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Couple-Based Physical Activity Planning for New Parents: A Randomized Trial

Ryan E. Rhodes, PhD,[1] Chris M. Blanchard, PhD,[2] Alison Quinlan, MSc,[1] Danielle Symons Downs, PhD,[3] Darren E.R. Warburton, PhD,[4] Mark R. Beauchamp, PhD[4]

From the [1]School of Exercise Science, Physical and Health Education, University of Victoria, Victoria, Canada; [2]Faculty of Medicine, Dalhousie University, Halifax, Canada; [3]Departments of Kinesiology and Obstetrics and Gynecology, Pennsylvania State University, University Park, Pennsylvania; and [4]Faculty of Education, School of Kinesiology, and Faculty of Medicine, Experimental Medicine Program, University of British Columbia, Vancouver, Canada

Address correspondence to: Ryan E. Rhodes, PhD, Behavioural Medicine Laboratory, School of Exercise Science, Physical and Health Education, PO Box 3010 STN CSC, University of Victoria, Victoria, B.C., V8W 3N4 Canada. E-mail: rhodes@uvic.ca.

Introduction: The demands of parenthood may limit the pursuit of moderate-to-vigorous intensity physical activity (MVPA), establish inactivity patterns into middle age, and lead to long-term poorer health and well-being. The purpose of this study was to examine the efficacy of a couple-based planning skills intervention to support MVPA from baseline (~2 months after birth) up to 6 months later in first-time parents.

Setting/participants: This study included 264 parents (132 couples) at the 2-month point of parenting their first child.

Intervention: Couples were randomized to either an education control (n=58 couples) or an education plus planning condition (n=74 couples).

Main outcome measures: Participant MVPA was assessed via accelerometry and self-report at baseline, 6 weeks, 3 months, and 6 months. Health-related fitness (aerobic fitness, muscular strength, flexibility) and BMI tests were conducted at baseline and 6 months. The trial was conducted with rolling recruitment between 2014 and 2017.

Results: The accelerometry results had large amounts of missing data that were not missing at random, so only self-reported MVPA was analyzed. Dyadic multilevel modeling conducted in 2020 showed that mothers' MVPA had a significant quadratic pattern over time that was similar for both conditions, and BMI decreased while strength and flexibility increased. Fathers did not have significant outcomes. Participants who were not meeting MVPA guidelines at baseline responded to the education plus planning condition with increased MVPA (father B=1.31, mother B=1.14, $p<0.05$) compared with those who initially met those guidelines.

Conclusions: Mothers may be more responsive than fathers to MVPA interventions in early parenthood. Already active parents likely have little to be gained from additional intervention.

Future targeted research is needed to better understand how to effectively promote MVPA during fatherhood and identify novel ways to sustain PA past the early response to an intervention.

Trial registration: This study is registered at www.clinicaltrials.gov NCT02290808.

INTRODUCTION

Despite the health benefits of regular moderate-to-vigorous intensity physical activity (MVPA),[1,2] many adults do not meet international guidelines of 150 minutes of weekly MVPA.[3] MVPA prevalence, however, is not uniform across the adult population[4]; some groups of adults are more at risk of inactivity than others. Parents typically report less MVPA than adults without children.[5–8] Longitudinal research has shown that these declines in MVPA may persist into sustained inactivity patterns for middle age.[6,8] Clearly, parents represent an important demographic group for targeted MVPA promotion.

The demands of parenthood influence lifestyle changes, which in turn may compromise the pursuit of MVPA.[5,9] This assumption is supported in research underpinned by social cognitive theory[10] and the theory of planned behavior (TPB).[11] Specifically, declines in MVPA among parents are predicted by lower perceived control[12–14] or self-efficacy, rather than attitudes.[15] Lack of time due to caregiving commitments is reported as the critical barrier that predicts MVPA among new parents, followed by fatigue and low social support.[5] The predictors of MVPA do not appear to differ by parent gender in observational studies,[12,16] which suggests that similar intervention approaches may be useful for all parents.

In line with these findings, interventions that focus on building perceived control/self-efficacy and strengthen intention–behavior correspondence through self-regulatory tactics (e.g., problem solving, barrier identification, planning, self-monitoring)[17,18] have had some success increasing MVPA among mothers in the short term. For example, Gilinsky et al.[19] conducted a review of intervention studies among mothers between 4 and 12 weeks after giving birth, and 86% studies showed evidence for effectiveness of targeting self-regulation on MVPA in the short term (average 1 month duration). Interestingly, a closer look at these studies showed that this effect was not sustained at 6-month follow-up[15,20–23] and it is noteworthy that the effect sizes of these PA changes was very modest (*d*=0.15). Further, research conducted since this review was published has seen considerable variability in intervention efficacy, with some interventions resulting in positive outcomes,[24,25] but also several null trial outcomes.[26–30]

Although this emerging evidence shows promise that new parents can improve MVPA with intervention, it also points to limitations. First, almost all of this research is composed of small sample short-term feasibility trials, which are at risk of biased and underpowered findings. Second, current parent intervention research is almost exclusively focused on mothers. There is a need to examine how new mothers and fathers respond to MVPA interventions. From a family systems perspective,[31] couple-based intervention allows parents to engage in workload negotiation, social support, and collective MVPA goals to be managed together. This has not been explored among parents to date, but there is some evidence for this approach in couples, more generally.[32,33] For example, though dyadic interventions can be counterproductive if there is inherent discord in the relationship,[34] a recent review evaluating couple-based interventions found 57% (4 of 7) interventions were more effective for behavior change than regular care.[32] Thus, exploring the effect of a dyadic MVPA intervention may have promise and warrants exploration.

The primary objective of this study was to employ a randomized trial design to examine the short- and long-term effects of an education-only control (EC) compared with an education plus self-regulatory MVPA planning intervention (EP) among new parents. Specifically, the EC condition was designed to affect PA attitude, and the EP condition was designed to affect PA attitude plus improve perceived behavioral control and strengthen intention–behavior correspondence through self-regulatory tactics, using an extended TPB framework.[17,18] Based on the preliminary findings of Gilinsky and colleagues,[19] it was hypothesized that participants in the EP condition would exhibit greater MVPA compared with those in the EC group over 6 months.

