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Original Research

# Impact of COVID-19 Pandemic on Adolescents and Young Adults Living With Type 2 Diabetes



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## Key Messages

- The COVID-19 pandemic has had various impacts on the daily lives of adolescents and young adults living with type 2 diabetes.
- The majority of participants felt less socially connected, but they expressed life satisfaction since the pandemic began and reported positive coping strategies.

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## ABSTRACT

**Objectives:** The aim of this study was to assess the impacts of the COVID-19 pandemic on adolescents and young adults living with type 2 diabetes (T2D) involved in the national Improving Renal Complications in Adolescents with T2D through REsearch (iCARE) study.

**Methods:** The Environmental influences on Child Health Outcomes (ECHO) COVID-19 Questionnaire developed by the National Institutes of Health ECHO COVID-19 Task Force was administered to participants (n=85) from the iCARE study between June 2020 and October 2020. Children 12 years old (via parent report) and adolescents and young adults ≥13 years old (via self-report) participated. The questionnaire assessed the impact of the pandemic on health-care appointments, lifestyle, internet use, social connections and mental health.

**Results:** Participants were 17.0±3.1 (range, 12 to 27) years of age and predominantly female (61.3%). During the pandemic, 69.4% were able to attend their health-care appointments by telephone or virtual platforms, 31.7% ate more, 45.1% slept more and 29.3% spent less time on physical activities. There was an increase in internet use for both educational (42.0%) and noneducational purposes (54.9%). Participants felt less socially connected (64.6%). Participants also felt sometimes (59.2%), often (19.7%) and very often (6.7%) satisfied with their lives.

**Discussion:** Our study revealed that the COVID-19 pandemic has had various impacts on the daily lives of adolescents and young adults living with T2D. Future research should include longitudinal studies of the health burden of the COVID-19 pandemic on this population, with a more in-depth evaluation of mental health outcomes and clinical outcomes.

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## R É S U M É

**Objectifs :** L'objectif de la présente étude était d'évaluer les répercussions de la pandémie de la COVID-19 sur la vie des adolescents et des jeunes adultes atteints du diabète de type 2 (DT2) qui ont participé à l'étude nationale Improving Renal Complications in Adolescents with T2D through REsearch (iCARE).

**Méthodes :** Les participants (n = 85) de l'étude iCARE ont rempli le questionnaire Environmental Influences on Child Health Outcomes (ECHO) sur la COVID-19 élaboré par le groupe de travail de l'ECHO sur la COVID-19 des National Institutes of Health entre juin 2020 et octobre 2020. Les enfants de 12 ans (déclaration par le parent) et les adolescents et les jeunes adultes  $\geq 13$  ans (autodéclaration) y ont participé. Le questionnaire a permis d'évaluer les répercussions de la pandémie sur les rendez-vous en soins de santé, le mode de vie, l'utilisation de l'internet, les liens sociaux et la santé mentale.

**Résultats :** Les participants avaient  $17,0 \pm 3,1$  (étendue, de 12 à 27) ans et étaient principalement des femmes (61,3 %). Durant la pandémie, 69,4 % étaient en mesure de participer à leurs rendez-vous en soins de santé par téléphone ou via les plateformes virtuelles, 31,7 % mangeaient plus, 45,1 % dormaient plus et 29,3 % passaient moins de temps à faire des activités physiques. Il y a eu une augmentation de l'utilisation de l'internet à des fins éducatives (42,0 %) ou non éducatives (54,9 %). Les participants se sentaient moins connectés socialement (64,6 %). Les participants se sentaient aussi parfois (59,2 %), souvent (19,7 %) et très souvent (6,7 %) satisfaits de leur vie.

**Conclusion :** Notre étude a révélé que la pandémie de la COVID-19 a eu des répercussions variées sur la vie quotidienne des adolescents et des jeunes adultes atteints du DT2. Des recherches subséquentes devraient inclure des études longitudinales sur le fardeau en santé de la pandémie de la COVID-19 sur cette population, et une évaluation plus poussée des résultats en matière de santé mentale et des résultats cliniques.

