



**Western University**

---

**From the Selected Works of Michelle Mottola**

---

2023

# How Did Participating in a Prenatal Nutrition and Exercise Program Influence Postpartum Behaviour During COVID-19?

Michelle F Mottola, Dr, *Western University*



*Original Research*

---

## **How Did Participating in a Prenatal Nutrition and Exercise Program Influence Postpartum Behaviour During COVID-19?**

ROZHAN MOMEN\*<sup>1,2</sup>, MAYA WEINREICH\*<sup>1,2</sup>, TANIYA S. NAGPAL<sup>‡3</sup>, and MICHELLE F. MOTTOLA<sup>‡1,2</sup>

<sup>1</sup>R. Samuel McLaughlin Foundation-Exercise and Pregnancy Laboratory, University of Western Ontario, London, ON, CANADA; <sup>2</sup>School of Kinesiology, Faculty of Health Sciences, University of Western Ontario, London, ON, CANADA; <sup>3</sup>Faculty of Kinesiology, Sport and Recreation, University of Alberta, Edmonton, AB, CANADA

\*Denotes undergraduate student author, †Denotes graduate student author, ‡Denotes professional author

---

### ABSTRACT

*International Journal of Exercise Science* **16(3): 1-11, 2023**. Lifestyle interventions focusing on prenatal physical activity (PA) and healthy nutritional habits can carry forward into the postpartum period. As many health resources, like PA facilities and postpartum support groups, were inaccessible due to the Coronavirus-19 (COVID-19) pandemic restrictions, it may be plausible that individuals who participated in a prenatal lifestyle intervention continued engaging in positive health behaviours on their own. This study explored experiences of postpartum individuals during the pandemic who had engaged in a prenatal PA and nutrition program prior to COVID-19. Semi-structured interviews were completed with postpartum individuals following a qualitative description approach. The study objectives were to identify and summarize the impact of the COVID-19 pandemic on PA and nutritional behaviours postpartum, and the role of previous participation in a prenatal lifestyle intervention, pre-pandemic, on PA and nutritional habits during postpartum quarantine restrictions. Thirteen participants completed interviews and reported that overall, PA levels stayed the same however, there was a change in PA type, as walking became the prominent choice of PA. Diet became more limited and involved a great deal of meal planning. Participation in a prenatal lifestyle intervention prior to the pandemic positively impacted PA and nutritional habits postpartum during COVID-19 restrictions. Specifically, it enabled individuals to implement walking as a daily PA habit and encouraged important concepts such as mindful eating and meal planning. Prenatal lifestyle interventions can be beneficial in establishing healthy postpartum habits, even during pandemic restrictions.

**KEY WORDS:** Qualitative, lifestyle intervention, pandemic

### INTRODUCTION

Nutrition and physical activity (PA) lifestyle interventions during pregnancy can have positive effects on maternal health and fetal development. Some of these benefits include prevention of perinatal complications (26), improved delivery outcomes (13), and improved maternal mental

health (20). Additionally, a healthy lifestyle in pregnancy improves postpartum recovery and is associated with reduced risk of postnatal depression (15) and weight retention (23). Canadian guidelines for PA throughout pregnancy suggest that pregnant individuals should accumulate at least 150 minutes of moderate intensity PA weekly, spread over a minimum of 3 days per week, to achieve clinically significant health benefits and decrease risk of pregnancy complications (17). The guidelines indicate incorporating a variety of aerobic and resistance training activities throughout gestation. Canadian nutrition guidelines indicate that pregnant individuals should be mindful of their eating habits to make healthier food choices (10). Pregnant individuals are recommended to increase their iron intake, choose foods with healthy fats instead of saturated fats, and drink plenty of water during pregnancy and throughout breastfeeding (10). Despite existing prenatal nutrition and PA guidelines, few individuals report meeting these recommendations (25). Furthermore, current standard prenatal care guidelines in Canada do not include mandatory delivery of PA and nutrition resources, likely contributing to reduced adherence to guidelines and limiting support for overcoming barriers. For example, documented barriers to prenatal physical activity include lack of time and social support (8). Problematically, the Coronavirus-19 (COVID-19) pandemic may have exacerbated barriers for pregnant individuals to adhere to prenatal nutrition and PA recommendations. For instance, the pandemic reduced availability of in person social support and resources promoting activity, and many people were juggling time responsibilities with managing both their expectations at work and at home simultaneously (e.g., childcare), thus likely further exacerbating lack of time and social support as barriers to being active.

