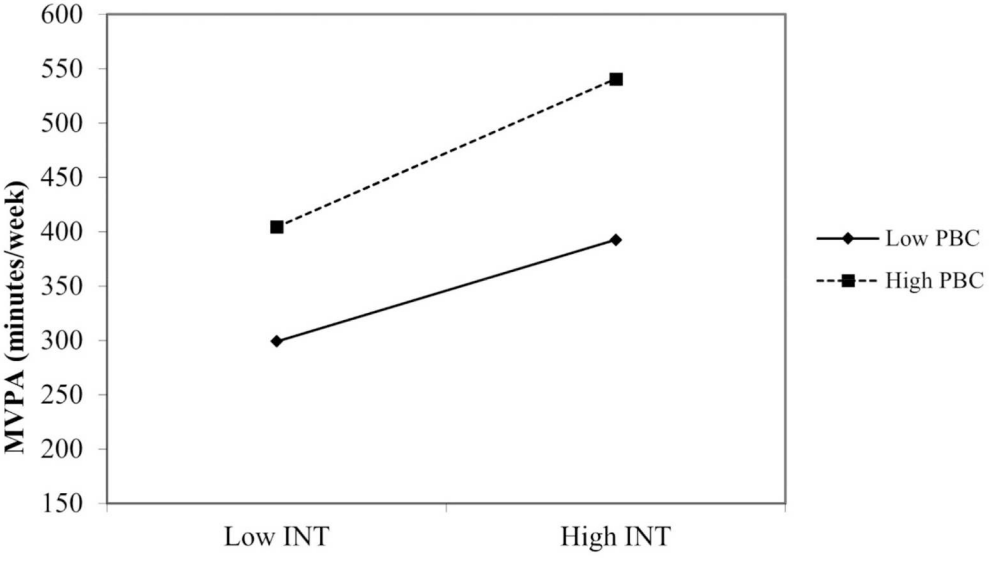

Figure 4. Interaction between intention (INT) and PBC to predict prenatal MVPA.

