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Pilot Lifestyle Intervention Effect on Lifestyle Behaviors, Psychosocial Factors, and Affect

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Abstract

Background: This paper presents results of a pilot intervention effect on lifestyle behaviors, psychosocial factors, and affect among overweight or obese pregnant women.

Methods: 70 participants were randomized to the intervention or usual care group. During the 20-week intervention, participants completed a weekly online intervention module and joined individual online health coaching. Data were collected at baseline (<17 weeks gestation), 24-27 weeks gestation (T2), and 35-37 weeks gestation (T3). Lifestyle behaviors included dietary intake (caloric, fat, added sugar, fruit, and vegetable) and physical activity (PA). Psychosocial factors were autonomous motivation, self-efficacy, executive functions, and consideration of future consequences (CFC). Affect comprised stress and emotional control. Two-sample *t*-tests and Cohen's *d* effect sizes were used to compare between group mean differences in the change from baseline to T2 and T3.

Results: At T2, intervention positively influenced fruit intake (d = 0.47), autonomous motivation for healthy eating (d = 0.36), self-efficacy for healthy eating (d = 0.25) and PA (d = 0.24), executive functions (behavior regulation, d = -0.21; metacognition, d = -0.69), and emotional control (d = 0.79). At T3, the intervention improved PA (d = 0.19), autonomous motivation for healthy eating (d = 0.33), self-efficacy for healthy eating (d = 0.50) and stress management (d = 0.62), executive functions (metacognition, d = -0.46), CFC (d = 0.25), stress (d = -0.45), and emotional control (d = 0.72).

Conclusion: The pilot intervention has positive effects on most psychosocial variables and affect in both the short and long terms.

Keywords: Diet; Physical activity; Autonomous motivation; Self-efficacy; Consideration of Future Consequences; Executive functions; Obesity

Introduction

Excessive gestational weight gain, which is highly prevalent in overweight or obese women [1,2] is associated with adverse maternal and birth outcomes, for example, gestational hypertension, gestational diabetes, and large for gestational age fetus [3,4]. Of women with gestational diabetes, 70% will develop type 2 diabetes within 10 years postpartum [5-7]. Also, women with gestational hypertension or gestational diabetes are at increased risk for cardiovascular disease (1.5 [8] and 2.3 times, [5-7] respectively) later in life. Despite these dire statistics, pregnancy is a window of opportunity for modifying lifestyle behavior (healthy eating and physical activity) to prevent

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excessive gestational weight gain and promote positive maternal and birth outcomes.

In addition to the need for healthy eating and physical activity, growing evidence has pointed to the need to address affect --perceived stress (hereafter stress) [9], and emotion [10,11] because they are associated with excessive gestational weight gain. Higher levels of stress, which are highly prevalent in pregnant women [12,13] are associated with increased intake of high fat and added sugar foods, leading to weight gain [14,15]. Negative emotion is associated with higher levels of stress and eating unhealthy foods [14,15] and decreased motivation and cognitive ability to adhere to lifestyle behavior interventions [16].

Motivation (agency thoughts) and cognitive ability (pathway thoughts) are key concepts of Hope Theory [16]. Motivation refers to initiating interest in making plans and cognitive ability means ability to make and execute plans for accomplishing goals. Based on Hope Theory, motivation and cognitive ability are needed to make positive behavioral changes [16]. In this paper, motivation included autonomous motivation (personal value or interest [17]) and self-efficacy (one's confidence in performing a task [18]). Cognitive ability consisted of considering future consequences and executive functions. Consideration of future consequences is a cognitive-motivational process in which one weighs the immediate and future positive outcomes (pros) and negative consequences (cons) of behavior during decision-making [19]. Executive functions, required for successful lifestyle behavior change [20], includes (for example) inhibitory control, cognitive flexibility, decision making, problem-solving, and planning [21].