A secondary study objective was to examine whether the EP intervention had a greater impact on: (1) mothers or fathers and (2) less active parents compared with active parents at trial commencement entry. Specifically, whether mothers or fathers would respond differently to the intervention was explored. It was hypothesized that parents who were inactive at baseline would respond to the intervention with a greater magnitude of MVPA change compared with those who were active at baseline owing to the law of initial values.[35]

A tertiary objective of this study was to examine whether the effect of EP intervention resulted in changes to a measure of "planning" when compared to the EC condition. Based on the content of the EP intervention, it was hypothesized that planning would increase and remain higher in this condition across the trial when compared with the EC condition. A final study objective was to examine whether the EP intervention would also result in improvements in PA-related fitness and BMI measures from baseline to 6 months. It was hypothesized that parents in the EP group would display higher fitness scores and lower BMI compared with the EC group.

METHODS

Full detailed methods for this study are reported elsewhere.[36] The study was approved by the University of Victoria Human Research Ethics Board. Participants provided informed consent prior to being enrolled. The design, conduct, and reporting of the trial followed the CONSORT guidelines.[37] The trial was registered with the Clinical Trials Registry (NCT02290808).

A 2-arm parallel design randomized trial was conducted, where participants were randomized using an online program[38] that allocated (1:1 ratio) participants to 1 of 2 (EC, EP) groups after baseline assessment. Couples were assessed at baseline, and then 6 weeks (MVPA, planning), 3 months (MVPA, planning), and 6 months (MVPA, planning, fitness) following randomization. Participants were aware of their condition, but blind to the other condition. Recruiters were blinded to treatment allocation as this was concealed by the trial coordinator (who performed the randomization). Fitness testers were blinded to the trial conditions; however, the intervention delivery team was aware of the condition so they could deliver appropriate intervention materials. Rolling recruitment began in November 2014 and completed in July 2017.

Study Population

Participants were recruited through several clinical and community avenues; online interest sites; advertisements; as well as in-person at baby fairs, health shows, and community markets. Participants received a $25 CAN grocery store gift card if they referred another couple who enrolled in the study.

Participants were common law or married couples who were 2 months postpartum. Recruitment proceeded to develop a waiting list of couples who were expecting or had just had their first child and baseline assessment began at 2 months after the child was born. Participants were screened for PA readiness,[39] and excluded if they were not ready or able to participate in MVPA.

Participants were recruited in the Capital Region District, British Columbia, Canada.

Interventions

Intervention materials were delivered face-to-face by a research assistant after the baseline assessment. Both conditions received MVPA guidelines in booklet form and verbal presentation on the importance of PA postpartum.[40]

For the EP condition, couples received the aforementioned education material plus a workbook that served as the template for dialogue with the research assistant for the study. The booklet was informed by prior intervention research, based primarily on the TPB, with mothers and couple-based health interventions (Appendix Table 1).[15,20,21,23,41,42] The booklet consisted of 2 main sections. The first section focused on the benefits of postpartum PA on immune function, a good night's sleep, increase in energy levels, control of food cravings, reduced pain, and prevention and treatment of postpartum depression. The section concluded with a brainstorming exercise for couples to list activities that they might find enjoyable as a basis for developing an action plan.[43]

The second section guided couples to plan for postpartum PA via self-regulatory approaches.[44–46] Participants were asked to brainstorm a list of potential and past barriers (and strategies to overcome these) when setting PA goals. The content addressed social support strategies, facilitated problem solving (to overcome common barriers to pursuing regular PA), and covered the implementation of planning methods (e.g., calendar, mobile phone, Day-Timer book). The section concluded with a discussion of a reset day (often Sunday) where the couple could reorganize their PA goals and plans for the following week. Two booster check-in sessions (6 weeks and 3 months) were provided in person (with a research assistant) to ascertain goal progress and facilitate problem solving.

Measures

The primary outcome of the study was minutes per week of MVPA and the primary endpoint was the full 6 months of the trial, with secondary endpoints at the 6-week and 3-month assessments. The primary measure of MVPA was accelerometry; self-reported MVPA was assessed as a secondary comparator.

Participants wore triaxial accelerometers (Actigraph GT3X) on an elastic belt above the right hip for 7 consecutive days for ≥10 hours a day. The ActiLife software, version 6.11.9[47] was used to download and analyze the data. The accelerometers were initialized to collect pre-filtered data at a sample rate of 60 Hz and were downloaded using the Freedson VM3 cut points.[48] A minimum of 4 days (at least 1 weekend day) with ≥600 minutes per day were included based on recommended best practice.[49,50] To determine valid wear time, the algorithm of Troiano et al.[51] was used. Two data sets were produced to provide 2 approaches. The first approach rebuilt the data sets so that all participants had a complete 7-day data set.[52] The second approach did not rebuild the data sets; thus, participants could have between 4 and 7 days of valid wear time.

As the secondary indicator of MVPA, a modified Godin Leisure-Time Questionnaire was used.[53,54] Both weekly frequency and duration of PA were provided with an open-ended assessment, and the multiplicative (frequency **X** duration) sum of moderate- and vigorous-intensity minutes were used as the estimate of weekly MVPA.[55]

The secondary outcomes of the trial were health-related physical fitness and body composition. Measured height and weight were used to calculate BMI. A steady state walking treadmill test[56] was used to calculate a predicted maximal aerobic power (VO_2max). Push-ups, sit and reach flexibility, and partial curl-ups were measured to determine musculoskeletal fitness using the protocols established by Gledhill and colleagues[57] and Jamnik et al.[58]

The tertiary outcome of this study was a measure of planning. Six items were adapted from other sources[44,59] (e.g., *I made plans regarding what to do if something interfered with engaging in PA*, *I set short-term goals for PA…*).[36] The time ref was changed to correspond with the time-lag in the assessment period (e.g., at 6-week assessment, the ref was "over the last 6 weeks"). Internal consistency was acceptable for baseline (α=0.85), 6 weeks (α=0.82), 3 months (α=0.84), and 6 months (α=0.86). Finally, a trial process evaluation included 6 questions that asked EP participants to rate the effectiveness of the intervention on increasing their PA, perceived utility of the workbook, counseling sessions, and overall intervention (Appendix Table 5).

The study followed procedures established in a prior family-based PA study[45] as a guide for recruitment, study protocol, and assessment. The trial coordinator conducted study protocol quality control training and crosschecks with all research assistants to ensure standardization. After interested couples contacted the researcher and were determined to be eligible to participate, baseline assessment was scheduled approximately 2 months after the birth of their child. Baseline assessment included a questionnaire for each parent (age, sex, gender, ethnicity, education, income, marital status, employment status), MVPA assessment, and a fitness test.