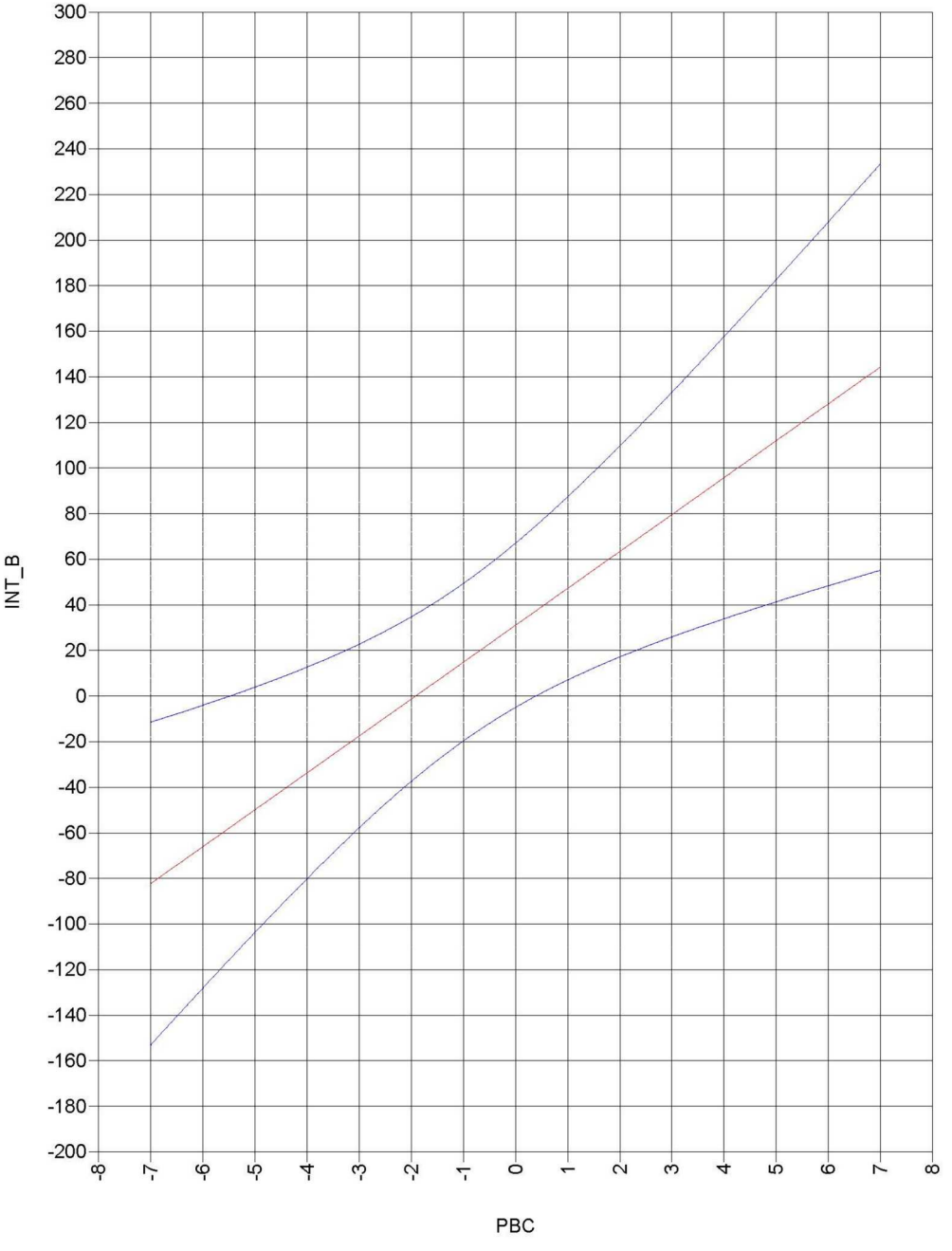

Figure 5. Johnson-Neyman plot to interpret the interaction between intention adjusted effect (INT_B) and PBC to predict prenatal MVPA.

from friends') ($p < .001$) and 4 ('approval from mother/father') ($p = 0.002$) display a significant association with intention toward prenatal MVPA. Finally, for the CB model, the results indicate satisfactory fit indices ($\chi^2 = 20.34_{(8)}$; $p = 0.01$; CFI = 0.945; TLI = 0.882; RMSEA = 0.090). In this model, beliefs 2 ('Being tired') ($p = 0.001$) and

Table 3. Maternal salient beliefs about prenatal moderate-to-vigorous physical activity (indirect paths to intention [standardized estimates]).

Beliefs	Beta (SE)	*p* value
Behavioral beliefs		
If I practiced regularly one or more physical activities in my free times over the next month, I would …		
1. Likely be in better physical condition	0.07 (0.08)	0.401
2. Unlikely be more tired*	0.13 (0.04)	**0.001**
3. Likely better manage weight gain	0.06 (0.05)	0.277
4. Unlikely have pregnancy-related pain/ discomfort*	0.05 (0.06)	0.348
5. Likely have better preparation for childbirth	0.04 (0.06)	0.518
6. Likely feel better mentally	0.35 (0.06)	**< 0.001**
7. Likely foster better health for the baby	0.07 (0.06)	0.231
Normative beliefs		
My ___ would approve of me practicing regularly one or more physical activities over the next month		
1. Health professionals	−0.07 (0.05)	0.190
2. Spouse	0.08 (0.05)	0.088
3. Friends	0.19 (0.05)	**< 0.001**
4. Mother and/or father	0.18 (0.06)	**0.002**
Control beliefs		
If I was/had ___ over the next month, I would still practice regularly one or more physical activities.		
1. Lacking time	−0.03 (0.07)	0.709
2. Tired	0.38 (0.09)	**< 0.001**
3. Missing social support	0.10 (0.05)	**0.047**
4. Discomfort and pain	0.00 (0.06)	0.989
5. Physical limitations	0.04 (0.05)	0.441
6. Concerns about the safety of the baby	0.02 (0.04)	0.518
7. No access to sport facilities	0.03 (0.05)	0.542
8. No supportive environment	0.00 (0.06)	0.992

Note: * These two behavioral believes were negatively written so they were recoded (unlikely = 7; likely = 1).