Even though affect and psychosocial factors can influence success in weight management, prior lifestyle behavior intervention studies aimed at preventing excessive gestational weight gain in overweight or obese pregnant women have paid little or no attention to these variables. Our pilot randomized controlled lifestyle behavior intervention was designed to bridge this gap. The pilot study aimed to evaluate feasibility of recruitment, retention, and implementing the intervention. The primary outcome was gestational weight gain and secondary outcomes included maternal and birth outcomes. Results of the feasibility evaluation and primary and secondary outcomes have been described elsewhere [22]. This paper presents results of the intervention effect on lifestyle behaviors, psychosocial factors (autonomous motivation, self-efficacy, consideration of future consequences, and executive functions), and affect (stress and emotional control) among overweight or obese pregnant participants.

Materials and Methods

Study setting, participants, and procedure

A detailed description of study setting, participants, and procedure has been published elsewhere [23]. Briefly, clinicians at our 5 collaborating prenatal care clinics affiliated with The Ohio State University Wexner Medical Center referred their first trimester pregnant patients to the study. Next, the trained research assistants called the potential participants to screen for qualification based on the study criteria. Qualified participants had to be ≤13 weeks gestation at referral, overweight or obese (body mass index, BMI 25.0-45.0 kg/m^2 computed using self-reported height and weight), between 18 and 45 years old, and without diagnoses of either hypertension or type 1 or 2 diabetes. Qualified women provided online electronic consent prior to participation. We enrolled all participants between February, 2021 and March, 2022. The Ohio State University Institutional Review Board approved the study procedure.

Randomization and usual care group

A detailed description of randomization and usual care group has been described [22]. Briefly, we randomized participants (N = 70) who completed the baseline data collection and were less than 17 weeks gestation to an intervention or usual care group (1:1 ratio). All participants received usual prenatal care at our collaborating clinics. We emailed all participants a newsletter with topics related to pregnancy health (e.g., avoidance of eating fish containing high levels of mercury) every other month throughout the 20-week intervention.

The 20-week intervention

Details of the intervention have been described [22]. The intervention covered 3 main topics: stress and emotion management, healthy eating, and physical activity. We applied and integrated goal oriented episodic future thinking (GoEFT, picturing) and concepts of Hope Theory to develop the intervention. During the 20-week intervention, participants completed a weekly online intervention module (1 module per week, a total of 20 modules) and joined a total of 10 online individual health coaching sessions [23]. Each online intervention module had 2 parts. Part I (25 minutes) centered on increasing motivation to initiate plans and cognitive ability to generate and implement plans by asking participants to picture activities selected from dropdown menus. These activities featured strategies to better manage stress and emotion, eat healthier, and be more physically active. Part II (5 minutes) focused on evaluating progress toward goals, followed by a tailored message and identification of benefits of making positive changes. The health coaching session (~45 min per session) reinforced contents learned from the online intervention.

Measures

We collected data at 3 time points: baseline (T1, <17 weeks gestation), 24-27 weeks gestation (T2), and 35-37 weeks gestation (T3). Unless noted, all measures were completed online.