As part of the baseline assessment, participants were provided with an accelerometer (including verbal instructions) for each parent. After completing the accelerometry assessment, participants were randomized to 1 of 2 conditions. Following randomization, the trial coordinator scheduled a follow-up session with the couple to deliver the study materials. At 6 weeks and 3 months, a member of the research team met with parents to provide accelerometers and conduct a check-in session. As an incentive for couples to complete all assessments, an honorarium was provided upon pick-up of the accelerometers starting at $25 at baseline and increased by $5 at each time point. In addition to the follow-up testing at 6 months (including fitness testing), couples assigned to the EP intervention condition completed the brief process evaluation questions.[36,45]

Statistical Analysis

Data missingness was inspected to determine the appropriate imputation procedures[60] and normality of all variables was checked to determine whether any transformations were required. Given that the individual repeated assessments (Level 1) were nested within the couple (Level 2), hierarchical linear modeling (HLM, version 6.0) was used for the main analyses.[61,62] A full description of the analysis protocol can be found in Appendix Table 6. Power set at 0.80 with 4 repeated assessments, 1 between-group factor, and an α of 0.05 suggested that a sample size ranging from 128 (ES=0.25) to 200 (ES=0.20) couples (or 64–100 couples per condition) could detect the primary hypothesis.[63] For the secondary fitness outcomes, changes in fitness from baseline to 6 months were investigated using ANCOVA, controlling for baseline, between conditions (EP, EC). For the end of study process evaluation of the EP group, descriptives were generated followed by exploratory *t*-tests of the results between fathers and mothers.

RESULTS

A total of 132 couples met the inclusion criteria, completed baseline assessments, and were randomly assigned to 1 of 2 conditions (Figure 1) (*n*=74 couples in the EP condition and 58 couples in the EC condition). The slight assignment inequality was an unintended result of the random number sequencing. Seventy-one couples in the EP and 56 couples in the EC group completed the study to the 6-month endpoint (96% retention).

Couples reported a mean age of 31.94 (SD=4.90) years, with 50% male/female representation. Participants were primarily White, university-educated, employed, and above the median income for Canadian adults (Appendix Table 2). On average, parents had a BMI in the overweight category (mean=26.35, SD=4.50), yet reported minimal health conditions. For health behaviors, participants reported an average of 6.42 hours of sleep, were non-smokers, more than two thirds reported being healthy eaters, and 50% reported meeting MVPA guidelines.

Despite using multiple strategies to wear accelerometers, such as providing reminder e-mails, incentives, and monitoring logs,[49] compliance to wearing the PA monitors was low. For example, at the 6-month primary endpoint, 13% of the sample (*n*=34) did not complete the 4-day minimum required for estimation, and an additional 71.2% (*n*=188) were missing ≥1 day of accelerometry, indicating that 84% of the sample had missing data (average across the trial=76%). In a subsequent examination of patterns of wear time, the number of valid days of accelerometer data (*r* =0.14 to *r* =0.27) and average number of minutes per valid day (*r* =0.23 to *r* =0.48) were significantly correlated at all 4 timepoints. Wear time was also significantly correlated with education (+), income (+), self-reported sleep (+), sex (male participants more likely to wear), and employment status (those on leave more likely to wear). Of note, wear time was significantly associated with MVPA across all time periods when using both unmodeled (*r* =0.26 to *r* =0.39) and data modeled to 7 days of wear for the entire sample (*r* =0.15 to *r* =0.31). Accordingly, participants who wore their accelerometer more often were also more physically active, and this association was present even after accounting for variance in wear time. As a consequence, these data were missing not at random. Based on the proportion of missing data and that the data were missing not at random, conducting imputation for the missing data is not recommended.[64] Similar to the procedures outlined by Ruissen and colleagues,[65] and on the basis of both the amount of missing data and non-randomness of those missing data, no further analyses were conducted with the accelerometry data.

Descriptive statistics for self-reported MVPA data are presented in Table 1. MVPA was significantly skewed[66] for the fathers and mothers at all 4 timepoints. Therefore, a square root transformation was performed that resulted in acceptable values. Results from the preliminary analyses showed that a Level 1 model with a random intercept, random linear trend, and fixed quadratic trend controlling for age provided the best model fit. The final model is presented in Table 2, which showed that the linear (B= –0.39) and quadratic (B= –0.10) trends were non-significant for fathers and neither were significantly predicted by condition. This suggest that MVPA was stable over the 6-month period for fathers in both conditions. For mothers, there was a significant quadratic trend (B= –0.38), but it was not significantly predicted by condition (B= –

0.10). It can be seen in Appendix Figure 1 that MVPA for mothers steadily increased from baseline to 3 months in both conditions, after which it remained relatively steady in the EP condition, but declined slightly in the EC condition. Finally, there was a positive correlation between the fathers and mothers' intercepts (i.e., MVPA at 3 months; r =0.38) and linear trends (r =0.18).

In the EP condition, sub-analyses showed that meeting MVPA guidelines at baseline significantly predicted the quadratic trend for fathers (B=1.31) (Appendix Table 3). As shown in Figure 2A, fathers meeting the MPVA guidelines at baseline showed a steady decline in MVPA by 3 months, after which it declined by 6 months. Conversely, fathers not meeting the baseline MVPA guideline showed a steady increase in MVPA from baseline until 3 months, after which it began to decline by 6 months. A similar quadratic pattern (B=1.14) (Appendix Table 3) was found for the mothers from baseline to 3 months; however, MVPA was relatively stable from 3 to 6 months (Figure 2B).

All health-related fitness test data were normally distributed; however, 5% of these data were missing at 6-month follow-up. Missingness of fitness data showed no association with demographic or behavioral variables. Thus, an imputation approach was conducted using the expectation-maximization algorithm.[60,67] No significant differences between the EC and EP conditions on BMI or health-related fitness were identified (p>0.05) (Appendix Table 4). Mothers showed decreased BMI over the 6 months of the trial, as well as improvements in upper body strength (push-ups), abdominal strength (curl-ups), and flexibility (sit and reach).

The planning variable was normally distributed over time (Table 1). Preliminary analyses showed that a Level 1 model with random intercepts and linear and quadratic trends for the fathers and mothers displayed the best model fit. The final model (Table 2) showed that the intercept X condition interaction was significant (B= –0.33) for fathers, which suggests that the fathers in the EP condition had higher planning at 3 months compared with the EC condition. Further, the quadratic trend X condition interaction was significant (B=0.10). Planning remained relatively stable in the EC condition, whereas it increased from baseline to 3 months and declined by 6 months in the EP condition (Appendix Figure 2A). For mothers, there was a significant intercept X condition interaction (B= –0.50), suggesting that mothers in the EP condition had higher planning at 3 months compared with the EC condition. The quadratic trend (B= –0.10) was also significant and showed that mothers in the EC condition had stable planning until 3 months, after which it began to decline. However, planning steadily increased from baseline to 3 months for mothers in the EP condition, after which it declined slightly by 6 months (Appendix Figure 2B). Finally, there were positive correlations between the fathers and mothers' intercepts (i.e., planning at 3 months; r =0.35) and linear (r =0.44) and quadratic (r =0.55) trends.

