

Recent Patterns of Physical Activity and Sedentary Behaviour Among Pregnant Adults in Canada

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ABSTRACT

Objective: To evaluate current levels of physical activity and sedentary behaviour among pregnant and non-pregnant adults in Canada.

Methods: We ascertained population-based cross-sectional data from the Canadian Community Health Survey (CCHS), 2015–2019, and the Canadian Health Measures Survey (CHMS), 2007–2019. We included adults who were assigned female at birth and were of reproductive age (aged 18–55 years) living in the provinces. We analyzed activity data from validated questionnaires and accelerometers.

Results: We included 53 765 adults from the CCHS and 5321 from the CHMS, weighted to represent 16 million people. Based on accelerometers, both pregnant and non-pregnant adults spent 9.5 hours per day (70% of their time) engaged in sedentary behaviour. Across all survey years, ages, and Canadian regions, pregnant adults, especially those aged under 35 years, spent less time engaged in moderate-to-vigorous physical activity (MVPA) compared with non-pregnant adults. Pregnant adults reported 34.3 minutes (95% CI 30.5–38.2) and objectively accrued 14.9 minutes (95% CI 7.9–21.8) in MVPA per day — 15.1 and 8.9 fewer minutes than non-pregnant adults, respectively. After accounting for self-report bias, only 27.5% (95% CI 24.1–31.0) of the pregnant and

41.1% (95% CI 40.4–41.9) of the non-pregnant adults met the Canadian physical activity guidelines (i.e., ≥ 150 minutes of MVPA per week).

Conclusion: Physical activity levels are remarkably low among both pregnant and non-pregnant adults, with few meeting current guidelines. Given the substantial physical and mental health benefits, more support is needed to increase pre-pregnancy and prenatal activity in Canada.

RÉSUMÉ

Objectif : Évaluer les niveaux actuels d'activité physique et de comportements sédentaires chez les adultes enceintes et non enceintes au Canada.

Méthodologie : Nous avons vérifié des données populationnelles transversales tirées de l'Enquête sur la santé dans les collectivités canadiennes (ESCC), 2015–2019, et de l'Enquête canadienne sur les mesures de la santé (ECMS), 2007–2019. Nous avons inclus les adultes de sexe féminin assigné à la naissance et en âge de procréer (18–55 ans) vivant dans les provinces. Nous avons analysé les données d'activité à partir de questionnaires validés et d'accéléromètres.

Résultats : Nous avons inclus 53 765 adultes de l'ESCC et 5321 de l'ECMS et avons pondéré les données pour représenter 16 million de personnes. Selon les accéléromètres, les adultes enceintes et non enceintes ont eu des comportements sédentaires pendant 9.5 heures par jour (70% de leur temps). Peu importe l'année d'enquête, l'âge ou la région canadienne, les adultes enceintes, en particulier les moins de 35 ans, ont passé moins de temps que les adultes non enceintes à pratiquer des activités physiques de modérées à vigoureuses (APMV). Les adultes enceintes ont déclaré 34.3 minutes (IC à 95% : 30.5–38.2) et ont cumulé objectivement 14.9 minutes (IC à 95% : 7.9–21.8) d'APMV par jour, soit 15.1 et 8.9 minutes de moins que les adultes non enceintes, respectivement. Après avoir tenu compte du biais d'autodéclaration, seulement 27.5% (IC à 95% : 24.1–31.0) des adultes enceintes et 41.1% (IC à 95% : 40.4–41.9) des adultes non enceintes ont répondu aux normes des lignes directrices canadiennes sur l'activité physique (c.-à-d. ≥ 150 minutes d'APMV par semaine).

Keywords: physical activity; sedentary behavior; pregnancy; Canada; maternal health; public health surveillance

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Conclusions : Les niveaux d'activité physique sont remarquablement bas chez les adultes enceintes et non enceintes, et peu d'entre elles répondent aux normes des lignes directrices actuelles. Il faut plus de soutien pour augmenter l'activité physique prégestionnelle et prénatale au Canada en raison des bienfaits importants qu'elle procure pour la santé physique et mentale.