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- **Dietary intake:** We used a National Cancer Institute Self-Administered 24-hour Dietary Recall (ASA-24) assessment tool to collect dietary intake data [24]. Participants completed two 24-hour dietary recalls within 2 weeks. The dietary variables included caloric, total fat, added sugar, fruit, and vegetable intakes.
- **Physical activity:** We used Actigraph accelerometer, GT3X, an objective and valid measure [25,26] of physical activity. Participants were asked to wear the Actigraph on the wrist of the non-dominant hand during waking hours for 7 consecutive days (≥ 10 hrs/day) except during showers/baths and water activities. We included data with at least 3 days worn (≥ 10 hrs/day) in the analyses. To create metabolic equivalent of task (MET or energy expenditure), we assigned light physical activity as 1.5 MET/hour, moderate activity as 3 MET/hour, and vigorous physical activity as 6 MET/hour [27]. We summed MET for the 3 levels of physical activity and then divided the number of days worn to get an average MET per day. Next, we multiplied the average MET per day by 7 to create METs for 7 days.
- **Autonomous motivation:** We used the Treatment Self-Regulation Questionnaire to measure autonomous motivation for healthy eating (6 items), physical activity (6 items), and stress management (6 items). This previously validated survey asked participants to report reasons for eating healthier, being more physically active, and better managing stress using a 7-point scale ranging from 1 (not at all true) to 7 (very true) [28]. Responses to the 6 items of autonomous motivation for healthy eating were summed to create a score. The same approach was used to create a score for physical activity and a score for stress management. Higher scores reflected higher autonomous motivation.
- **Self-efficacy:** We used 1 survey to measure self-efficacy for healthy eating (8 items) [29], 1 survey to measure self-efficacy for physical activity (10 items) [30], and another survey to measure stress management (6 items) [30]. Each previously validated survey asked participants to report confidence in eating healthier, being more physically active, or better managing stress using a 4-point scale ranging from 1 (not all confident) to 4 (very confident). Responses to the 10 items on self-efficacy for healthy eating were summed to create a score. We used the same approach to create a score for physical activity and a score for stress management. Higher scores indicated more confidence.
- **Consideration of future consequences:** We used the Consideration of Future Consequence Scale to measure this concept. This survey (12 items) asked participants to rate the extent to which consideration of immediate- and long-term consequences of potential behaviors was characteristic of them using a 5-point scale ranging from 1 (extremely uncharacteristic) to 5 (extremely characteristic) [19]. We summed the responses to the 12 items to create a composite score. Higher scores meant that participants viewed consideration of immediate- and long-term consequences of potential behaviors as more characteristic of them.
- **Executive functions:** The Behavior Rating Inventory of Executive Function-Adults (75 items) was used to measure executive function [31]. This survey asked participants to rate self-regulation behaviors in the everyday environment using a 3-point scale ranging from 0 (never) to 2 (often). This survey covers 2 main domains: behavior regulation (30 items) and metacognition (45 items). We summed responses to the 30 behavior regulation items to create a behavior regulation score. We used the same approach to create a composite score for metacognition. Higher scores indicated worse behavior regulation or metacognition.
- **Stress:** The Perceived Stress Scale (10 items) was used to measure stress. The scale asked participants to rate the frequency of stressful life situations in the past month using a 4-point scale ranging from 1 (never) to 4 (often) [32]. We summed the responses to 10 items to create a composite score. Higher scores meant perceived higher levels of stress.
- **Emotional control:** The Emotion Regulation Questionnaire (10 items) was used to measure emotional control. The questionnaire asked participants to report the use of emotional regulatory process (reappraisal: 6 items, suppression: 4 items) using a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree) [33]. Responses to the 6 reappraisal items were summed to create a reappraisal score. After reversing codes, responses to the 4 suppression items were summed to create a suppression score. Finally, responses to all 10 items were summed to create an emotional control score. Higher scores indicated better emotional control.

Statistical Analysis

We applied descriptive statistics to summarize sample demographics and baseline measures. We conducted two-sample t-tests to compare between group differences (intervention vs. usual care) and outcome changes from baseline (T1) to each follow-up time point (T2 and T3). Because of nature of the pilot intervention study, a small sample size per group, we did not report P-values from the t-tests. Instead, we reported point estimates of the mean differences, their 95% confidence intervals, and Cohen's d effect size measures for between-group comparisons in the change from T1 to T2 and T3. All analyses were conducted using SAS 9.4 (SAS® Institute, Cary, North Carolina).

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Results

Demographics

Table 1 shows demographic characteristics of the study participants. Demographic characteristics of the study sample were equally distributed between groups. Most participants were non-Hispanic White, married, highly educated (at least bachelor's degree), and employed full time.