End of trial process evaluation measures showed that the intervention was appraised as "somewhat" useful in terms of the workbook, counseling sessions, and overall (Appendix Table 5). Most of these responses varied by gender. Specifically, mothers found the workbook, counseling, and overall delivery more useful than fathers (p<0.05), as well as specific content on barrier identification, goal setting, planning, and monitoring.

DISCUSSION

Overall, the results did not support the broad hypothesis that the EP condition would result in greater MVPA compared with the EC group over the 6 months of the trial. Instead, the secondary analyses indicated that specific groups, under specific conditions, were responsive to these interventions.

The overall null findings add to an increasing literature on PA interventions following new parenthood, which have shown difficulty in sustaining MVPA improvements past very early gains.[15,20–23,26–28,30] Tertiary analyses of a measured self-regulatory planning construct showed that the EP intervention did increase self-regulation behavior compared with the EC group, particularly during the phase of intervention delivery (i.e., baseline to 3 months). Thus, an increase in the use of self-regulatory tactics, using an extended TPB, was not sufficient to provide an overall effect on MVPA. Clearly, new parenthood is a difficult period of adjustment and thus promoting health behaviors like MVPA is extremely challenging.[5] Continued innovation in interventions is recommended, particularly using behavior change techniques that may target constructs associated with MVPA maintenance, which often extend beyond social cognitive models like TPB.[68] Implementation features such as smartphone technology,[26] and group programming[20] may also be prudent to increase reach and promote social connections during this transitional time in lifestyle development.[69]

The secondary objectives were to examine whether the effect of the EP intervention had a greater impact on: (1) mothers or fathers, (2) less active parents compared with active parents at entry into the trial, and (3) BMI and health-related fitness. These findings proved illuminating. Women in both conditions showed positive gains in MVPA from baseline to 3 months, after which it remained relatively steady, whereas fathers showed no changes in MVPA overall across 6 months. Women in both conditions also showed body composition improvements and several improvements in clinically relevant[70] health-related fitness (upper body strength, abdominal strength, and flexibility), whereas fathers showed minimal changes. Finally, mothers expressed more satisfaction with the intervention compared with fathers. This is the first intervention that included both new mothers and fathers, to the authors' knowledge. The results complement past research that has shown mothers respond, particularly in the short-term, to MVPA interventions.[19] Yet, the results highlight the intervention failed to impact fathers overall and failed to demonstrate the efficacy of a couples approach to intervention.[32] Reaching fathers in PA interventions is an ongoing challenge,[71–73] which may originate from not sufficiently addressing new fathers' health needs.[74] Sustained formative research on MVPA and fatherhood to explore the efficacy of targeted interventions is recommended.

Second, it was hypothesized that parents who were inactive at baseline would respond to the planning intervention with a greater magnitude of MVPA change compared with those who were active at baseline. This hypothesis had clear support. This effect is likely due to the law of initial values,[35] where one can make greater changes to a system with more capacity to change. Although many intervention studies often seek to screen out active participants in order to create change in PA, this intervention was focused on both preventing MVPA declines from new parenthood and improving PA.[36] The results generally failed to support this premise and align more with past research that only included inactive parents.[19] Subsequently, the inclusion of inactive parents in future trials is recommended.

Limitations

Despite the novel study findings and the strong methods employed, there are noteworthy limitations. First, an active attempt to use accelerometry was made, yet the results yielded disappointing missing data that were not missing at random. Data points reflected biases among the more active participants and additional associations with participants who may have had better parenting situations (e.g., better sleep, more leave time, higher income). Wrist-based wearables may yield better adherence, as these types of monitors are more benign to one's attention, and easier to wear than waist-based devices.[75] Second, this sample was mainly White, middle income, and university educated. Although these features represent Greater Victoria,[76] the generalizability to other regions is unknown. Third, the intervention was intense with face-to-face laboratory/home visits, yet participants indicated there was room to improve its utility, suggesting that there may be barriers to expanding implementation.

CONCLUSIONS

An intervention focused on EP to support MVPA among new parents did not result in significant overall MVPA change over a 6 month period after childbirth compared to an EC intervention. Sub-analyses of these data, however, showed that mothers responded to both intervention conditions with increases in MVPA, select clinically meaningful health-related fitness benefits, improvements in body composition, and intervention satisfaction compared to fathers. Furthermore, those parents who were inactive at baseline resulted in significant increases in MVPA in the EP condition compared to those parents who were already active. Research to improve the maintenance of MVPA outcomes and assist fathers in successful behavior change is needed.

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LIST OF FIGURES

Note: Figure 2a is the Quadratic trend by meeting the MVPA guideline (or not) at baseline for fathers. Figure 2b is the Quadratic trend by meeting the MVPA guideline (or not) at baseline for fathers.

MVPA = moderate and vigorous intensity physical activity.

Table 1. Descriptive Statistics for Moderate to Vigorous Physical Activity (MVPA) and Planning for Fathers and Mothers

	Fathers		**Mothers**	
Variable	**EP**	**EC**	**EP**	**EC**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
MVPA				
Baseline	320.77 ± 285.44	224.85 ± 240.89	142.47 ± 185.11	169.29 ± 154.92
6 weeks	310.05 ± 314.58	273.72 ± 232.20	203.68 ± 140.10	205.89 ± 160.59
3 months	320.55 ± 300.35	235.69 ± 185.42	200.89 ± 178.67	214.89 ± 140.73
6 months	251.80 ± 226.24	248.46 ± 174.02	231.23 ± 183.76	177.71 ± 118.86
Planning				
Baseline	2.26 ± .95	2.48 ± 1.00	2.55 ± .93	2.59 ± 1.00
6 weeks	2.76 ± .90	2.51 ± .98	3.24 ± .76	2.72 ± .76
3 months	2.65 ± .91	2.34 ± 1.00	3.02 ± .79	2.75 ± .82
6 months	2.53 ± .98	2.39 ± .90	3.04 ± .98	2.47 ± .85

EP, Education + Planning Intervention; EC, Education Only Control.