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BACKGROUND

An active lifestyle is an important component of health throughout the life course. During pregnancy without contraindication, regular physical activity is safe for both fetal and neonatal health^{1–3} and is associated with improved health outcomes for the mother and child.⁴ Benefits of regular physical activity include reduced odds of developing gestational diabetes, preeclampsia, gestational hypertension, prenatal depression, and macrosomia.^{1,5,6} Independent of physical activity, decreased sedentary time during pregnancy is associated with improved maternal metabolic health and birth outcomes.⁷ Accordingly, the new Canadian guidelines from 2019 recommend engaging in at least 150 minutes of moderate-intensity physical activity per week throughout pregnancy (if without contraindication) and limiting sedentary behaviour, as both are considered preventive and therapeutic health behaviours.⁴

Given the maternal–fetal benefits of a more active and less sedentary lifestyle, it is important to monitor the activity levels of pregnant people in Canada. However, recent population-based data are lacking, hindering our ability to evaluate current public health behaviours and enact evidence-based policies. To update our surveillance data up to 2019, we compared self-reported and objectively measured physical activity and sedentary behaviour between pregnant and non-pregnant adults assigned female at birth (aged 18–55 years) living in the provinces. We also examined the extent to which these populations were meeting the new Canadian physical activity recommendations.

METHODS

Statistics Canada received approval to conduct the Canadian Community Health Survey (CCHS) and the Canadian Health Measures Survey (CHMS) from Health

Canada's Research Ethics Board and obtained informed consent from all study participants. As per Article 2.2 of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans, this research did not require research ethics board review as it exclusively relies on data that are publicly available through legislation or regulation and protected by law.

Study Population

We ascertained data from 2 annual, population-based surveys of non-institutionalized Canadians living in the provinces: the CCHS 1-year files, 2015–2019 (median response rate: 58.8%),⁸ and the CHMS, 2007–2019 (median response rate: 51.7%).⁹ Additional information on these data sources can be found elsewhere.^{8,9} We included all adults who were assigned female at birth and who were of reproductive age (between 18 and 55 years; ages at which pregnancy remains biologically plausible). We focussed on the adult population, as the guidelines for physical activity during pregnancy were based on this age group. We excluded those who did not provide valid pregnancy and physical activity information.

Self-reported Measures Ascertained From the CCHS

The Physical Activity for Adults Questionnaire (PAAQ), included in the CCHS, provides estimates of time spent engaged in active travel, recreational, or other (including occupational) moderate-to-vigorous physical activities (MVPAs) in the past 7 days. It was developed by Statistics Canada and has demonstrated reasonable validity compared with accelerometer data and other questionnaires.¹⁰ The PAAQ was administered to all participants between 2015 and 2018 and to only those living in Prince Edward Island, Saskatchewan, and Alberta in 2019. We derived the total MVPA by summing time across the 3 activity domains. We additionally categorized participants as having met the 2019 Canadian guidelines for physical activity during pregnancy if they reported at least 150 minutes of MVPA in the last 7 days.⁴

In 2017 and 2018, participants were also asked to report the amount of free time they spent sitting or lying down while watching a screen on school/workdays or other days. From this, we derived a weighted measure of average minutes of sedentary screen time per day.

Objectively Recorded Measures Ascertained From the CHMS

Ambulatory CHMS participants were asked to wear a waterproof Actical accelerometer (Phillips Respironics,

Bend, OR) on a belt for 7 days during waking hours. Participants were blinded to the activity data. We included participants with at least 4 valid days of activity data in analyses, as recommended by Statistics Canada.¹¹ Canadian studies have calibrated and validated the Actical accelerometer for monitoring physical activity in the general population^{11–14} and during pregnancy.¹⁵ Statistics Canada also applies stringent data quality procedures to the data before dissemination.¹¹ We used validated cut points to classify movement as sedentary, light physical activity, or MVPA.^{12,13,16} We additionally categorized participants as having met the 2019 Canadian guidelines for 150 weekly minutes of MVPA during pregnancy.⁴ As no guidelines exist for sedentary behaviour during pregnancy, we did not dichotomize this measure.

Descriptive Variables

Participants of both surveys reported sociodemographic and health information, including their age, education level, total household income (imputed by Statistics Canada if missing), marital status, race/ethnicity, immigrant status, region of residence, general health, and general mental health. We determined the season based on the month of data collection.