The World Health Organization (WHO) declared COVID-19 a global pandemic in March 2020 (9). Consequently, quarantine and physical distancing regulations were implemented worldwide to help prevent the transmission of this debilitating virus. Pregnant and postpartum individuals are a high-risk population for COVID-19 thus, several changes were made to their delivery of healthcare earlier in the pandemic to reduce transmission. For example, most in-person check-ups with family physicians were cancelled or replaced with virtual and phone appointments with the exception of those with serious concerns for newborns that needed in-person pediatric care (27). Prenatal and postpartum care by midwives and doulas were primarily provided virtually (4). Community-based facilities such as breastfeeding clinics and prenatal and postpartum group fitness classes were unavailable with limited online access options for some programs (24).

In a study that examined the impact of COVID-19 in May 2020 on pregnant people's health behaviours, approximately 17% of individuals reported that their diet had worsened, 22% had indicated that they had stopped being active, while only 2% reported they had become active (28). Moreover, findings are indicative of an increase in maladaptive health behaviours in pregnancy such as emotional eating (29) and a rise in postnatal depressive symptoms during the pandemic (7). In a study that measured postnatal depression by the Edinburgh Postnatal Depression Scale (EPDS), 40.7% of mothers who were pregnant or within 1-year postpartum reported EPDS > 13 (indicative of depression) compared to only 15% pre-pandemic (7).

Pregnancy is normally a time when most individuals report wanting to improve their lifestyle and adopt healthier habits regarding nutrition and PA (1). Problematically, the restrictions put in place due to COVID-19 likely prevented access to lifestyle resources that would have normally been available, such as community-based nutrition and PA programs. Previously, lifestyle interventions that delivered in-person nutrition and PA programs to pregnant individuals demonstrated improved self-efficacy and motivation to maintain healthful behaviours on their own in pregnancy and postpartum (18). One example of a successful lifestyle intervention delivered in pregnancy is the Nutrition and Exercise Lifestyle Intervention Program (NELIP), which was shown to improve adherence to nutrition and exercise recommendations in pregnancy and improve health outcomes such as prevention of excessive gestational weight gain (18, 19). It may be plausible that those who were receiving a nutrition and PA intervention prior to commencement of the pandemic were equipped with the knowledge and support to maintain these health behaviours on their own. As we transition to a post-pandemic world and healthcare system, it is important to carry forward lessons learned to enhance our delivery of standard care. The purpose of this exploratory study was to examine the potential role of participation in the NELIP during pregnancy before pandemic restrictions on PA and nutrition habits postpartum during the pandemic, and specifically while quarantine restrictions were implemented.

## **METHODS**

### *Participants*

English speaking postpartum individuals participating in the NELIP from London, Canada before the onset of the pandemic in March 2020, were recruited between June and September of 2020, to engage in a one-time, semi-structured interview. Inclusion criteria were: 1. participating in the NELIP while pregnant pre-pandemic and up to one year postpartum at the start of quarantine in March 2020; and 2. previously agreed to be contacted for future studies (checked on their consent forms).

### *Protocol*

This research was carried out fully in accordance the ethical standards of Helsinki (21). We received ethical approval from the Research Ethics Board at Western University for the current sub-study. The recruitment window ensured that the participants were involved in the NELIP while pregnant but when the pandemic was declared in March 2020, they were up to one year postpartum at the time of the interview. Detailed description of the NELIP has been published elsewhere (19). Briefly, the NELIP included offering weekly nutrition and PA support including a facilitated and progressive walking program (starting at 25 minutes per session, increasing 2 minutes each week until 40 minutes was met), and nutrition counselling, meal planning and tracking support. Participants were recruited through purposeful sampling, and were contacted by a NELIP investigator, via phone call, to determine if they were interested in participating in the present study. If they were interested, the study investigator sent an email with the letter of information and informed consent was obtained prior to the interview beginning. A Zoom interview was scheduled at the participant's convenience. The interviews took place throughout

the summer of 2020 which coincided with the transition from stage 2 to 3 of the reopening framework for Ontario (22). This transition entailed slow re-opening of businesses and increased limit on the number of people allowed in gatherings.