Intervention effects on lifestyle behaviors

Table 2 presents intervention effects on lifestyle behaviors. The intervention increased fruit intake at T2 (Cohen's d = 0.47) and physical activity at T3 (d = 0.19). However, our intervention also increased dietary intake of calories (T2, d = 0.49; T3, d = 0.51), fat (T2, d = 0.27; T3, d = 0.66), and added sugar (T2, d = 0.66; T3, d = 0.46), and the intervention decreased physical activity at T2 (d = -0.20). As one would expect, however, given the small sample size, one must take these patterns with caution, as all the 95% CIs included zero.

Intervention effects on psychosocial factors and affect

Table 3 shows intervention effects on psychosocial factors. The intervention increased autonomous motivation for healthy eating (T2, d = 0.36: T3, d = 0.33) and boosted self-efficacy for healthy eating (T2, d = 0.25; T3, d = 0.50), physical activity (T2, d = 0.24), and stress management (T3, d = 0.62). Also, the intervention increased executive functions: behavior regulation (T2, d = -0.21) and metacognition (T2, d = -0.69; T3, d = -0.46), and consideration of future consequences (T3, d = 0.25). Table 4 presents intervention effects on affect. Our intervention reduced stress (T3, d = -0.45) and promoted emotional control (a combined score of reappraisal and suppression; T2, d = 0.69; T3, d = 0.72) and reappraisal (T2, d = 0.77; T3, d = 0.66). Similar to the lifestyle behavior outcomes, few of the 95% CIs for the psychosocial factors excluded zero, though improvements in metacognition did. Yet, several 95% CIs on affect excluded zero (emotional control at T2 and T3; reappraisal at T2) or came close (reappraisal at T3) despite the small sample size.

Discussion

This paper presents results of intervention effect on lifestyle behaviors, psychosocial factors, and affect among overweight or obese pregnant women enrolled in a pilot randomized controlled lifestyle behavior intervention study. Despite some unexpected results on dietary intake, our intervention demonstrates promise in improving physical activity, psychosocial factors, and affect. Comparison of our study findings with those of prior studies is difficult. This is because prior lifestyle behavior intervention studies did not integrate concepts of Hope Theory and goal-oriented episodic future thinking to influence autonomous motivation, self-efficacy, executive function, stress, and emotional control.

Lifestyle Behaviors

Even though the intervention increased fruit intake at 24-27 weeks gestation (T2), the intervention effect diminished at 35-37 weeks gestation (T3). We unexpectedly found that intervention participants reported higher intake of calories, fat, and added sugar over time (24-27 weeks and 35-37 weeks gestation). We collected dietary intake data through 24-hour dietary recall, which required participants to accurately recall and estimate portion size of food intake over the last 24 hours.

Table 1: Sample demographics (N = 70).

	All	Intervention (N=35)	Usual care (N=35)
Age (years), Mean ± SD	32.2 ± 4.0	32.3 ± 4.3	32.0 ± 3.8
Race/Ethnicity, N (%)			
Non-Hispanic White	51 (72.9)	25 (71.4)	26 (74.3)
Minority	19 (27.1)	10 (28.5)	9 (25.7)
Marital Status, N (%)			
Married	63 (90.0)	31 (88.6)	32 (91.4)
Not married	7 (10.0)	4 (11.4)	3 (8.6)
Education, N (%)			
Associate degree or less	7 (10.0)	5 (14.3)	2 (5.8)
Bachelor degree or higher	63 (90.0)	30 (85.7)	33 (94.3)
Employment, N (%)			
Employed, full time	56 (80.0)	30 (85.7)	26 (74.3)
Not employed, full time	14 (20.0)	5 (14.3)	9 (25.7)
Pre-pregnancy BMI category, N (%)			
Overweight	30 (42.9)	16 (45.7)	14 (40.0)
Obese	40 (57.1)	19 (54.3)	21 (60.0)

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Table 2: Intervention effect on lifestyle behaviors.