Statistical Analysis

We calculated descriptive statistics to characterize the study sample by survey and compare physical activity patterns among pregnant and non-pregnant adults. In addition, we presented trends over time and differences by age and region (CCHS only). To account for the complex sampling design and non-response bias in both surveys, we used Statistics Canada-derived sample weights to ensure our estimates were representative of the Canadian population and bootstrap weights to estimate 95% CI.

All analyses were conducted using SAS Enterprise Guide 7.1 (SAS Institute, Cary, NC). This manuscript follows the STROBE reporting guidelines for observational research in epidemiology (see [File S1](#); [online Appendix](#) for the completed checklist).¹⁷ We suppressed small cell sizes and estimates with large coefficients of variations in accordance with privacy and release guidelines set by Statistics Canada.^{8,9}

Sensitivity Analysis

In addition, we undertook 4 pre-specified sensitivity analyses to test the robustness of our findings. We aimed to estimate the impact of selection and information biases associated with our exclusion criteria, differential accelerometer wear time by pregnancy status, a lack of information on contraindications to prenatal exercise, and self-reported data on physical activity in the CCHS. Detailed

methods and results for these sensitivity analyses can be found in [File S2](#); [online Appendix](#).

RESULTS

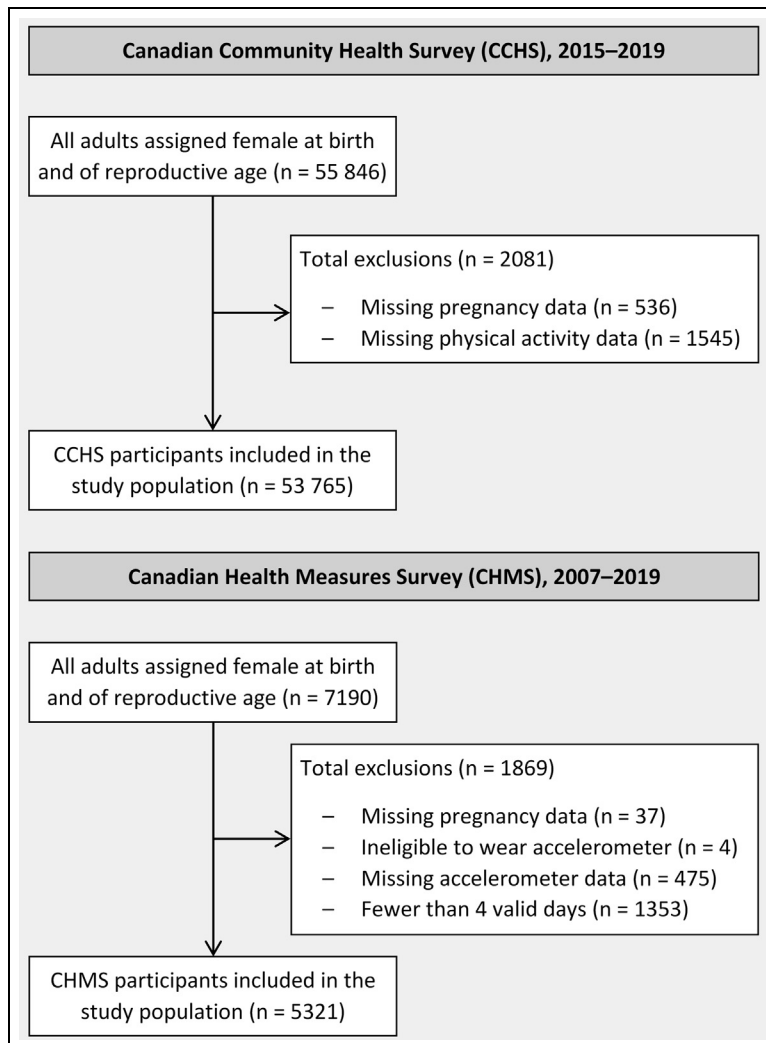
[Figure 1](#) presents the flow diagram for this study. Of the participants included, 1625 (3.0%) from the CCHS and 87 (1.6%) from the CHMS were pregnant. We weighted the pregnant and non-pregnant samples to represent 7 312 134 people in the CCHS and 9 109 121 people in the CHMS.