Each interview was hosted privately via Zoom and only the audio recording of the interview was used for analysis. At the beginning of the interview, the investigator collected demographic data regarding age, weeks postpartum, number of children, and work status. Throughout the duration of the interview, the study investigator took notes on the common findings of the interview. In addition, the investigator journaled before and after each interview to record any initial thoughts related to emerging codes, and notes that may assist with reducing biases when interpreting findings such as the investigator's mood, and any distractions the participant may have experienced.

### *Statistical Analysis*

A qualitative descriptive approach (QDA) was used in this investigation. A QDA aims to understand and describe a novel phenomenon through perspectives of individuals who have experienced the phenomena directly (2). The QDA follows a constructivism perspective, accepting that individuals may address the same phenomena with different perspectives in real time and in specific situations. Hence the findings are influenced by both previous knowledge and experiences of the investigator and participants (6). The goal of QDA in healthcare research is to paint an in-depth understanding of a phenomenon and encourage further investigation (2). Following a semi-structured interview approach, an interview guide was developed. The questions were designed to accomplish the following main objectives: 1. Evaluate the impact of COVID-19 quarantine regulations on PA and nutritional behaviours (e.g., How do you think your nutrition habits may have changed during quarantine measures? How do you think your exercise habits may have changed during quarantine measures?); and 2. The impact of previous participation in a lifestyle intervention on PA and nutrition habits during quarantine measures (e.g., Did participating in an exercise intervention during your pregnancy impact your physical activity/nutrition behaviours while you were quarantined in the postpartum period?). A content analysis was completed whereby the codes represented the summarized answers to the primary research questions: 1. How did the quarantine stay at home regulations affect PA and nutrition behaviours up to one year postpartum? 2. Did participating in the NELIP during pregnancy have an impact on PA and nutrition behaviours during quarantine stay at home regulations up to one year post-delivery?

All interviews were recorded, transcribed verbatim, and saved under the unique identification code assigned to each participant. The transcripts were read several times to gain a full sense of the participants' experience. In the first round of transcript assessment, general notes were taken with the focus on identifying potential codes to be representative of responses for each primary objective. The transcripts were coded by reading line by line and assigning a word or phrase that accurately captured the core essence of the data for each objective. Next, the investigator highlighted quotes and assigned the selected quotes to codes from notes taken during the first round. Transcripts were then reviewed and categorized according to the influence of quarantine measures on PA and nutritional behaviours and the potential effects of participating in NELIP

during pregnancy on postpartum PA and diet during quarantine. Finally, the investigator reviewed and finalized the overarching codes that would best represent the findings which were then reviewed by the research team and consensus was achieved. All analyses were completed on Nvivo Software (12 plus).

## RESULTS

Twenty-one eligible postpartum participants were contacted, and thirteen individuals participated in the semi-structured interviews. Eight individuals declined due to lack of time, lack of interest, or became unresponsive after initial contact. Average age and weeks postpartum, at the time of the interview, were  $34 \pm 4$  years, and  $28 \pm 8$  weeks, respectively. Seven of the participants were first time mothers at the beginning of the quarantine measures in March 2020. The majority of the participants were of a Caucasian ethnic background (Caucasian:  $n = 12$ , Hispanic:  $n = 1$ ). In terms of highest level of education from our sample, 54% of participants ( $n = 7$ ) had a Bachelor's degree or College diploma and 46% of participants ( $n = 6$ ) had completed a Doctorate or Master's degree. All resided in the London- Middlesex region.

### *The influence of quarantine measures on PA and nutritional behaviour*

There were five main findings regarding the effect of quarantine on PA up to one year postpartum: 1. Participants increased walking; 2. They found it harder to find time to take part in strength training; 3. Weather had a big impact on whether or not they were active; 4. They perceived that their overall PA levels were similar, but slightly decreased from pre-quarantine levels, and; 5. PA levels dropped drastically after delivery and slowly increased as the newborn became older. One individual stated that *"there's less variety in my exercise, I do a lot more walking but less of other things."* Organized group sports and fitness activities were shut down due to lockdown measures. As a result, the most popular activity of choice was daily family walks as it was an easy and inexpensive way of being active for the whole family. Moreover, some individuals made use of PA content on social media such as YouTube and Instagram to introduce PA to their daily schedule. Lockdown measures introduced a great deal of uncertainty and participants commonly mentioned that implementation of PA into their daily routine was an outlet to decrease worries and promoted general sense of well-being. Selected quotes representing this information are presented in Table 1.