3 ('missing social support') ($p = 0.047$) are significantly related to intention toward prenatal MVPA.

Discussion

The main objective of this study was to validate the TPB model considering the interaction between intention and PBC to predict prenatal MVPA. Then, we wanted to identify which specific beliefs predicted intention toward prenatal MVPA to support intervention.

First, when we tested the original model of the TPB including PBC and intention to predict MVPA, we found that 20% of the explained variance in prenatal MVPA was predicted by PBC, which is close to the 25% found by Hausenblas (Hausenblas & Downs, 2004). Other prospective studies found that MVPA was predicted by intention, with an explained variance ranging from 28% to 47% (Downs & Hausenblas 2003, 2007; Zamora-Flyr, 2010). The discrepancy between our results and those mentioned above might be explained by the characteristics of the women included, such as their trimester of pregnancy, intention or PBC scores at baseline. Our results therefore suggest that among women included in our study, it is not the intention that would dictates their MVPA practice, but rather the degree of ease they perceived in adopting the behavior.

This hypothesis was confirmed when we added the intention*PBC interaction to the model (full model), which increased the explained variance of prenatal MVPA to 44%. Specifically, our result indicate that pregnant women intention predicts their MVPA when their PBC is high. In other words, when pregnant women express a high level of

intention toward prenatal MVPA, they will be more inclined to take action if they perceive it is easy to practice prenatal MVPA regularly. Our study is the first to investigate the interaction between intention and PBC to predict pregnant women MVPA. To our knowledge, only the recent meta-analysis from Hagger et al. (2022), including 39 studies ($N = 13$ 121 non-pregnant participants), examined this interaction to predict different health behaviors such as PA, alcohol consumption, or nutrition. Our results are in accordance with the findings of this meta-analysis.

In line with Ajzen's theory (Ajzen, 1991), all three direct determinants predicted the intention toward prenatal MVPA ($R2 = 87\%$-88%). Although there is a growing body of literature on the use of the TPB to explain PA during pregnancy, the relative importance of direct determinants in predicting intention toward prenatal MVPA and the explained variance of intention vary from one study to another. Addis et al. (Addis 2022) also found all three direct determinants to be significant predictors of intention ($R^2 = 79\%$), while other authors reported that intention toward prenatal PA was predicted either by ATT and PBC ($R^2 = 37\%$) (Downs & Hausenblas, 2003), ATT and SN ($R^2 = 68\%$) (Hausenblas & Downs, 2004), PBC and SN ($R^2 = 59\%$) (Zamora-Flyr, 2010), or only by PBC ($R^2 = 48\%$) (Aiken & West, 1991). These varying results regarding the relative importance of direct determinants in predicting intention toward prenatal MVPA can be explained by several factors. First, the trimester of pregnancy in which the women were at the time of data collection could be one of the factors. For instance, the above-mentioned studies were carried out among women in different trimesters. Some studies, as well as the present one, included women in all trimesters (Leeet al., 2016; Addis al., 2022), whereas others included women in the 2nd and 3rd trimesters (Zamora-Flyr, 2010), 1st trimester (Hausenblas & Downs, 2004), 2nd trimester (Downs & Hausenblas, 2003) or 3rd trimester (Downs & Hausenblas, 2007). Considering that women experience important changes over the course of pregnancy, (*i.e.* physical, physiological, emotional), the contribution of each of the direct determinants may vary considerably between the different trimesters and may explain some of the differences across studies. Another factor could be the cultural background of women. For example, one study conducted among Chinese women reported that the reason most frequently cited for not being more active was fear of miscarriage (Zhang et al. 2014). In this regard, the only study looking at specific beliefs related to the safety of regular PA during pregnancy and comparing two cultures indicated a significant difference in this belief (Guelfi et al., 2015). In this study, Chinese pregnant women were more concerned than Australian pregnant women. The explained variance of intention also varies across studies and might be explained by the number of direct determinants that significantly contribute to the prediction of intention. We found that ATT, SN and PBC predicted 88% of intention, what is higher than expected. This result could be explained by the fact that the score of intention toward MVPA at baseline was very high in our population (mean of 5.9 out of a maximum score of 7, see Online Supplementary Table 2) and some women reported high levels of MVPA.