[Tables 1](#) and [2](#) present characteristics of the 2 samples by pregnancy status. In both samples, pregnant adults were more likely to be younger than 35 years, have excellent mental health, and have participated in the surveys during fall or winter than non-pregnant adults. In addition, pregnant adults in the CCHS were more likely to be recent immigrants, have more education, be married or in a common-law relationship, and have excellent physical health than non-pregnant adults.

[Figure 2](#) presents results from the CCHS (see [File S1](#); [online Appendix](#) for tabular data). Based on self-reported data, 45.6% (95% CI 41.8–49.4) of the pregnant and 59.7% (95% CI 59.0–60.4) of the non-pregnant adults met the Canadian guidelines for physical activity ([Figure 2A](#)). Pregnant adults reported approximately 15.1 fewer minutes of total MVPA per day than non-pregnant adults, mostly because of fewer minutes of recreational MVPA ([Figure 2C](#)). Pregnant adults also reported approximately 11.1 fewer minutes of sedentary screen time on any day than non-pregnant adults ([Figure 2D](#)). Across all survey years, ages, and Canadian regions, pregnant adults reported less time engaged in MVPA and sedentary screen time ([Figure 2E](#), [Figure 2F](#)). The gaps in MVPA were most pronounced between pregnant and non-pregnant adults under 35 years (19.7 fewer minutes; [Figure 2E](#)) and, for gaps in sedentary screen time, between those living in the Atlantic region (34.9 fewer minutes; [Figure 2F](#)).

[Figure 3](#) presents results from the CHMS (see [File S1](#); [online Appendix](#) for tabular data). Based on the accelerometer-measured data, 42.4% (95% CI 39.4–45.5) of the non-pregnant adults met the Canadian guidelines for physical activity; fewer pregnant adults met the guidelines, but we suppressed the results as they were too unreliable to be published ([Figure 3A](#)). Both pregnant and non-pregnant adults spent approximately 9.5 hours engaged in sedentary behaviour per day, accounting for over 70% of their time ([Figure 3B](#)). Pregnant adults spent approximately 8.9 fewer minutes (1.0% less of their time)

Figure 1. Flow diagram for the inclusion of participants into the study population from the Canadian Community Health Survey (which includes self-reported measures of physical activity) and the Canadian Health Measures Survey (which includes objective measures).



engaged in MVPA per day than non-pregnant adults (Figure 3B). Similar to the CCHS, the gaps in MVPA were most pronounced between pregnant and non-pregnant adults under 35 years (21.9 fewer minutes; Figure 3C). The gaps in light physical activity and sedentary behaviour were not modified by the survey year or age (Figure 3D, Figure 3E).

Sensitivity Analysis

In sensitivity analyses, we found that our results may have been impacted by selection and information biases (File S2; online Appendix). In both surveys, included adults reported better health and social determinants of health than excluded adults, possibly inflating our estimates of

activity. Pregnant adults in the CHMS wore their accelerometers for less time than non-pregnant adults, likely leading to differentially biased results. In addition, we identified 51 (3.0%) pregnant adults included in the CCHS who may have been contraindicated for physical activity based on health conditions. These adults spent similar amounts of time engaged in MVPA compared with healthier pregnant adults, suggesting that this selection bias was unlikely to have impacted our estimates of activity. Finally, we found that self-report bias may have inflated our estimates in the CCHS by 15.1 minutes across all adults. After correcting for this bias, only 27.5% (95% CI 24.1–31.0) of the pregnant and 41.1% (95% CI 40.4–41.9) of the non-pregnant adults in the CCHS met

Table 1. Characteristics of included adults assigned female who participated in the Canadian Community Health Survey (CCHS), 2015–2019, by pregnancy status