There were three findings for how quarantine measures affected nutrition behaviours: 1. Diet was more limited because of their fear to go into grocery stores; 2. Mothers and their partners spent more time on preparation and organization of weekly meals, and; 3. There were inconsistencies in eating habits exemplified by ordering in and snacking on unhealthy foods which increased while in quarantine, however many still indicated wanting to be more conscious about their eating habits to ensure adequate nutrition for breastfeeding. To limit exposure, participants decreased grocery store trips which introduced challenges such as resorting to items with more shelf life rather than fresh produce and creating a thorough meal plan in advance to inform grocery lists. One individual stated that *"It was harder to get fresh fruit and vegetables because we're trying not to go to the grocery store as often."* Furthermore, the majority

reported that because of restrictions, they were snacking more often especially in the evening which they identified as a form of stress-eating after a busy day of taking care of their children and working from home. Selected quotes representing this information are presented in Table 1.

**Table 1.** Selected quotes to represent the effects of quarantine measures on physical activity and nutritional behaviour in the postpartum period

---

*Effects of Quarantine on Physical Activity*

---

P01: "I think that they're pretty similar to what I usually do... I do at home exercise classes like on the, on the online thing so it's been a little harder to fit those in with trying to like do it during a nap or when he's quietly playing."

P01: "I think that pelvic floor health is maybe um undersold ... that's probably something exercise, exercise programs or just different exercises that could be helpful for um prevention and healing of you know the diastasis and pelvic floor issues."

P02: "The weather was too cold in March. Not very inviting to, uh to do outdoor activities and indoor activities were no longer an option. Uh, I didn't adapt doing at home workouts, it actually pissed me off."

P03: "Walking has been one of my biggest stress relievers in general, something I can do with the kids, which is awesome, and uh has been the most maintainable during the pandemic, which is awesome."

P05: "There's less variety in my exercise, I do a lot more walking but less of other things."

---

*Effects of Quarantine on Nutrition*

---

P02: "I think essentially the planning of how the week was going to be in terms of what I was going to eat, that I was allowed to eat. So I think that the planning was the best part."

P03: "We definitely we eat out once a week, so whether that's like, any kind of takeout, really, so there's definitely more takeout than we usually do. Um, and we definitely snack every night after the girls go to bed."

P04: "I'm trying to do better with my nutrition anyways in pregnancy and with breastfeeding trying to do better with my nutrition."

P05: "Harder to get fresh fruit and vegetables because we're trying not to go to the grocery store as often."

---

*The impact of a pregnancy NELIP on postpartum PA and nutrition behaviours during quarantine measures.*

From the participant experiences, a pregnancy NELIP impacted their general postpartum lifestyle behaviours during quarantine by helping them remain more mentally and physically healthy. Specifically, individuals noted how the pregnancy walking portion of NELIP led to more walking postpartum which provided them with an opportunity to engage in an act of self-care for their mental health.

The structured walking program specifically impacted the women in two key ways: 1. Helped give structure on how to maintain and improve PA levels; and 2. Encouraged them to go outside and walk. One individual stated that "*It was primarily what I did, so it, it did impact.*" Another stated that "*I don't think I would be walking as actively, um if I didn't do it.*" The walking program of NELIP initiated during pregnancy presented an inexpensive and accessible example of PA which they felt they could continue during the postpartum despite their busy daily schedules now raising a newborn.