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## Introduction

The COVID-19 pandemic has had widespread impact, affecting virtually every country throughout the world. As of June 24, 2021, there have been 1,410,927 confirmed cases of COVID-19 in Canada, including 26,175 deaths (1). Infectious disease outbreaks have become one of the major threats to global public health, with significant physical and mental health impacts (2). Since March 2020, countries have implemented various regional and countrywide lockdowns to mitigate the risks of transmission. The effects of these containment measures have drastically modified daily societal routines. In Canada, some of the main provincial measures taken to reduce community transmission have been mask-wearing, hand-washing, social distancing, closing schools and businesses and limiting gathering sizes in both indoor and outdoor spaces (3). These public health measures have also included pivoting chronic disease care to virtual platforms (4).

Adults living with type 2 diabetes (T2D) are disproportionately affected by COVID-19, with disruption in diabetes management and care contributing to poorer metabolic control since the pandemic began (5). Evidence suggests that those with poorer diabetes control are also more likely to have COVID-19 infections, hospitalization and death compared with the general population (6,7). The United States Centers for Disease Control and Prevention included T2D in the list of underlying medical conditions that increase the risk for severe illness caused by COVID-19 (8).

In contrast, there are limited data available regarding the health outcomes of adolescents and young adults living with T2D with respect to COVID-19 infection and morbidity. Available pediatric data show that children do not seem to develop severe clinical manifestations of COVID-19 (9). However, the indirect effects of the pandemic, including public health restrictions, have had a significant impact on children and adolescents overall and those living with chronic disease (10). Substantial changes to daily routines may cause disruption in sleep–wake cycles, meal consumption and timing, and diabetes management, along with physical and social isolation causing high levels of psychological stress. Provinces in Canada have implemented strict interprovincial travel restrictions and mandatory

isolation for returning travellers (11). This could disproportionately impact adolescents and young adults with T2D living in rural northern communities, who need to travel for medical appointments to see specialists (12). In the province of Manitoba, the northern region includes all land in Manitoba above the 53rd parallel (13). Many schools have implemented alternate-day schedules to ensure social distancing, whereas some in northern Manitoba have been closed since the pandemic began (14). In addition, a significant proportion of youth with T2D live in poverty or socially disadvantaged households (15). The unintended consequences of these public health measures may be heightened anxiety and fear regarding chronic illness management, food insecurity and decreased access to health-care services. The aim of this research was to evaluate the direct impacts of COVID-19 infection and exposure on adolescents and young adults living with T2D, as well as the indirect impacts of the public health measures associated with the pandemic.

## Methods

### Study population

This research involves a subgroup of adolescents and young adults living with T2D who were recruited from an ongoing longitudinal cohort study, the Improving Renal Complications in Adolescents with T2D through REsearch (iCARE) cohort study ([ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT02818192) identifier NCT02818192) (16). The iCARE study is a prospective, observational cohort study designed to identify the biopsychosocial risk factors for early-onset albuminuria and the progression of chronic kidney disease in adolescents living with T2D. The substudy protocol was approved by the biomedical research board at the University of Manitoba (HS13255-B2011:024). In accordance with the Declaration of Helsinki and before enrolment, every parent or guardian gave verbal informed consent via telephone and each youth participant provided verbal informed consent via telephone.

Active participants (n=250) were approached by telephone to participate in this substudy, which involved 1-time administration of a questionnaire. Participants who agreed to take part in the substudy were 12 to 27 years old at the time of survey collection.

## Data collection

The Environmental influences on Child Health Outcomes (ECHO) COVID-19 Questionnaire, developed by the National Institutes of Health ECHO COVID-19 Task Force, was used to collect data on the impacts of the COVID-19 pandemic on adolescents and young adults participating in the iCARE cohort study (17). The questionnaire was administered over the telephone by trained research associates from June 4, 2020, to October 31, 2020. Telephone contact was attempted 3 times for each potential participant. Children >12 years of age (n=83) completed the survey, facilitated by a research associate via self-report, and children ≤12 years of age (n=2) had their parents or guardian complete the survey as their proxy via parent report. A full copy of the questionnaire is provided in the [Supplementary Appendix](#).