Table 2. Results From the Dyadic Regression Analysis for Moderate to Vigorous Physical Activity

Parent	**Coefficient**	**SE**	**T-ratio**	***p*-value**
Fathers				
Intercept	15.29	0.87	17.56	<0.001
Linear trend	–0.39	0.24	–1.64	0.10
Quadratic trend	–0.10	0.19	–0.53	0.59
Intercept x condition	–1.13	1.30	–0.87	0.39
Intercept x age	–0.22	0.10	2.23	0.03
Linear trend x condition	0.67	0.36	1.85	0.06
Quadratic trend x condition	–0.07	0.28	–0.26	0.79
Mothers				
Intercept	13.63	0.59	23.03	<0.001
Linear trend	0.83	0.21	4.04	<0.001
Quadratic trend	–0.38	0.15	–2.49	0.01
Intercept x condition	0.08	0.89	0.09	0.92
Intercept x age	–0.01	0.09	–0.15	0.88
Linear trend x condition	–0.56	0.31	–1.82	0.07
Quadratic trend x condition	–0.10	0.23	–0.45	0.65

Note: Follow-up regression analyses examined intercept x condition interactions with the linear and quadratic trends centered at baseline, 6 weeks and 6 months and showed that all interactions were non-significant (i.e., physical activity levels were similar for the intervention and control participants for fathers and mothers at each time point).

Final Regression Model

Level -1

$$\text{MVPA} = \pi_{1i}(\text{father}_{ti}) + \pi_{2i}(\text{father linear trend}_{ti}) + \pi_{3i}(\text{father quadratic trend}_{ti}) + \pi_{4i}(\text{mother}_{ti}) + \pi_{5i}(\text{mother linear trend}_{ti}) + \pi_{6i}(\text{mother quadratic trend}_{ti}) + e_{ti}$$

Level -2

$\pi_{1i} = \beta_{10} + \beta_{11}(\text{condition}) + \beta_{12}(\text{Age}) + r_{1i}$

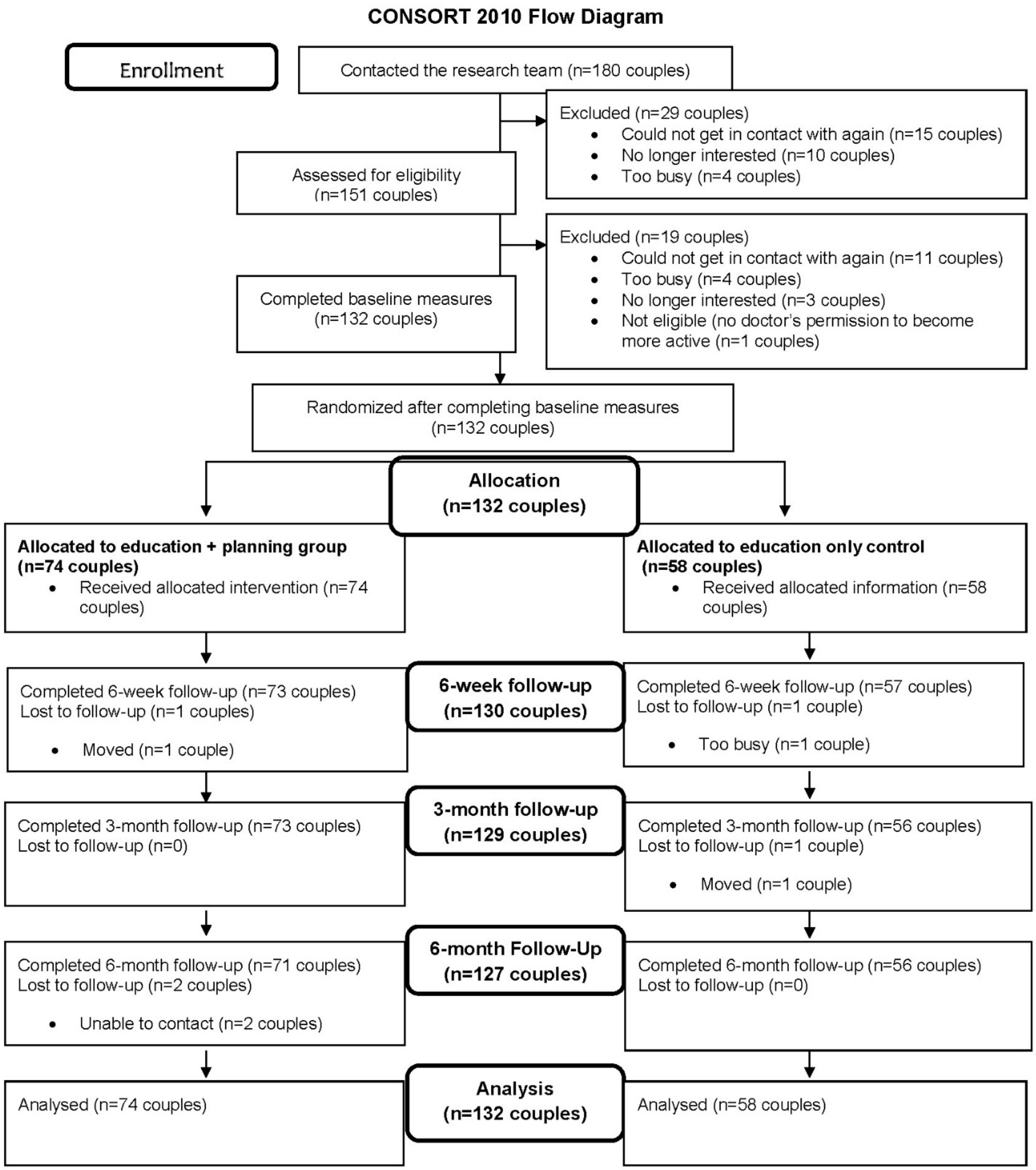
$\pi_{2i} = \beta_{20} + \beta_{21}(\text{condition}) + r_{2i}$

$\pi_{3i} = \beta_{30} + \beta_{31}(\text{condition})$

$\pi_{4i} = \beta_{40} + \beta_{41}(\text{condition}) + \beta_{42}(\text{Age}) + r_{4i}$