The nutrition portion of NELIP initiated during pregnancy was found to have two key benefits postpartum: 1. It helped give individuals structure and information on proper nutrition

behaviours; and 2. It aided in the development of more conscious eating. Participants alluded to the fact that that it was a “good trigger” to ensure proper nutrition. Additionally, many stated that it was a “good influence” on their conscious eating, making them more “mindful” of what they were putting in their bodies. Moreover, the informational nutrition component of NELIP expanded their knowledge on proper meal planning and snacking. They said that they became more ‘conscious of concepts such as ‘food portions’ and ‘food groups’. Participants found it was helpful to plan their meals in advance and keep a journal to track what they were eating and make changes if necessary. Selected quotes to describe their experience with the NELIP and the impact on postpartum during the pandemic are presented in Table 2.

**Table 2.** Selected quotes to represent the effects of NELIP during pregnancy pre-pandemic on postpartum PA and nutritional habits during quarantine measures

---

*Effects of NELIP during pregnancy pre-pandemic on postpartum PA during quarantine.*

---

P2: “NELIP motivated me to go outside for a walk... I would reflect back to the good feeling that I had after walking with more energy and better mood and that motivated me to go out for a walk.”

P3: “[as a result of participating in NELIP] I think I got into a habit of walking and enjoying walking.”

P4: “Ever since [participating in NELIP] it’s been like a daily goal that I meet my step count and but on top of that just like implementing fitness every single day.”

---

*Effects of NELIP during pregnancy pre-pandemic on postpartum nutritional habits during quarantine.*

---

P1: “I became more conscious, so I paid much more attention to the quantities and quality of the food that I was eating. I was mindful of what I ate and when I ate, making sure I eat a variety of things and balance them. From the standpoint of education, it was fantastic and very helpful, so I try to stick with it.”

P4: “Just being more aware of what I was eating so filling out those daily logs really made me sit down and look at uh where I was lacking food what I was eating too much of and where I could implement healthier foods throughout my day.”

P6: “I mean I learned a lot in terms of portion sizes and like ideas for snacks and stuff so I tried to keep up. Also, I have a better sense of portion sizes. The printouts they gave me is still in the kitchen and I grab some ideas when meal prepping here and there.”

---

## DISCUSSION

From our discussion with postpartum individuals who participated in a lifestyle intervention during pregnancy prior to the COVID-19 pandemic we identified that quarantine measures influenced PA and nutritional habits. The participants noticed that PA levels stayed the same however there was a change in type of PA as walking became the prime contributor to their daily PA routine. Diet became more limited and required planning to decrease grocery store trips due to fear of virus exposure. Moreover, there were inconsistent nutrition behaviours. It was found that there was a shift towards home cooked and healthy meals and contrastingly an increase in ordering takeout food and snacking later in the evening. Further, it was found that participation in NELIP during pregnancy had positively impacted postpartum PA and nutritional habits during quarantine measures. Participants felt that NELIP provided a structure on how to implement and maintain PA into their daily activities by suggesting walking, which is a simple and inexpensive example of PA. NELIP helped individuals become more mindful of their diet by inducing a sense of accountability through daily diet logs. In addition, the prenatal intervention educated them on proper meal planning and provided examples of healthy choices



for reference when meal planning. These findings indicate that as we progress towards a post-pandemic world, we should advocate for inclusion of nutrition and PA interventions in pregnancy care to support individuals with healthy decision-making during pregnancy that can empower individuals to continue these behaviours into the postpartum period.

In a study that examined the impact of quarantine on PA, postpartum individuals reported limited access to exercise facilities, such as gymnasiums and swimming pools, and this was the main reason that their PA levels had decreased (14). Positively, our findings may suggest that offering the prenatal NELIP led to increasing other modes of activity, primarily walking, post-delivery which does not require physical facilities that were inaccessible during quarantine measures. This is likely because NELIP offers a guided walking program that the participants engaged in during their pregnancy before the pandemic (18). Walking is noted to be the most popular movement behaviour in pregnancy (5), and in the NELIP, it is promoted as an effective way to engage in structured exercise. As the participants had access to this information in pregnancy, once the pandemic restricted traditional activities (e.g., using fitness facilities), walking may have still been an acceptable and accessible form of activity. A study that examined the influence of quarantine on diet of Canadians found that the most common changes to meal routines were as follows; making more homecooked meals from scratch, spending more time on cooking as a way of entertaining the family, fewer takeout meals, and more snacking in parents (3). These findings are in accordance with experiences of the postpartum individuals in our study.