To compare the clinical characteristics, the demographics of participating individuals were obtained at the last follow-up visit in the pre-COVID-19 period and compared with assessments made during the COVID-19 period. For this research, the “pre-COVID-19 period” was defined as the period before March 11, 2020, the day the World Health Organization declared COVID-19 to be a public health emergency of international concern (18). The “COVID-19 period” was defined as the period from June 4, 2020, to October 31, 2020, the start and end date of survey collection, respectively. The variables collected in the pre-COVID-19 period included age, sex, duration of diabetes, self-reported ethnicity, type of residence (urban vs rural), glycated hemoglobin (A1C), urine albumin-to-creatinine ratio (ACR), average daytime reading of 24-hour ambulatory blood pressure monitoring (19), family characteristics (number of household occupants, number of rooms in the house, water supply source and annual family income) and food security as measured by the Canadian Community Health Survey (20). During the COVID-19 period, the variables collected included A1C, urine ACR, a 1-time clinical blood pressure reading and the duration from last follow-up visit. The duration of diabetes was calculated from the date of diagnosis noted in medical records to the date of survey completion.

## Data analysis

Continuous variables are reported as mean and standard deviation (SD), and as median and interquartile range for non-normally distributed data. Descriptive analysis was performed using R version 6.2 (R Core Team, Vienna, Austria). A paired t test was conducted to compare the A1C and ACR values of the survey respondents from the pre-COVID-19 period to the COVID-19 period.

## Direct impacts of COVID-19 pandemic

The first section of the ECHO COVID-19 questionnaire assessed participants' direct experience with COVID-19 infection with regard to possible exposure, symptoms, testing method and test results. The responses were reported as “yes” or “no” and as multiple checkbox options.

## Indirect impacts of COVID-19 pandemic

The second section of the questionnaire evaluated the indirect impacts of the COVID-19 pandemic related to public health restrictions. The questions were grouped according to their impact on health-care appointments, school, internet use, food security, lifestyle, social connections, mental health and stress and anxiety levels. The responses were reported using a “yes-or-no” option, a multiple checkbox option or a Likert scale score ranging from “much less” (score=1) to “no change/same amount” (score=3) to

“much more” (score=5). “More healthy coping strategies” were defined as doing activities like puzzles or reading books; engaging in more family activities; meditation or mindfulness practices; talking to mental health-care providers (i.e. psychologists, therapists or counsellors); and doing volunteer work. “Less healthy coping strategies” were defined as eating more often, including snacking; using marijuana; vaping marijuana or other substances; using tobacco; and drinking alcohol.

## Results

### Participant characteristics

Participant characteristics are provided in [Table 1](#), which also shows the clinical characteristics of the cohort in the pre-COVID-19 period and during the COVID-19 period. Of the 250 participants contacted, 3 declined participation, 162 could not be reached and 85 agreed to participate in the survey (35.6%). In the pre-COVID-19 period, the clinical characteristics of survey respondents (n=85) were collected at their last follow-up visit before March 11, 2020, at <3 months (n=27), 3 to 6 months (n=10), 6 to 9 months (n=8), 9 to

**Table 1**  
Description of participant characteristics

	Survey respondents (n=85)	Survey nonrespondents (n=165)
Age (years)	17.0±3.1	16.9±3.0
Sex (% female)	62.3%	68.5%
Duration of diabetes, years	4.5 (3.0–7.0)	4.3 (2.4–6.0)
Ethnicity		
First Nations	82.5%	95.8%
White	3.8%	2.4%
Other	13.8%	1.8%
Type of residence		
Rural	74.0%	76.4%
Urban	26.0%	23.6%
A1C (% mmol/mol)		
Pre-COVID-19 period	9.9 (7.0–11.7)	10.0 (7.6–12.3)
COVID-19 period (n=34)	11.0 (6.6–12.0)	–
ACR (mg/mmol)		
Pre-COVID-19 period	3.6 (2.1–11.0)	1.2 (0.4–4.8)
COVID-19 period (n=28)	2.4 (0.9–6.9)	–
Blood pressure (mmHg)		
Pre-COVID-19 period SBP	124.1±11.7	123.4±14.0
Pre-COVID-19 period DBP	73.9±8.6	73.5±7.2
COVID-19 period SBP (n=19)	123.1±28.8	–
COVID-19 period DBP (n=19)	75.6±12.4	–
Water supply source		
Piped in (local or community water)	73.1%	64.2%
Trucked in	11.5%	22.8%
Well	1.3%	4.1%
River, lake, pond, stream	1.3%	0.8%
Water plant	7.7%	5.7%
Neighbour's house	1.3%	0.8%
Other sources (bottled, boiled)	3.8%	1.6%
Food security		
Food secure	35.0%	41.2%
Marginally food insecure	10.0%	6.7%
Moderately food insecure	25.0%	24.8%
Severely food insecure	30.0%	27.3%
Annual family income (n=34)		
<\$20,000 CAD	38.2%	41.6%
\$20,000–\$50,000 CAD	58.8%	50.7%
>\$50,000 CAD	2.9%	7.7%