Characteristics	CCHS sample Group; no. (%) ^a	
	Pregnant; n = 1625	Non-pregnant; n = 52 140
Age group, y		
18–24	208 (9.8)	6530 (16.3)
25–34	1026 (62.6)	14 167 (27.2)
35–44	302 (21.5)	14 687 (25.8)
45–55	89 (6.1) ^b	16 756 (30.8)
Racialized group		
Yes	310 (30.6)	8158 (27.8)
No	1182 (69.4)	40 390 (72.2)
Immigrant status		
Recent (<5 y) immigrant	109 (9.2)	1541 (4.1)
Long-term (≥5 y) immigrant	194 (19.1)	6469 (20.7)
Canadian born	1261 (71.6)	42 402 (75.1)
Education level		
Less than high school	117 (5.5)	3611 (5.7)
High school	322 (16.9)	11 618 (22.4)
Some post-secondary	1177 (77.6)	36 474 (71.9)
Household income, CAD\$		
<\$20 000	97 (4.3)	3887 (5.6)
\$20 000–\$39 999	205 (14.2)	7207 (11.5)
\$40 000–\$59 999	239 (13.8)	7786 (13.9)
\$60 000–\$79 999	250 (14.6)	7476 (14.0)
≥\$80 000	834 (53.1)	25 784 (54.9)
Marital status		
Married or common-law	1352 (87.6)	29 798 (60.0)
Separated, divorced, or widowed	55 (2.3) ^b	6214 (8.3)
Single, never married	218 (10.2)	16 052 (31.7)
Self-reported health		
Poor or fair	80 (4.0)	5067 (8.4)
Good	348 (21.6)	13 679 (26.4)
Very good	662 (37.9)	20 567 (39.3)
Excellent	535 (36.5)	12 797 (25.9)
Self-reported mental health		
Poor or fair	80 (4.1)	4980 (9.0)
Good	334 (20.3)	13 023 (24.7)
Very good	631 (36.8)	19 734 (37.5)
Excellent	578 (38.8)	14 359 (28.8)
Season		
Spring	425 (23.1)	13 353 (25.2)
Summer	377 (21.0)	12 067 (22.3)
Fall	388 (24.3)	13 344 (26.3)
Winter	435 (31.6)	13 376 (26.1)
Canadian region of residence		
Atlantic	152 (5.7)	5939 (6.2)
Québec	366 (24.2)	10 654 (21.6)
Ontario	440 (34.9)	15 030 (38.2)

(continued)

Table 1. (Continued)

Characteristics	CCHS sample Group; no. (%) ^a	
	Pregnant; n = 1625	Non-pregnant; n = 52 140
Prairies	466 (22.1)	13 801 (21.5)
British Columbia	201 (13.2)	6716 (12.6)

^aData are weighted using sampling weights derived by Statistics Canada.

^bEstimate has high sampling variability; use with caution.

CCHS: Canadian Community Health Survey.

the Canadian guidelines for physical activity, similar to our objectively measured results from the CHMS accelerometers.

DISCUSSION

Using recent population-based data from the Canadian provinces, we found that physical activity levels were remarkably low among both pregnant and non-pregnant adults. Nonetheless, pregnant adults, especially those aged under 35 years, reported and objectively accrued less time in MVPA compared with non-pregnant adults. After

Table 2. Characteristics of included adults assigned female who participated in the Canadian Health Measures Survey (CHMS), 2007–2019, by pregnancy status