In the context of the TPB, it is the specific beliefs identified that would distinguish low and high intenders that should ultimately be targeted (Ajzen, 1991). This step remains essential since it provides an idea of the specific objectives of a TPB-based mass media campaign. Pregnant women of the present study were more likely to have a positive attitude toward the intention of being physically active if they believed that they would feel

better mentally and would not be more tired after their PA session (BB). These two beliefs are in accordance with those from previous studies (Downs et al., 2015; Downs & Hausenblas, 2007; Hausenblas et al., 2011; Tinius et al., 2020; Weir et al., 2010). Although the benefits of PA are recognized by many pregnant women (Lindqvist et al., 2017), our results and those of previous studies underlined that messages highlighting the positive effect of prenatal PA on mental health and those deconstructing false beliefs (*i.e.* that PA causes fatigue) remain important. Moreover, women were more likely to give importance to the opinion of their mother/father or friends about prenatal PA (NB), which is also in accordance with results of previous studies (Downs et al., 2007; Hausenblas et al., 2011; Muzigaba et al., 2014; Tinius et al., 2020). Social support could be a behavior change technique to use to make sure pregnant women have support from their relatives and to know the people who support them to perform the behavior. Finally, pregnant women were more likely to have a sense of control over the behavior if they were able to overcome tiredness and lack of social support (CB). Fatigue or lack of energy is the CB that emerges in almost all studies conducted among pregnant women (Downs & Ulbrecht, 2006; Downs & Hausenblas, 2007; Weir et al., 2010; Hausenblas et al., 2011; Muzigaba et al., 2014; Downs et al., 2015; Guelfi et al., 2015; Tinius et al., 2020). Therefore, identifying ways to overcome this specific barrier by using behavior change techniques, ask for help from healthcare professional or even educate the women themselves on the behavior should be the target of interventions to increase first the PBC, then behavioral intention, and ultimately prenatal PA. Raising awareness on the importance of providing support as well as identifying different ways to overcome this barrier (*i.e.* lack of support) should be favored in order to increase the level of PBC. On a practical standpoint, some of the behavior change techniques taxonomy developed by Michie et al. (2013) can be used to help pregnant women develop a positive attitude toward prenatal PA (*e.g.* Salience of consequences), have support from their relatives (*e.g.* Social support), and consider regular practice of PA as easy (*e.g.* Graded tasks).

Limitations/strengths

First, the use of a recognized theoretical framework is undoubtedly one of the most important strengths of this study. Indeed, although TPB is recognized for its ability to predict PA behavior (McEachan et al., 2011), it is also recognized for its ability to modify this behavior (McEachan et al., 2011). Second, from an interventional standpoint, the identification of specific beliefs is essential. However, few studies using rigorous methodology (*e.g.* prospective design, large sample size) have done so. Third, although Von Haeften et al. (Steinmetz et al., 2016) suggest a method of analysis involving the use of multiple regression analyses in order to identify salient beliefs in the context of TPB, we used structural equation modeling analyses as suggested by Barbeau et al. (2019). This method enables researchers to infer and test a sequence of causal links and simultaneously examine the relationships between several predictor and dependent variables, which multiple regression does not allow to do in one single model (Barbeau et al., 2019). However, despite the many strengths of this study, some limitations are worth mentioning. First, women included in this study were highly educated, most of them were of normal pre-pregnancy BMI, already had a high level of intention toward regular MVPA and nearly half were achieving prenatal PA recommendations at baseline.

Our sample is therefore not entirely representative of the general population of Quebec pregnant women and the likelihood of selection bias cannot be totally excluded. Second, prenatal PA data were collected with the IPAQ-short version. Although it is a reliable and valid tool to assess PA (Gauthier et al., 2009) and is widely used among pregnant women (Von Haeften et al., 2001), overestimation of PA practice has been reported (Silva-Jose et al., 2022). However, even if MVPA was overestimated in our study, this should not have impacted our results. Indeed, we do not believe that women who may have overestimated their level of PA responded differently to the questions related to TPB than those who did not overestimate their practice. Also, for the purpose of our study, questions were asked about PA practice over the last month, and not the last week, which may have led to a greater recall bias. Ideally, an objective measurement tool, such as accelerometer, should have been used, in combination with the IPAQ in order to capture, to the best, all types of PA practiced by pregnant women (Garriguet & Colley, 2014).