	Intervention		Usual Care		Intervention vs. Usual care		
	M	**SD**	**M**	**SD**	**M_{diff}**	**95% CI**	**ES**
At T1 (baseline)[1]							
Dietary Intake							
Caloric intake (Kcal)	1887	555.4	2041	532.0			
Fat (gm)	80.58	29.25	86.63	28.16			
Fruit (cup)	0.92	0.74	1.36	0.85			
Vegetable (cup)	1.89	1.00	1.89	1.07			
Added sugars (teaspoon, 4 gm)	11.43	10.29	11.20	8.57			
Physical Activity (7-day MET)*[2]	32.38	14.22	33.72	16.38			
Change at T2 from T1							
Dietary Intake[3]							
Caloric intake (Kcal)	162.9	545.7	-149	655.9	312.29	-134.89, 759.47	0.49
Fat (gm)	9.89	32.74	-0.84	40.73	10.73	-16.81, 38.27	0.27
Fruit (cup)	0.63	2.50	-0.25	1.37	0.88	-0.42, 2.18	0.47
Vegetable (cup)	0.18	1.65	0.22	0.84	-0.05	-0.88, 0.79	0.04
Added sugars (teaspoon or 4 gm)	2.35	7.26	-2.99	8.16	5.34	-0.32, 11.00	0.66
Physical Activity (7-day MET)*[4]	1.77	9.31	3.65	9.85	-1.88	-7.23, 3.47	0.20
Change at T3 from T1							
Dietary Intake[5]							
Caloric intake (Kcal)	98.34	651.4	-217	627.0	315.35	-139.66, 770.36	0.51
Fat (gram)	15.18	43.30	-11.1	38.83	26.26	-2.91, 55.43	0.66
Fruit (cup)	0.12	1.07	0.19	1.32	-0.07	-0.93, 0.80	0.06
Vegetable (cup)	-0.11	1.65	0.08	1.34	-0.19	-1.25, 0.87	0.13
Added sugars (gram)	3.08	13.27	-2.28	10.96	5.35	-3.25, 13.95	0.46
Physical Activity (7-day MET)*[6]	3.06	7.09	1.13	11.40	1.92	-4.14, 7.99	0.19

Shaded areas: the lower score the better. *MET: Metabolic Equivalent of Task.
[1]Basline dietary intake: N = 70 (intervention =35, usual care = 35).
[2]Basline physical activity: N = 67 (intervention =33, usual care = 34). Although 70 participants wore Actigraph, data from 3 participants were not included in the analysis. This is because their wearing time did not meet criterion for analysis (at least 3 days with at least 10 hours per day)
[3]T2 dietary intake: N = 36 (intervention =12, usual care = 24).
[4]T2 physical activity: N = 53 (intervention =23, usual care = 30).
[5]T3 dietary intake: N = 33 (intervention =15, usual care = 18).
[6]T3 physical activity: N = 46 (intervention =18, usual care = 28).
ES = effect size

Prior studies have documented that overweight or obese women tend to under-report dietary intake [34]. It is possible that our intervention participants recalled food eaten and portion size more accurately than the usual care participants, as our intervention emphasized executive function by increasing (for example) awareness of and/or paying more attention to dietary intake [22]. As pregnancy progresses, many women decrease physical activity, especially during late pregnancy [35]. Although our intervention did not positively influence physical activity at 24-27 weeks gestation, the intervention promoted physical activity at 35-37 weeks gestation, an encouraging finding. This might partly relate to the challenges in changing habitual behaviors in a short period of time, [36] especially during pregnancy.

Psychosocial Factors

Overall, our intervention tended to improve most psychosocial factors in overweight or obese pregnant participants. Our intervention increased autonomous motivation for healthy eating at 24-27 weeks and 35-37 weeks gestation. However, our intervention had minimal influence on autonomous motivation for physical activity and stress management. The intervention effect on autonomous motivation might have been affected by the survey used. We used the Treatment Self-Regulation Survey, which was not designed to measure autonomous motivation for pregnant women. The survey asked participants to report reasons for making positive lifestyle behavior change and better managing stress. The reasons included in the survey

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Table 3: Intervention effect on psychosocial factors.