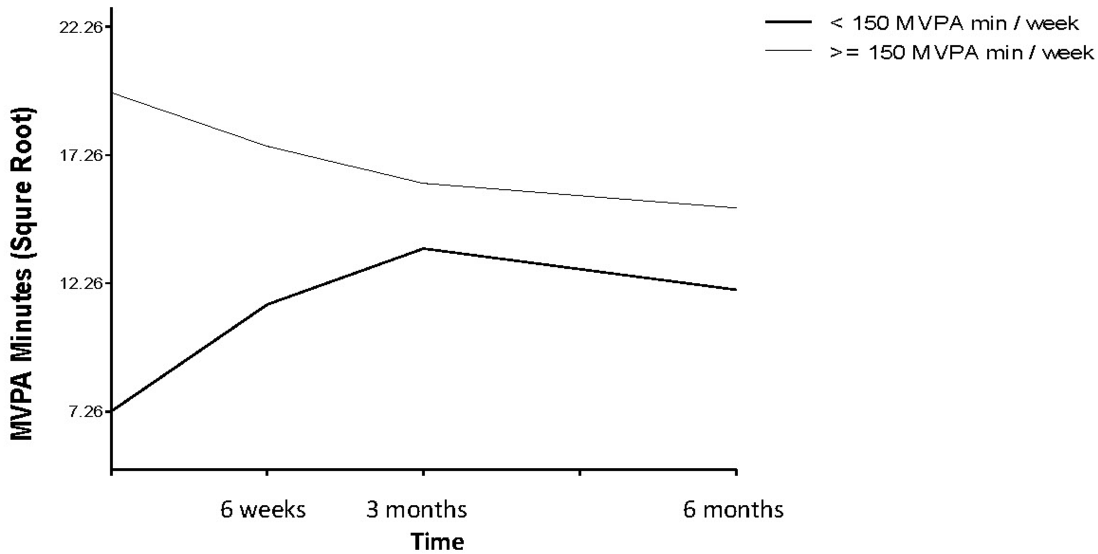
$\pi_{5i} = \beta_{50} + \beta_{51}(\text{condition}) + r_{5i}$

$\pi_{6i} = \beta_{60} + \beta_{61}(\text{condition})$


CONSORT 2010 Flow Diagram
Enrollment
Contacted the research team (n=180 couples)
Excluded (n=29 couples)
• Could not get in contact with again (n=15 couples)
• No longer interested (n=10 couples)
• Too busy (n=4 couples)
Assessed for eligibility (n=151 couples)
Excluded (n=19 couples)
• Could not get in contact with again (n=11 couples)
• Too busy (n=4 couples)
• No longer interested (n=3 couples)
• Not eligible (no doctor's permission to become more active (n=1 couples)
Completed baseline measures (n=132 couples)
Randomized after completing baseline measures (n=132 couples)
Allocation (n=132 couples)
Allocated to education + planning group (n=74 couples)
• Received allocated intervention (n=74 couples)
Allocated to education only control (n=58 couples)
• Received allocated information (n=58 couples)
6-week follow-up (n=130 couples)
Completed 6-week follow-up (n=73 couples)
Lost to follow-up (n=1 couples)
• Moved (n=1 couple)
Completed 6-week follow-up (n=57 couples)
Lost to follow-up (n=1 couple)
• Too busy (n=1 couple)
3-month follow-up (n=129 couples)
Completed 3-month follow-up (n=73 couples)
Lost to follow-up (n=0)
Completed 3-month follow-up (n=56 couples)
Lost to follow-up (n=1 couple)
• Moved (n=1 couple)
6-month Follow-Up (n=127 couples)
Completed 6-month follow-up (n=71 couples)
Lost to follow-up (n=2 couples)
• Unable to contact (n=2 couples)
Completed 6-month follow-up (n=56 couples)
Lost to follow-up (n=0)
Analysis (n=132 couples)
Analysed (n=74 couples)
Analysed (n=58 couples)

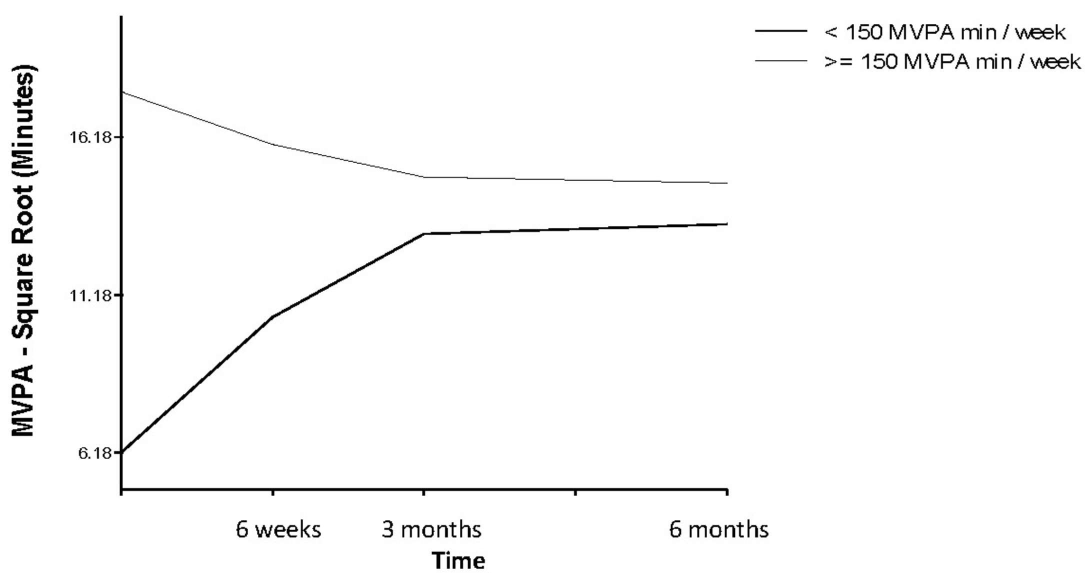
2

a)



< 150 MVPA min / week
>= 150 MVPA min / week
22.26
17.26
12.26
7.26
MVPA Minutes (Squre Root)
6 weeks
3 months
6 months
Time

b)



< 150 MVPA min / week
>= 150 MVPA min / week
16.18
11.18
6.18
MVPA - Square Root (Minutes)
6 weeks
3 months
6 months
Time

Appendix Table 1. Description of Intervention Components of the New Parent Physical Activity Education + Planning Condition

Intervention component	Description	Physical activity behavior change techniques
New Parent resources	Canadian Physical[1] Activity Guidelines Postpartum physical activity guidelines for moms[2]	• Goal setting (behavior) • Goal setting (outcome) • Information about health benefits
	Information/education booklet: Included list of benefits of physical activity and specific benefits of postpartum physical activity for both Moms and Dads. Brainstorming activity to identify PA Benefits for Moms/PA Benefits for Dads Brainstorming exercise to help find enjoyable activities for couples to do together. *Goal setting and planning worksheets:* Brainstorming exercise of potential barriers and strategies to overcome them. Included brainstorming worksheets for where to be active, new modes for being active, how to plan activity, how to incorporate rewards, & cues and journaling and tracking worksheets. Addressed identifying time wasters, listing priorities (where does PA fall into list of priorities), Social support strategies, problem solving around bad weather, low cost-activities, and coping with fatigue. Discussion of a re-set day, to reorganize physical activity goals and plans for next week.	• Goal setting (behavior) • Goal setting (outcome) • Problem solving • Action planning • Review behavior goals • Review outcome goals • Self-monitoring of behavior • Self-monitoring of outcome(s) behavior • Instruction on how to perform the behavior • Social support (unspecified) • Social support as a couple (practical) • Monitoring of emotional consequences • Non-specific reward • Discrepancy between current behavior and goal (reset day) • Prompts/cues