Conclusion

In conclusion, this study shows that mass media campaign and interventions aiming to promote regular MVPA during pregnancy should target the six beliefs we identified as being predictors of the intention toward prenatal MVPA: raise women's awareness of the fact that prenatal MVPA does not cause fatigue and will help feel better mentally and help them overcome the barriers of fatigue and lack of social support when it comes to prenatal MVPA practice, and raise pregnant women's friends and mother/father awareness on the importance of their approval of prenatal MVPA. Future clinical research is needed to assess whether targeting these beliefs leads to higher levels of MVPA practice in pregnant women.

Acknowledgements

The last author would like to sincerely thank Professor François Boudreau for his time and invaluable advice, as well as the participants and prenatal health care providers working in different clinical settings attached to the Centre intégré universitaire de santé et de services sociaux de la Mauricie-et-du-Centre-du-Québec who helped disseminate the project.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was funded by the Université du Québec à Trois-Rivières Junior chair in physical activity and maternal and neonatal health.

Data availability statement

The data are not available. The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available.

References

Addis, A., Alemnew, W., Kassie, A., & Handebo, S. (2022). Physical exercise and its associated factors among Ethiopian pregnant women: A cross-sectional study based on the theory of planned behavior. *BMC Psychology*, *10*(1), 146. https://doi.org/10.1186/s40359-022-00847-z

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. SAGE Publications.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Prentice-Hall.

Ajzen, I., & Manstead, A. S. R. (2007). Changing health-related behaviours: An approach based on the theory of planned behaviour. In M. Hewstone, H. A. W. Schut, J. B. F. De Wit, K. Van Den Bos, & M. S. Stroebe (Eds.), *The scope of social psychology: Theory and applications* (pp. 43–63). Psychology Press.

Barbeau, K., Boileau, K., Sarr, F., & Smith, K. (2019). Path analysis in Mplus: A tutorial using a conceptual model of psychological and behavioral antecedents of bulimic symptoms in young adults. *The Quantitative Methods for Psychology*, *15*(1), 38–53. https://doi.org/10.20982/tqmp.15.1.p038

Bobak, C. A., Barr, P. J., & O'Malley, A. J. (2018). Estimation of an inter-rater intra-class correlation coefficient that overcomes common assumption violations in the assessment of health measurement scales. *BMC Medical Research Methodology*, *18*(1), 93. https://doi.org/10.1186/s12874-018-0550-6

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates, Publishers.

Craig, C., Marshall, A., Sjostrom, M., Bauman, A., Booth, M., Ainsworth, B., Pratt, M., Ekelund, U., Yngve, A., Sallis, J., & Oja, P. (2003). International Physical Activity Questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise*, *35*(8), 1381–1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Davenport, M. H., McCurdy, A. P., Mottola, M. F., Skow, R. J., Meah, V. L., Poitras, V. J., Jaramillo Garcia, A., Gray, C. E., Barrowman, N., Riske, L., Sobierajski, F., James, M., Nagpal, T., Marchand, A. A., Nuspl, M., Slater, L. G., Barakat, R., Adamo, K. B., Davies, G. A., & Ruchat, S. (2018a). Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: A systematic review and meta-analysis. *British Journal of Sports Medicine*, *52*(21), 1376–1385. https://doi.org/10.1136/bjsports-2018-099697

Davenport, M. H., Meah, V. L., Ruchat, S. M., Davies, G. A., Skow, R. J., Barrowman, N., Adamo, K. B., Poitras, V. J., Gray, C. E., Jaramillo Garcia, A., Sobierajski, F., Riske, L., James, M., Kathol, A. J., Nuspl, M., Marchand, A. A., Nagpal, T. S., Slater, L. G., Weeks, A., ... Mottola, M. F. (2018b). Impact of prenatal exercise on neonatal and childhood outcomes: A systematic review and meta-analysis. *British Journal of Sports Medicine*, *52*(21), 1386–1396. https://doi.org/10.1136/bjsports-2018-099836