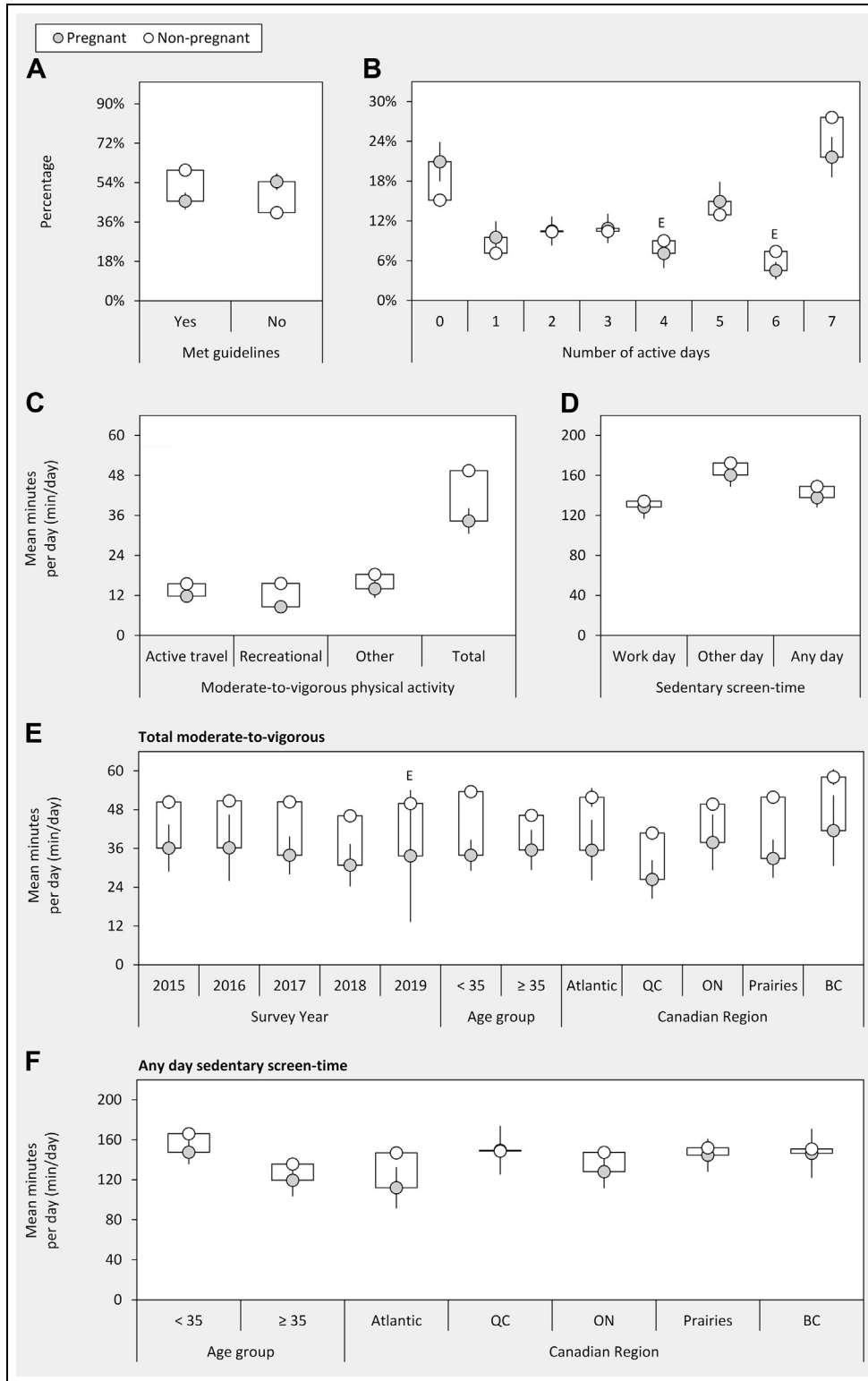
Characteristics	CHMS sample Group; no. (%) ^a	
	Pregnant; n = 87	Non-pregnant; n = 5234
Age group, y		
<35	30 (43.5) ^b	1007 (26.8)
≥35	57 (56.5) ^b	4227 (73.2)
Household income, CAD\$		
<\$80 000	43 (42.6) ^b	2329 (55.0)
≥\$80 000	34 (57.4) ^b	2144 (45.0)
Self-reported health		
Less than excellent	63 (83.1)	4333 (83.6)
Excellent	24 (16.9) ^b	901 (16.4)
Self-reported mental health		
Less than excellent	51 (60.0) ^b	3781 (72.0)
Excellent	36 (40.0) ^b	1439 (28.0)
Season		
Spring or summer	44 (44.4) ^b	2615 (48.3)
Fall or winter	43 (55.6) ^b	2619 (51.7)

^aData are weighted using sampling weights derived by Statistics Canada.

^bEstimate has high sampling variability; use with caution.