A1C, glycated hemoglobin; ACR, albumin-to-creatinine ratio; CAD, Canadian dollars; COVID-19, coronavirus disease-2019; DBP, diastolic blood pressure; SBP, systolic blood pressure.

Notes: Data expressed as median and interquartile range or as mean ± standard deviation. All variables expressed here were collected in the pre-COVID-19 period, except for the COVID-19 period variables (A1C, ACR and blood pressure), and the age and duration of diabetes for survey respondents that were calculated at the time of survey completion.

12 months (n=11) and >12 months (n=29). Survey respondents had a mean  $\pm$  SD age of 17.0 $\pm$ 3.1 (range, 12.0 to 27.0) years, a median diabetes duration of 4.5 (range, 3.0 to 7.0) years, were primarily female (61.3%) and had a First Nations ancestry (82.5%). Participants were mostly from the province of Manitoba (n=73), with the majority residing in rural First Nations communities (74.0%). In the COVID-19 period, only a subgroup of participants had clinical results for A1C (n=34), ACR (n=28) and blood pressure (n=19) measurements. The mean durations of the A1C and ACR measures between the pre-COVID-19 period and COVID-19 period were 12.3 $\pm$ 7.5 months and 12.4 $\pm$ 10.3 months, respectively. In addition, there were no significant differences in A1C (p=0.230) and ACR (p=0.082) measurements between the 2 periods. The blood pressure measurements were not compared because the measurements in the pre-COVID-19 period were taken using the average daytime loads of an ambulatory blood pressure monitoring device, whereas those in the COVID-19 period were taken using a 1-time clinic blood pressure assessment. During province-wide lockdowns, participants were, on average, isolating with 6 other people (3 adults and 3 children) in a living space consisting of 2 or more bedrooms (92.3%), a kitchen (98.7%), a living room (100%) and the main source of water piped in (73.1%). The occupants-to-rooms ratio was 1.0.

The characteristics of survey nonrespondents (n=165) are also outlined in Table 1. There were no differences in the demographics of those who participated compared with the overall iCARE cohort with respect to age, sex, duration of diabetes, ethnicity and type of residence (urban vs rural).

#### Direct impacts of COVID-19 pandemic

All participants responded to all the questions in the survey. None of the participants tested positive for COVID-19. However, 1.2% had close contact with a case of COVID-19, 11.8% had symptoms suspicious of COVID-19, 4.7% were advised to self-isolate or quarantine and 2.4% of participants went for testing and received negative results during the study period.

#### Indirect impacts of COVID-19 pandemic

A summary of the indirect impacts of the COVID-19 pandemic is presented in Table 2. During the pandemic, 69.4% of participants were able to attend their health-care appointments with providers through telephone or virtual visits, whereas 30.6% were unable to attend their appointments due to concerns of contracting COVID-19 in health-care facilities (8.2%), their appointments were cancelled and rescheduled (20.0%) or they were told to self-isolate by public health authorities (2.4%). Before the COVID-19 pandemic, 12.9% of participants received free meals at school and subsequently had worsened food security because of school closures during the pandemic. For a majority of participants, the impact on their lifestyle varied: 48.8% ate the same amount, 45.1% slept more, 53.7% did the same amount of physical activity and 61.0% spent less time outside. Almost half (43.4%) of the participants reported an overall negative impact of the COVID-19 pandemic on their lives, yet 19.7% often and 6.7% very often felt satisfied with life and 84.3% indicated little or no stress and anxiety. Interestingly, participants who reported a positive impact (25.0%) described that the social isolations suited their introverted lifestyle, such as spending more time indoors and having fewer social interactions in-person or none at all.