Pregnancy lifestyle interventions have several long-term benefits in the postpartum, including reduced postpartum weight retention (16), improved glucose regulation, and reduced risk for diabetes (12), and overall improving nutrition and PA levels (11). Our study further highlighted that despite the COVID-19 pandemic restrictions, having access to a lifestyle program in pregnancy continues to have positive behavioural effects postpartum. Pregnant individuals should be supported to incorporate PA in their routine and be educated on a multitude of ways to be active beyond traditional physical activity narratives (e.g., going to the gym, attend fitness classes) which may be inaccessible due to a variety of reasons, especially during a pandemic. Regarding nutritional habits, important topics such as meal planning, learning about different food groups and their impact on health, and keeping a journal of meals to reflect on their nutritional choices are some strategies that could be taught in pregnancy and carried forward postpartum. The goal is to advocate for mindful eating while opting for a nutritious and satisfying dietary behaviour.

To our knowledge this is the first study to focus on postpartum individuals during the pandemic who previously received a lifestyle intervention during pregnancy before the pandemic. Other strengths include journaling throughout the interview and the coding process to establish rigor. Additionally, the semi-structured interviews provided leeway to adapt the script's questions to the direction of the responses given by participants, allowing for more natural conversations with in-depth responses during the interviews.

A limitation of our study is the homogenous sample with respect to ethnicity, geographic location, and education level. We also were not able to specifically recruit to saturation as the sample was restricted to only those who engaged in the NELIP during pregnancy, limiting generalizability. Lastly the COVID-19 quarantine restrictions were constantly changing based on public health guidelines. The fluidity of the situation could have affected the individual experiences and the reported results are applicable to stage 3 of the 're-opening Ontario framework' (22) since it coincided with the interview process. Future studies should consider recruiting a more diverse sample of participants to evaluate the potential role of factors such as geographic location, parity, and PA and nutritional habits prior to participation in a lifestyle intervention comparing and logging their experiences during quarantine measures. Given our positive feedback from participants, future studies may include testing the implementation of NELIP in primary care settings and through objective and subjective means to measure the impact of the program on prenatal and postpartum outcomes during and outside of pandemic situations.

In conclusion, participation in a nutrition and PA intervention in pregnancy may facilitate greater awareness of health behaviours postpartum, despite pandemic restrictions. The participants included in the present study had access to the NELIP during their pregnancy, and this led to engagement in more meal preparation and physical activity, like walking postpartum even during the pandemic restrictions. Our results suggest a need for the primary care system to consider prioritizing offering nutrition and PA support in pregnancy, which can carry forward to improving postpartum health behaviours as well.

## REFERENCES

1. Almli I, Haugdahl HS, Sandsæter HL, Rich-Edwards JW, Horn J. Implementing a healthy postpartum lifestyle after gestational diabetes or preeclampsia: a qualitative study of the partner's role. *BMC Pregnancy Childbirth* 20(1): 66, 2020.
2. Bradshaw C, Atkinson S, Doody O. Employing a qualitative description approach in health care research. *Glob Qual Nurs Res* 4: 2333393617742282
3. Carroll N, Sadowski A, Laila A, Hruska V, Nixon M, Ma D, et al. The impact of COVID-19 on health behavior, stress, financial and food security among middle to high Income Canadian families with young children. *Nutrients* 12(8): 2352, 2020.
4. College of Midwives of Ontario. COVID-19: Information from the college. 2020.
5. Connolly CP, Conger SA, Montoye AHK, Marshall MR, Schlaff RA, Badon SE, et al. Walking for health during pregnancy: a literature review and considerations for future research. *J Sport Health Sci* 8(5): 401-11, 2019.
6. Crotty M. *The foundations of social research: meanings and perspectives in the research Process*. London: Sage publications, 1998.
7. Davenport MH, Meyer S, Meah VL, Strynadka MC, Khurana R. Moms are not OK: COVID-19 and maternal mental health. *Front Glob Womens Health* 1, 2020.
8. Gaston A, Cramp A. Exercise during pregnancy: a review of patterns and determinants. *J Sci Med Sport* 14(4): 299-305, 2011.
9. Government of Canada. Clinical management of patients with COVID-19: second interim guidance. 2020.