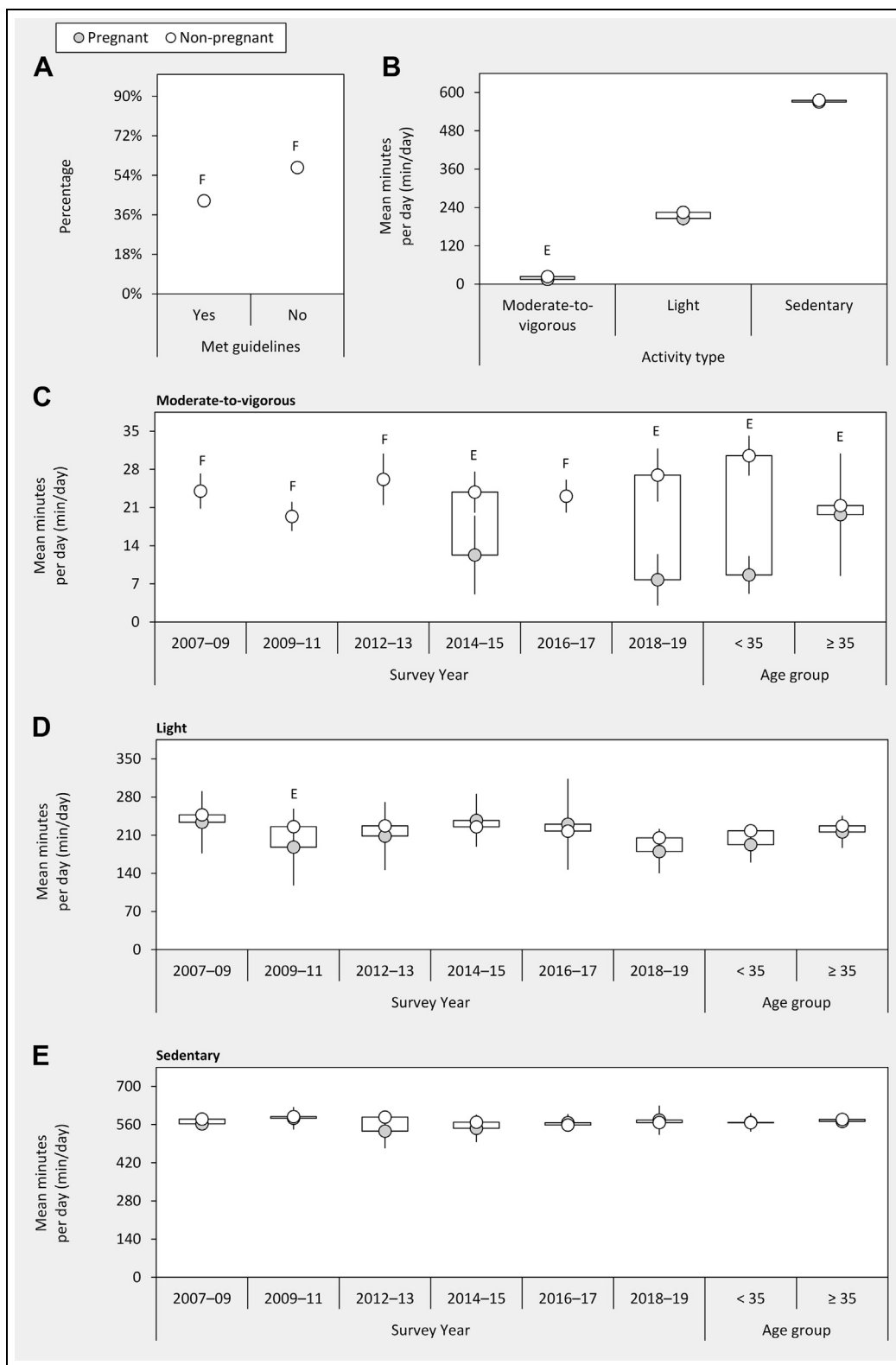
CHMS: Canadian Health Measures Survey.

Figure 2. Self-reported moderate-to-vigorous physical activity (MVPA) and sedentary screen time among pregnant and non-pregnant adults.



(A) Percent meeting Canadian guidelines for physical activity during pregnancy (i.e., ≥ 150 min of MVPA per week). (B) Number of active days in the last 7 days. (C) Mean minutes of MVPA per day in the last 7 days by activity type. (D) Mean minutes of sedentary screen time per day in the last 7 days by day type. (E) Mean minutes of MVPA per day in the last 7 days by survey year, age group, and the Canadian region. (F) Mean minutes of sedentary screen time per day in the last 7 days by age group and the Canadian region. Data are from the Canadian Community Health Survey, 2015–2019, for MVPA and 2017–2018 for screen time. Bars highlight differences between groups. Estimates indicated with E have high sampling variability; use with caution. Tabular results available in [File S1](#); [online Appendix](#). BC: British Columbia; ON: Ontario; QC: Québec.

Figure 3. Accelerometer-measured physical activity and sedentary behaviour among pregnant and non-pregnant adults with 4 or more valid days based on wear time.