#### Discussion

In this study, we evaluated the direct and indirect impacts of the COVID-19 pandemic on adolescents and young adults currently

**Table 2**  
Summary of COVID-19 pandemic impacts during lockdown period (N=85)

	Percentage
Impact on health care	
Health-care provider changed to phone or online visits	69.4%
Did not attend appointments due to concerns of entering health-care facilities	8.2%
Health-care provider cancelled and rescheduled appointments	20.0%
Told to isolate by public health authority	2.4%
Impact on education	
School closure	68.2%
Online learning	56.5%
Impact on internet use	
More internet use for educational purposes	42.0%
More internet use for noneducational purposes	54.9%
Impact on food security	
Usually received meals at school	12.9%
Impact on lifestyle	
Eating less	19.5%
Eating the same amount	48.8%
Eating more	31.7%
Sleeping less	20.7%
Sleeping the same amount	34.1%
Sleeping more	45.1%
Less physical activity	29.3%
Same amount of physical activity	53.7%
More physical activity	17.1%
Spending less time outside	61.0%
Spending the same amount of time outside	17.1%
Spending more time outside	22.0%
Impact on social connections	
Spending more time with friends in person	6.1%
Spending the same amount of time with friends in person	19.5%
Spending less time with friends in person	74.4%
Spending more time with friends remotely	52.4%
Spending the same amount of time with friends remotely	33.0%
Spending less time with friends remotely	14.6%
Less socially connected	64.6%
More socially connected	35.4%
Impact on mental health	
More healthy coping strategies	78.8%
Less healthy coping strategies	21.2%
Positive overall impact on their lives	25.0%
No overall impact on their lives	31.6%
Negative overall impact on their lives	43.4%
Life satisfaction: "Not at all satisfied"	2.6%
Life satisfaction: "Rarely satisfied"	11.8%
Life satisfaction: "Sometimes satisfied"	59.2%
Life satisfaction: "Often satisfied"	19.7%
Life satisfaction: "Very often satisfied"	6.7%
Impact on stress and anxiety (level of severity) *	
None	38.2%
Mild	46.1%
Moderate	13.2%
Severe	2.5%
Extreme	0.0%

\* Impact on stress and anxiety (level of severity) is a scored answer based on responses to multiple questions.

living with T2D. All were enrolled in the iCARE study during the first epidemiologic wave of the pandemic in Canada. Although there have been studies on the impacts of the COVID-19 pandemic on adults with T2D and type 1 diabetes (T1D) (5,21,22), and in children and youth with T1D (23–26), little is known of the impact of the pandemic on adolescents and young adults with T2D, the majority of whom reside in rural communities. Our findings provide additional insight into the current body of literature in pediatric patients with T2D in rural communities and the effects of the pandemic on their access to health care, education, internet use, food security, lifestyle, social connections, mental health and stress and anxiety levels.

Due to nationwide lockdowns and travel restrictions, it was found that adolescents and young adults with T2D ate the same

amount, slept more and did the same amount of physical activity, but spent less time outside. This is consistent with results of a Canadian national survey which reported that youth were more likely to sleep more (72.6%) and spend less time outside (41.6%) (27). Participants were also unable to see their friends in person because of rules on social and physical distancing, but increased their social interactions virtually through video calls and text messages (28). This has resulted in an increased use of the internet for engaging with their peers on social media platforms and mobile messaging applications. Participants further reported engaging in more recreational screen-based activities, such as playing video and computer games. There was also an increase in the use of the internet for educational purposes due to school closures and the subsequent migration to distance and online learning systems. Studies from Australia (29) and Bangladesh (30) reported similar outcomes of increased online media consumption in adolescents and young adults compared with before the pandemic. Australian adolescents 13 to 19 years of age had increased social media and internet use (odds ratio [OR]=1.86), and Bangladeshi young adults, with a mean age of 23.7 years, engaged in more social media use (64.9%) and recreational online activities, such as watching movies or television series (78.0%).