	Intervention		Usual Care		Intervention vs. Usual care		
	M	SD	M	SD	M_{diff}	95% CI	ES
At T1 (baseline)[1]							
Autonomous motivation							
Healthy eating	36.49	6.20	36.06	5.61			
Physical activity	37.20	6.31	35.14	6.37			
Stress management	37.00	5.20	35.09	6.13			
Self-efficacy							
Healthy eating	20.29	4.64	20.31	3.76			
Physical activity	25.77	5.92	23.63	5.46			
Stress management	24.03	5.37	23.97	4.46			
Executive functions							
Behavioral regulation	46.34	8.12	48.63	10.39			
Metacognition	55.46	18.34	54.57	17.21			
Consideration of future consequences	56.03	8.21	58.29	6.96			
Change at T2[2] from T1							
Autonomous Motivation							
Healthy eating	2.00	3.29	0.38	4.53	1.62	-1.46, 4.69	0.36
Physical activity	1.64	2.80	0.92	5.55	0.71	-2.88, 4.31	0.14
Stress management	-0.09	2.84	1.54	4.96	-1.63	-4.88, 1.63	0.34
Self-efficacy							
Healthy eating	2.27	3.58	1.31	3.58	0.97	-1.65, 3.58	0.25
Physical activity	2.45	5.89	1.19	4.42	1.26	-2.30, 4.83	0.24
Stress management	1.09	4.72	1.35	4.34	-0.26	-3.50, 2.99	0.05
Executive Functions							
Behavior regulation	0.36	5.71	1.88	7.39	-1.52	-6.60, 3.55	0.21
Metacognition	-8.36	15.81	1.46	12.21	-9.83	-19.56, -0.09	0.69
Consideration of future consequences	0.82	5.40	1.72	7.44	-0.90	-5.98, 4.17	0.12
Change at T3[3] from T1							
Autonomous motivation							
Healthy eating	-0.93	5.75	-2.95	6.70	2.01	-2.42, 6.45	0.33
Physical activity	-1.60	4.79	-1.26	6.81	-0.34	-4.56, 3.89	0.06
Stress management	-0.27	5.38	-0.68	6.71	0.42	-3.92, 4.75	0.07
Self-Efficacy							
Healthy eating	2.80	3.32	0.84	4.45	1.96	-0.85, 4.77	0.50
Physical activity	1.40	5.17	2.00	3.87	-0.60	-3.76, 2.56	0.14
Stress management	4.07	6.06	1.21	3.28	2.86	-0.45, 6.17	0.62
Executive Functions							
Behavioral regulation	-0.43	3.99	-0.17	5.22	-0.26	-3.70, 3.18	0.06
Metacognition	-5.86	11.37	-1.78	6.78	-4.08	-10.67, 2.51	0.46
Consideration of future consequences	2.85	6.76	1.28	5.99	1.57	-3.13, 6.27	0.25

Shaded areas: the lower score, the better
[1]T1 (Baseline): N = 70 (intervention =35, usual care = 35).
[2]T2: N = 37 (intervention =11, usual care = 26).
[3]T3: N = 32 (intervention =14, usual care = 18).
ES = effect size

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Table 4: Intervention Effect on Affect