10. Health Canada. Canada's food guide. 2021.
11. Hui A, Back L, Ludwig S, Gardiner P, Sevenhuysen G, Dean H, et al. Lifestyle intervention on diet and exercise reduced excessive gestational weight gain in pregnant women under a randomised controlled trial. *BJOG* 119(1): 70–7, 2012.
12. Huvinen E, Koivusalo SB, Meirilä J, Valkama A, Tiitinen A, Rönö K, et al. Effects of a lifestyle intervention during pregnancy and first postpartum year: findings from the RADIEL study. *J Clin Endocrinol Metab* 103(4): 1669–77, 2018.
13. Jukic AMZ, Evenson KR, Daniels JL, Herring AH, Wilcox AJ, Hartmann KE. A prospective study of the association between vigorous physical activity during pregnancy and length of gestation and birthweight. *Matern Child Health J* 16(5): 1031–44, 2012.
14. Lim S, Savaglio M, Skouteris H, Moran L. Mental health among postpartum women during the COVID-19 pandemic. *Acta Obstet Gynecol Scand* 100(8): 1537–8, 2021.
15. McCurdy AP, Boulé NG, Sivak A, Davenport MH. Effects of exercise on mild-to-moderate depressive symptoms in the postpartum period: a meta-analysis. *Obstetrics and gynecology* 129(6): 1087–97, 2017.
16. Michel S, Raab R, Drabsch T, Günther J, Stecher L, Hauner H. Do lifestyle interventions during pregnancy have the potential to reduce long-term postpartum weight retention? A systematic review and meta-analysis. *Obes Rev* 20(4): 527–42, 2019.
17. Mottola MF, Davenport MH, Ruchat S-M, Davies GA, Poitras VJ, Gray CE, et al. 2019 Canadian guideline for physical activity throughout pregnancy. *Br J Sports Med* 52(21): 1339–46, 2018.
18. Mottola MF, Giroux I, Gratton R, Hammond J-A, Hanley A, Harris S, et al. Nutrition and exercise prevent excess weight gain in overweight pregnant women. *Med Sci Sports Exerc* 42(2): 265–72, 2010.
19. Nagpal TS, Prapavessis H, Campbell C, Mottola MF. Measuring adherence to a nutrition and exercise lifestyle intervention: is program adherence related to excessive gestational weight gain? *Behav Anal Pract* 10(4): 347–54, 2017.
20. Nakamura A, van der Waerden J, Melchior M, Bolze C, El-Khoury F, Pryor L. Physical activity during pregnancy and postpartum depression: systematic review and meta-analysis. *J Affect Disord* 246: 29–41, 2019.
21. Navalta JW, Stone WJ, Lyons TS. Ethical issues relating to scientific discovery in exercise science. *Int J Exerc Sci* 12(1): 1–8, 2019.
22. Nielsen K. A timeline of COVID-19 in Ontario [Internet]. Global news. 2021.
23. Phelan S. Pregnancy: a “teachable moment” for weight control and obesity prevention. *Am J Obstet Gynecol* 202(2): 135.e1-8, 2010.
24. Region of Peel. Protecting yourself and others. 2020.
25. Richardsen KR, Falk RS, Jenum AK, Mørkrid K, Martinsen EW, Ommundsen Y, et al. Predicting who fails to meet the physical activity guideline in pregnancy: a prospective study of objectively recorded physical activity in a population-based multi-ethnic cohort. *BMC Pregnancy Childbirth* 16(1): 186, 2016.
26. Song C, Li J, Leng J, Ma RC, Yang X. Lifestyle intervention can reduce the risk of gestational diabetes: a meta-analysis of randomized controlled trials. *Obesity Reviews* 17(10): 960–9, 2016.
27. The Society of Obstetricians and Gynaecologists of Canada. SOGC COVID-19 resources. 2020.
28. Whitaker KM, Hung P, Alberg AJ, Hair NL, Liu J. Variations in health behaviors among pregnant women during the COVID-19 pandemic. *Midwifery* 95: 102929, 2021.
29. Zhang J, Zhang Y, Huo S, Ma Y, Ke Y, Wang P, et al. Emotional eating in pregnant women during the COVID-19 pandemic and its association with dietary intake and gestational weight gain. *Nutrients* 12(8): 2250, 2020.