Davenport, M. H., Ruchat, S. M., Poitras, V. J., Jaramillo Garcia, A., Gray, C. E., Barrowman, N., Skow, R. J., Meah, V. L., Riske, L., Sobierajski, F., James, M., Kathol, A. J., Nuspl, M., Marchand, A. A., Nagpal, T. S., Slater, L. G., Weeks, A., Adamo, K. B., Davies, G. A., ... Mottola, M. F. (2018c). Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: A systematic review and meta-analysis. *British Journal of Sports Medicine*, *52*(21), 1367–1375. https://doi.org/10.1136/bjsports-2018-099355

Downs, D. S., Devlin, C. A., & Rhodes, R. E. (2015). The power of believing: Salient belief predictors of exercise behavior in normal weight, overweight, and obese pregnant women. *Journal of Physical Activity and Health*, *12*(8), 1168–1176. https://doi.org/10.1123/jpah.2014-0262

Downs, D., Dinallo, J., & Kirner, T. (2007). Pregnant women's exercise motivation and behavior: The moderating influence of parental status. *Journal of Sport & Exercise Psychology*, *29*(S), S160.

Downs, D. S., & Hausenblas, H. A. (2003). Exercising for two: Examining pregnant women's second trimester exercise intention and behavior using the framework of the theory of

planned behavior. *Women's Health Issues*, *13*(6), 222–228. https://doi.org/10.1016/j.whi.2003.09.004

Downs, D. S., & Hausenblas, H. A. (2007). Pregnant women's third trimester exercise behaviors, body mass index, and pregnancy outcomes. *Psychology & Health*, *22*(5), 545–559. https://doi.org/10.1080/14768320701372018

Downs, D. S., & Ulbrecht, J. S. (2006). Understanding exercise beliefs and behaviors in women with gestational diabetes mellitus. *Diabetes Care*, *29*(2), 236–240. https://doi.org/10.2337/diacare.29.02.06.dc05-1262

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. Psychology Press.

Gagné, C., & Godin, G. (2000). Theory of planned behavior: Some measurement issues concerning belief-based variables. *Journal of Applied Social Psychology*, *30*(10), 2173–2193. https://doi.org/10.1111/j.1559-1816.2000.tb02431.x

Garriguet, D., & Colley, R. C. (2014). A comparison of self-reported leisure-time physical activity and measured moderate-to-vigorous physical activity in adolescents and adults. *Health Reports*, *25*(7), 3–11.

Gauthier, A. P., Lariviere, M., & Young, N. (2009). Psychometric properties of the IPAQ: A validation study in a sample of northern Franco-Ontarians. *Journal of Physical Activity and Health*, *6*(Suppl 1), S54–S60. https://doi.org/10.1123/jpah.6.s1.s54

Girard, S., Béland, S., Lemoyne, J., & Caron, P.-O. (2020). Interpreting the interaction of latent variables: A methodological exemplification of the Johnson-Neyman graphical method. *Revue des sciences de l'éducation*, *46*(2), 174–201. https://doi.org/10.7202/1073723ar

Gjestland, K., Bo, K., Owe, K. M., & Eberhard-Gran, M. (2013). Do pregnant women follow exercise guidelines? Prevalence data among 3482 women, and prediction of low-back pain, pelvic girdle pain and depression. *British Journal of Sports Medicine*, *47*(8), 515–520. https://doi.org/10.1136/bjsports-2012-091344

Guelfi, K. J., Wang, C., Dimmock, J. A., Jackson, B., Newnham, J. P., & Yang, H. (2015). A comparison of beliefs about exercise during pregnancy between Chinese and Australian pregnant women. *BMC Pregnancy and Childbirth*, *15*(1), 345. https://doi.org/10.1186/s12884-015-0734-6

Hagger, M. S., Cheung, M. W., Ajzen, I., & Hamilton, K. (2022). Perceived behavioral control moderating effects in the theory of planned behavior: A meta-analysis. *Health Psychology*, *41*(2), 155–167. https://doi.org/10.1037/hea0001153