	Intervention		Usual Care		Intervention vs. Usual care		
	M	SD	M	SD	M_{diff}	95% CI	ES
At T1 (baseline)[1]							
Stress	16.74	4.88	17.23	5.52			
Emotion control							
Emotional control[4]	38.97	6.94	41.94	5.81			
Reappraisal	27.51	5.96	29.74	4.31			
Suppression	11.46	4.96	12.20	4.92			
Change at T2[2] from T1							
Stress	1.73	6.12	2.04	5.39	-0.31	-4.41, 3.78	0.05
Emotional control							
Emotional control[4]	3.64	6.52	-0.50	5.26	4.14	0.01, 8.26	0.69
Reappraisal	4.09	5.89	0.04	4.49	4.05	0.45, 7.65	0.77
Suppression	-0.45	3.08	-0.54	3.51	0.08	-2.39, 2.56	0.02
Change at T3[3] from T1							
Stress	-1.60	6.23	0.72	4.52	-2.32	-6.15, 1.50	0.45
Emotional Control							
Emotional control[4]	2.73	5.76	-1.53	6.26	4.26	0.01, 8.51	0.72
Reappraisal	3.47	5.93	-0.21	5.52	3.68	-0.34, 7.69	0.66
Suppression	-0.73	4.04	-1.32	4.28	0.58	-2.36, 3.52	0.14

Shaded areas: the lower score, the better
[1]T1 (Baseline): N = 70 (intervention =35, usual care = 35).
[2]T2: N = 37 (intervention =11, usual care = 26).
[3]T3: N = 32 (intervention =14, usual care = 18).
[4]Emotional control: total score of reappraisal and suppression.
ES = effect size

centered on, for example, the respondent's own health, well-being, and life goals, all of which might be less appropriate for or applicable to pregnant women. This is because pregnant women are more likely to make positive changes in hope of having healthy pregnancies and healthy babies [37]. We observed that intervention participants increased their self-efficacy (confidence) for healthy eating and stress management at both 24-27 weeks and 35-37 weeks gestation. However, their confidence in being more physically active declined between 24-27 weeks and 35-37 weeks gestation. The reduced confidence might have been related to increased feelings of fatigue and discomfort during late pregnancy [38]. In terms of executive functions, we observed that intervention participants reported increased behavior regulation at 24-27 weeks gestation. Yet, the positive influence diminished at 35-37 weeks gestation, which might have been related to increasing anxiety about delivery or the anticipated change in family dynamics, thus, reducing individuals' ability to engage in behavior regulation [39]. Our intervention did not include strategies for reducing anxiety in late pregnancy. Despite the less favorable finding regarding behavior regulation at 35-37 weeks gestation, we observed that the intervention improved metacognition at both 24-27 weeks and 35-37 weeks gestation. The slightly decreased intervention effect on metacognition at 35-37 weeks gestation might have been related to increased anxiety in late pregnancy, which negatively affects individuals' ability to make and execute plans for achieving goals [16]. Our intervention also increased consideration of future consequences at 35-37 weeks gestation. In terms of affect, our intervention effectively reduced stress and promoted emotional control (a combined score of reappraisal and suppression) over time. These promising results might have resulted from the intervention's emphasis on executive functions.

Limitations

There are study limitations. As a pilot study, the sample size was small for each group: intervention vs. usual care. The present study was implemented immediately after the start of the COVID pandemic in the U.S. Our intervention was designed without taking consideration of the pandemic, which might have been negatively, affected our study findings. Consequently, interpretation of the study findings requires caution. Also, we collected dietary data through 24-hour dietary recall, which might not have represented habitual eating data, especially for T1. This is because some women might have experienced pregnancy-related symptoms such as nausea and vomiting, which altered their food intake.

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Finally, most participants were middle class, highly educated, and identified as non-Hispanic Whites, and data were collected during the COVID pandemic. Thus, our findings might not generalize to other pregnant women in different circumstances.

Conclusion

Our intervention temporarily increased fruit intake but also increased caloric, fat, and added sugar intake. However, our intervention demonstrated potential promise in many areas. Our intervention increased physical activity and most of the psychosocial factors over time: autonomous motivation for healthy eating, self-efficacy for healthy eating and stress management, and metacognition. Also, the intervention effectively reduced stress and promoted emotional control over time. Future larger scale randomized controlled lifestyle behavior intervention studies are needed to validate and extend the current study findings.

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Conflicts of Interest

The authors declare no conflict of interest. The sponsor has no role in the design, execution, interpretation, or writing of the study.

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