Notes: Behavior change techniques were coded as outlined by The Behaviour Change Technique Taxonomy Version 1.[2]

1. Tremblay MS, Warburton DER, Janssen I, Paterson DH, Latimer AE, Rhodes RE. New physical activity guidelines for Canadians. *Appl Physiol Nutr Metab*. 2011;36(1):36–46. https://doi.org/10.1139/h11-009.
2. HealthyPregnancyBC. I've had my baby. How can I fit in exercise when I have a new baby to care for? www.healthypregnancybc.ca. Published 2014.
3. Michie S, Richardson M, Johnston M, et al. The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. *Ann Behav Med*. 2013;46(1):81–95. https://doi.org/10.1007/s12160-013-9486-6.

Appendix Table 2. Baseline Demographic, Health, and Physical Activity Profile

Characteristic	**Education control (*n*=116)**	**Education + planning intervention (*n*=148)**
Target parent demographic profile		
Age, mean (SD)	32.50 (4.78)	31.49 (4.92)
% Female	50.5	51.0
% Visible minority	11.4	19.5
% Completed university	81.4	73.6
% >$74,000 CAN family income	73.5	61.1
% Currently employed	69.9	68.5
Health profile		
Mean BMI (SD)	26.65 (4.40)	25.99 (4.56)
Mean hours of sleep/night (SD)	6.43 (1.04)	6.46 (1.06)
% Smoker	0.0	2.8
% Drink alcohol	71.9	66.7
% Healthy eaters	71.5	76.4
% With heart disease	0.0	2.7
% With diabetes	5.3	2.8
% With cancer	0.0	1.4
% With high blood pressure	8.0	5.6
% With high cholesterol	4.4	1.4
Physical activity profile		
Mean MVPA min self-report (SD)	197.07 (203.55)	231.62 (255.88)
% Meeting guidelines self-report	50.9	50.0

MVPA = moderate and vigorous intensity physical activity, x.

Appendix Table 3. Results From the Exploratory Regression Analyses Comparing the Change in Physical Activity Over Time for Fathers and Mothers in the Intervention Only Condition Who Met Physical Activity Guidelines at Baseline

Model	**Coefficient**	**SE**	**T-ratio**	***p*-value**
Fathers model				
Intercept	11.07	3.62	3.06	<0.001
Linear trend	3.49	0.84	4.16	<0.001
Quadratic trend	–2.31	0.66	–3.51	<0.001
Intercept x MVPA guideline[1]	2.54	2.08	1.22	0.23
Linear x MVPA guideline	–2.31	0.48	–4.77	<0.001
Quadratic x MVPA guideline	1.31	0.39	3.31	<0.001
Mothers model				
Intercept	11.30	1.93	5.83	<0.001
Linear trend	4.34	0.62	7.02	<0.001
Quadratic trend	–1.97	0.43	–4.58	<0.001
Intercept x MVPA guideline[1]	1.80	1.41	1.28	0.21
Linear x MVPA guideline	–1.97	0.43	–4.58	<0.001
Quadratic x MVPA guideline	1.14	0.31	3.63	<0.001

MVPA, moderate to vigorous physical activity.

Appendix Table 4. Effects of Physical Activity Planning Plus Education and Education Only Control on Changes in Fitness Among New Parents (N=264)

Variable	**Baseline M (SD)**	**Post study M (SD)**	**Mean change M (95% CI)**	**Between-group difference M (95% CI)**	***p*-value**	**Cohen's *d***
Mothers						
BMI						
EP group	25.77 (5.13)	24.80 (5.17)	–0.97 (–1.28, –0.67)	–0.19 (–0.28, 0.67)	0.42	–0.04
EC group	26.07 (4.76)	24.89 (4.58)	–1.18 (–1.56, –0.80)			
VO_2 max						
EP group	35.98 (6.91)	37.23 (8.04)	1.25 (–0.34, 2.84)	–0.55 (–2.61, 1.52)	0.60	–0.05
EC group	37.12 (7.03)	38.76 (8.74)	1.63 (–0.45, 2.82)			
Push-ups						
EP group	9.00 (7.45)	11.95 (8.38)	2.95 (1.78, 4.13)	–0.06 (–1.72, 1.84)	0.95	<0.001
EC group	8.25 (6.45)	11.22 (7.75)	2.97 (1.60, 4.34)			
Sit and reach						
EP group	31.61 (9.23)	35.28 (8.56)	3.67 (2.72, 4.61)	0.81 (–0.52, 2.13)	0.29	0.12
EC group	33.21 (9.71)	35.79 (8.75)	2.58 (1.46, 3.69)			
Curl-ups						
EP group	15.55 (9.95)	21.11 (7.78)	5.56 (3.40, 7.73)	1.19 (–1.23, 3.61)	0.34	0.09
EC group	15.07 (10.10)	19.73 (8.27)	4.66 (2.33, 6.99)			
Fathers						
BMI						
EP group	26.22 (3.92)	26.30 (3.80)	0.08 (–0.34, 0.19)	–0.50 (–0.12, 1.11)	0.11	–0.16
EC group	27.58 (4.15)	27.00 (4.11)	–0.58 (0.05, –1.21)			
VO_2 max						
EP group	48.45 (6.97)	47.93 (8.30)	–0.51 (–2.35, 1.33)	–0.67 (–0.03, 1.65)	0.57	–0.15
EC group	46.92 (8.43)	47.57 (8.36)	0.65 (–0.09, 2.20)			
Push-ups						
EP group	18.69 (10.18)	19.36 (11.02)	0.67 (–0.49, 1.84)	–1.52 (–3.42, 0.38)	0.12	–0.16
EC group	17.56 (9.25)	19.83 (9.82)	2.27 (0.69, 3.86)			
Sit and reach						
EP group	26.38 (9.21)	27.54 (8.73)	1.15 (0.21, 2.10)	–0.06 (–1.25, 1.12)	0.92	<0.001
EC group	27.42 (9.45)	28.53 (9.39)	1.11 (0.41, 1.82)			

Curl-ups						
EP group	23.18 (5.62)	24.21 (3.44)	1.03 (–0.35, 2.40)	1.19 (–0.27, 2.64)	0.11	0.04
EC group	21.49 (7.22)	22.29 (6.28)	0.80 (–0.52, 2.12)			

Note: Between-group differences were adjusted for baseline values.