(A) Percent meeting the Canadian guidelines for physical activity during pregnancy (i.e., ≥ 150 minutes of moderate-to-vigorous physical activity [MVPA] per week). (B) Mean minutes of activity per day by type (moderate-to-vigorous, light, or sedentary). (C) Mean minutes of MVPA per day by survey year and age group. (D) Mean minutes of light physical activity per day by survey year and age group. (E) Mean minutes of sedentary behaviour per day by survey year and age group. Data are from the Canadian Health Measures Survey, 2007–2019. Bars highlight differences between groups. Estimates indicated with E have high sampling variability; use with caution. Tabular results available in [File S1](#); [online Appendix](#).

correcting for self-report bias, less than 1 in 3 pregnant adults met the 2019 Canadian guidelines for physical activity (i.e., ≥ 150 minutes of MVPA per week) compared with 2 in 5 non-pregnant adults.

Our findings suggest that pregnancy may lead to a notable reduction in physical activity, which is likely exacerbated by pre-existing tendencies towards sedentary behaviour in Canada. Indeed, all 5 of the previous, smaller Canadian studies found that levels of activity are low before pregnancy and universally decline during pregnancy and through each trimester.^{18–22} For instance, in a study of 1737 pregnant people with no contraindications in Nova Scotia, participants largely reduced their activity levels during the first 20 weeks of gestation compared with their pre-pregnancy levels, particularly those under 35 years.¹⁹ The authors also found pre-pregnancy exercise to be the strongest determinant of prenatal exercise, with only 11.1% of previously inactive participants exercising during early pregnancy compared with 62.2% of previously active participants.¹⁹ Low levels of MVPA and high levels of sedentary behaviour during pregnancy have also been found in the U.S. and internationally.^{7,23–25}

Several barriers may explain these low levels of physical activity during pregnancy, including a lack of clear guidance.²⁶ Indeed, contraindications listed in international guidelines for physical activity during pregnancy were recently found to be inconsistent, with many based on limited empirical evidence.²⁷ Moreover, 11 contraindications were found to be based on no evidence, some of which are listed in the Canadian guidelines.²⁷ Given the substantial maternal–fetal benefits of activity, even at levels well below guidelines,²⁷ physicians should more regularly recommend and guide their pregnant patients to modify rather than avoid activity in complex pregnancies.²⁸ Considering the low activity levels we showed overall and the strong association between pre-pregnancy and prenatal activity,¹⁹ guidance by physicians and other interventions to increase physical activity during pregnancy may be most effective if they start before pregnancy and continue until birth.

Despite using nationally representative data and rigorous methods, our study has several limitations. The CCHS collected only self-reported information, which may be biased by social desirability and recall. However, we employed objective measures from the CHMS to present a balanced perspective. To the extent possible, we additionally attempted to quantify and correct for this self-report bias in a sensitivity analysis. Neither survey collected information on pregnancy trimester or

contraindications, both of which may affect a pregnant person's ability to be physically active. In another sensitivity analysis, we found that the inclusion of contraindicated people was unlikely to have biased our estimates of MVPA. Neither survey collected information on gender identity, limiting our analysis to people assigned female at birth. As recommended based on our descriptive objectives,²⁹ we did not adjust for confounding in our results; instead, we opted to stratify by important characteristics to assess the heterogeneity between and within groups. This method allowed us to identify those who were least likely to participate in physical activity by age, year, and region but may preserve biases because of confounding. Finally, these datasets excluded the territories, on-reserve Indigenous communities, and the institutionalized population; our data are, therefore, not representative of these populations.

CONCLUSIONS

Few pregnant and non-pregnant adults are meeting current physical activity guidelines in Canada. As detailed in the guidelines, health care providers should continue to recommend physical activity to the majority of pregnant people. Physical activity modifications should be made for those with relative contraindications, and daily activities should be maintained for those with absolute contraindications. In addition, as multiple barriers may be limiting prenatal physical activity levels, consistent and continued guidance and support by health care providers is vital, even before pregnancy begins.

Author Contributions

S.A.S. and J.J.L. conceptualized the study and analyzed the data. S.A.S. drafted the initial manuscript. All authors (S.A.S., D.FdS., L.M.M., N.S., and J.J.L.) designed the study and its methodology, interpreted the findings, and revised the manuscript critically for important intellectual content. All authors approve of the version submitted for publication.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jogc.2022.11.011>.

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