Hausenblas, H. A., & Downs, D. (2004). Prospective examination of the theory of planned behavior applied to exercise behavior during women's first trimester of pregnancy. *Journal of Reproductive and Infant Psychology*, *22*(3), 199–210. https://doi.org/10.1080/02646830410001723788

Hausenblas, H., Giacobbi, P., Cook, B., Rhodes, R., & Cruz, A. (2011). Prospective examination of pregnant and nonpregnant women's physical activity beliefs and behaviours. *Journal of Reproductive and Infant Psychology*, *29*(4), 1–12. https://doi.org/10.1080/02646838.2011.629993

Hayman, M., Short, C., & Reaburn, P. (2016). An investigation into the exercise behaviours of regionally based Australian pregnant women. *Journal of Science and Medicine in Sport*, *19*(8), 664–668. https://doi.org/10.1016/j.jsams.2015.09.004

Hesketh, K. R., & Evenson, K. R. (2016). Prevalence of U.S. Pregnant Women Meeting 2015 ACOG Physical Activity Guidelines. *Am J Prev Med*, *51*(3), e87-9.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Jackson, D. L. (2003). Revisiting sample size and number of parameter estimates: Some support for the N: Q hypothesis. *Structural Equation Modeling: A Multidisciplinary Journal*, *10*(1), 128–141. https://doi.org/10.1207/S15328007SEM1001_6

Johnson, P. O., & Fay, L. C. (1950). The Johnson-Neyman technique, its theory and application. *Psychometrika*, *15*(4), 349–367. https://doi.org/10.1007/BF02288864

Klein, A. G., & Moosbrugger, H. (2000). Maximum likelihood estimation of latent interaction effects with the LMS method. *Psychometrika*, *65*(4), 457–474. https://doi.org/10.1007/BF02296338

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). The Guilford Press.

Lee, C. F., Chiang, I. C., Hwang, F. M., Chi, L. K., & Lin, H. M. (2016). Using the theory of planned behavior to predict pregnant women's intention to engage in regular exercise. *Midwifery*, *42*, 80–86. https://doi.org/10.1016/j.midw.2016.09.014

Lindqvist, M., Lindkvist, M., Eurenius, E., Persson, M., & Mogren, I. (2017). Change of lifestyle habits – motivation and ability reported by pregnant women in northern Sweden. *Sexual & Reproductive Healthcare*, *13*, 83–90. https://doi.org/10.1016/j.srhc.2017.07.001

Mardia, K. V. (1980). Tests of unvariate and multivariate normality. In *Handbook of statistics* (Vol. 1, pp. 279–320). Elsevier. https://doi.org/10.1016/S0169-7161(80)01011-5

Marsh, H. W., Wen, Z., Nagengast, B., & Hau, K. T. (2012). Structural equation models of latent interaction. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 436–458). Guilford.

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. *Health Psychology Review*, *5*(2), 97–144. https://doi.org/10.1080/17437199.2010.521684

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., … Wood, Caroline E.. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, *46*(*1*), 81–95. http://doi.org/10.1007/s12160-013-9486-6

Mielke, G. I., Crochemore-Silva, I., Domingues, M. R., Silveira, M. F., Bertoldi, A. D., & Brown, W. J. (2021). Physical activity and sitting time from 16 to 24 weeks of pregnancy to 12, 24, and 48 months postpartum: Findings from the 2015 Pelotas (Brazil) Birth Cohort Study. *Journal of Physical Activity and Health*, *18*(5), 587–593. https://doi.org/10.1123/jpah.2020-0351

Mottola, M. F., Davenport, M. H., Ruchat, S. M., Davies, G. A., Poitras, V. J., Gray, C. E., Jaramillo Garcia, A., Barrowman, N., Adamo, K. B., Duggan, M. , Barakat, R., Chilibeck, P., Fleming, K., Forte, M., Korolnek, J., Nagpal, T., Slater, L. G., Stirling, D., & Zehr, L. (2019). Canadian guideline for physical activity throughout pregnancy. *British Journal of Sports Medicine*, *52*(21), 1339–1346. https://doi.org/10.1136/bjsports-2018-100056