EP, Education + Planning intervention; EC, Education Only Control.

Appendix Table 5. Descriptive Statistics for End-of-Trial Evaluation Among Participants in the Planning + Education Intervention

Variable	**Fathers Mean ± SD**	**Mothers Mean ± SD**	**t**	***p*-value**	***d***
Delivery					
Usefulness of intervention workbook	1.70 ± 0.53	2.00 ± 0.66	2.95	0.05	0.50
Usefulness of the counseling sessions	1.85 ± 0.56	2.17 ± 0.65	3.07	<0.001	0.52
Effectiveness of the intervention delivery	2.38 ± 0.60	2.69 ± 0.73	2.66	0.01	0.46
Content (helpfulness of …)					
Benefits of PA	3.02 ± 1.21	3.41 ± 1.21	1.87	0.06	0.32
Making PA enjoyable	2.98 ± 1.14	3.24 ± 1.08	1.29	0.20	0.23
Overcoming barriers	3.06 ± 1.13	3.78 ± 1.13	3.62	<0.001	0.64
Setting goals	2.90 ± 1.15	3.56 ± 1.04	3.40	<0.001	0.60
Planning	2.89 ± 1.03	3.49 ± 1.20	3.03	<0.001	0.54
Monitoring	2.95 ± 1.13	3.49 ± 1.20	2.64	0.01	0.46

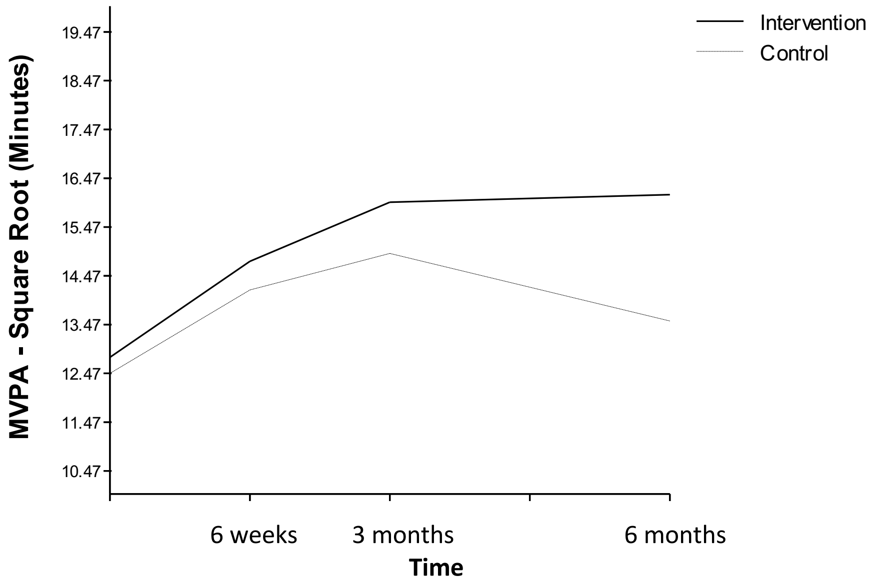
Note: Delivery scored on a 3-point scale from (1) not at all, (2) somewhat, and (3) extremely. Content scored on a 5-point scale from (1) not helpful, (3) somewhat helpful, (5) incredibly helpful.

PA, physical activity.

Appendix Table 6. Analysis Protocol Description

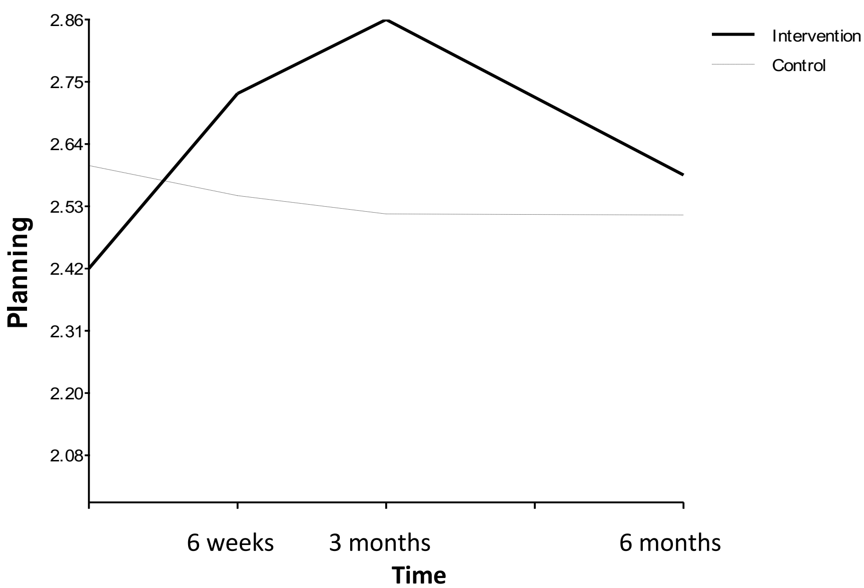
A Level-1 no intercept model was specified such that a main effect was entered for father (0=mother; 1=father), mother (0=father; 1=mother), a father linear trend centered at 3-months (–2 is baseline; –1 is 6-weeks, 0 is 3-months, 2 is 6-months), and a mother linear trend with all coefficients set to random. Next, quadratic trends were entered into the models to determine if they improved model fit, which was examined via a likelihood ratio test. Level-2 covariates (i.e., age, education, and income) were then entered into separate models to predict the Level-1 intercepts and determine their need to be controlled for in the final model. Once complete, the final model included condition (0=EP; 1=EC) at Level-2 to predict the Level-1 intercepts, linear and/or quadratic trends controlling for potential covariates. Finally, exploratory analyses were conducted for the fathers and mothers separately to determine if meeting the MVPA guideline at baseline (0 <150 minutes/week; 1 ≥150 minutes/week) was significantly associated with the MVPA linear and/or quadratic trends in the EP condition. This same analytic strategy was used for the planning variable in the tertiary analyses.

Appendix Figure 1. Quadratic trend for moderate to vigorous physical activity by condition for mothers.



Appendix Figure 2.

a) Quadratic trend by condition interaction for fathers



b) Quadratic trend by condition interaction for mothers