Muzigaba, M., Kolbe-Alexander, T. L., & Wong, F. (2014). The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. *Journal of Physical Activity and Health*, *11*(7), 1276–1283. https://doi.org/10.1123/jpah.2012-0386

Okely, A. D., Kontsevaya, A., Ng, J., & Abdeta, C. (2021). WHO guidelines on physical activity and sedentary behavior. *Sports Medicine and Health Science*, *3*(2), 115–118. https://doi.org/10.1016/j.smhs.2021.05.001

Raykov, T., & Marcoulides, G. A. (2006). *A first course in structural equation modeling* (Second édition ed, 248 p.). Psychology Press.

Rogosa, D. (1980). Comparing nonparallel regression lines. *Psychological Bulletin*, *88*(2), 307321.

Sanda, B., Vistad, I., Haakstad, L. A. H., Berntsen, S., Sagedal, L. R., Lohne-Seiler, H., & Torstveit, M. K. (2017). Reliability and concurrent validity of the International Physical Activity Questionnaire short form among pregnant women. *BMC Sports Science, Medicine and Rehabilitation*, *9*(1), 7. https://doi.org/10.1186/s13102-017-0070-4

Silva-Jose, C., Sánchez-Polán, M., Barakat, R., Gil-Ares, J., & Refoyo, I. (2022). Level of physical activity in pregnant populations from different geographic regions: A systematic review. *Journal of Clinical Medicine [Internet]*, *11*(15), 4638.

Srugo, S. A., Fernandes da Silva, D., Menard, L. M., Shukla, N., & Lang, J. J. (2023). Recent patterns of physical activity and sedentary behaviour among pregnant adults in Canada. *Journal of Obstetrics and Gynaecology Canada*, *45*(2), 141–149. https://doi.org/10.1016/j.jogc.2022.11.011

Steinmetz, H., Knappstein, M., Ajzen, I., Schmidt, P., & Kabst, R. (2016). How effective are behavior change interventions based on the theory of planned behavior?: A three-level meta-analysis. *Zeitschrift für Psychologie*, *224*(3), 216–233. https://doi.org/10.1027/2151-2604/a000255

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, *2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Thompson, E. L., Vamos, C. A., & Daley, E. M. (2017). Physical activity during pregnancy and the role of theory in promoting positive behavior change: A systematic review. *Journal of Sport and Health Science*, *6*(2), 198–206. https://doi.org/10.1016/j.jshs.2015.08.001

Tinius, R., Nagpal, T. S., Edens, K., Duchette, C., & Blankenship, M. (2020). Exploring beliefs about exercise among pregnant women in rural communities. *Journal of Midwifery & Women's Health*, *65*(4), 538–545. https://doi.org/10.1111/jmwh.13080

Von Haeften, I., Fishbein, M., Kasprzyk, D., & Montano, D. (2001). Analyzing data to obtain information to design targeted interventions. *Psychology, Health & Medicine*, *6*(2), 151–164. https://doi.org/10.1080/13548500125076

Wang, J., & Wang, X. (2012). *Structural equation modeling: Applications using Mplus*. Wiley.

Weir, Z., Bush, J., Robson, S. C., McParlin, C., Rankin, J., & Bell, R. (2010). Physical activity in pregnancy: A qualitative study of the beliefs of overweight and obese pregnant women. *BMC Pregnancy and Childbirth*, *10*(1), 18. https://doi.org/10.1186/1471-2393-10-18

Yuan, K.-H., & Bentler, P. (2007). Robust procedures in structural equation modeling. In S.-Y. Lee (Ed.), *Handbook of latent variable and related models* (pp. 367–397). North-Holland.

Zamora-Flyr, M. M. (2010). *Predictors of intention and performance of physical activity of pregnant hispanic women*. Loma Linda University.

Zhang, Y., Dong, S., Zuo, J., Hu, X., Zhang, H., & Zhao, Y. (2014). Physical activity level of urban pregnant women in Tianjin, China: A cross-sectional study. *PLoS One*, *9*(10), e109624. https://doi.org/10.1371/journal.pone.0109624