There was a varied overall impact of the COVID-19 pandemic on the self-reported mental health of the adolescents and young adults in the study. A majority of participants reported the pandemic as having a negative overall impact on their lives, with the remaining participants reporting no overall impact or a positive overall impact. However, more than half of the participants felt sometimes satisfied with their lives since the pandemic began. Almost 84% of participants reported either no stress or mild stress since the start of the COVID-19 pandemic. Taken together, these findings highlight the unique, individualized and varied experiences of adolescents and young adults living with T2D during the pandemic. In our research, a large proportion of participants primarily utilized positive coping strategies, such as reading books; doing activities like puzzles and crosswords; engaging in more family activities; practicing meditation or mindfulness methods; participating in volunteer work; and talking to health-care providers more frequently, including therapists, psychologists and counselors, to deal with the stress related to the COVID-19 pandemic. Youth and young adults in China and the United States reported using similar healthy coping strategies, including seeking social support and taking up old hobbies, respectively (31,32). Our results are in contrast to several studies that reported a deterioration of mental health in youth and adolescents in Canada, Australia and India (28,29,33). In Canadian children and adolescents 6 to 18 years of age, 67% to 70% of participants had a deterioration of mental health status in at least one mental health domain due to stress from social isolation (28). In Australia, adolescents 13 to 19 years of age reported lower levels of happiness (OR=0.38), lower levels of positive emotions (OR=0.23) and slightly greater increases in psychological distress (OR=1.48) upon the implementation of physical distancing measures (29). In India, isolation was found to be associated with moderate to severe stress (37.4%), anxiety (30.9%) and depression (24.6%) in youth and young adults 15 to 30 years of age (33).

None of the participants tested positive for COVID-19 infection and only a few had symptoms suspicious of COVID-19, and were advised to be tested and self-isolate or quarantine. This may have been due to the implementation of strict emergency lockdown measures. Northern communities in Canada were among the most well-protected regions in the early stages of the pandemic (34). For participants able to attend their health-care appointments over the phone or virtually, there were minimal changes in glycemic control. However, adolescents and young adults living with T2D are dependent on physical activity and dietary choices to help manage

glycemic control, and require support and resilience for managing day-to-day chronic disease management tasks (35). Strict community lockdowns and limited access to nursing stations could have led to the disruption in self-management of diabetes care activities. These factors, coupled with being less physically active, sleeping more and spending less time outside, may contribute to the disruption of diabetes management. A study in Japan reported increased A1C levels in adult patients living with T2D due to low levels of physical activity and increased food consumption due to pandemic stress (36). A study in India of 1,510 persons living with T1D and T2D, with a mean age of 41.6 years, reported that participants faced similar issues in the disruption of glycemic control during the COVID-19 pandemic. A majority had an increase in blood glucose levels (78.4%), a decrease in clinic visits due to fear of getting infected with COVID-19 (90.4%), decreased physical activity (69.1%) and increased food intake (46.9%) compared with before the pandemic (37).

Our study has revealed that the COVID-19 pandemic has had various impacts on the daily lives of adolescents and young adults living with T2D. A majority of participants felt less socially connected and spent less time with their friends in person. However, they felt satisfied with their lives since the pandemic began, reporting positive strategies to cope with stress and anxiety.

One of the great strengths of this study is the description of a distinctive cohort of pediatric patients in Canada who reside mostly in rural First Nations communities with unique living circumstances. Given that the evidence on the impacts of the COVID-19 pandemic on adolescents and young adults living with T2D has been scarce in this area, our study has provided novel insight into the challenges and experiences that this cohort currently faces. Second, we used the ECHO COVID-19 Questionnaire, which is a standardized tool that is part of a repository of COVID-19 research tools developed by the ECHO COVID-19 Task Force in the United States, enhancing data harmonization and interoperability. There are several limitations to our study. First, it was limited by its cross-sectional design and self-reported mental health data. Second, the sample size was relatively small and lacked diversity compared with the broader pediatric T2D community. Participants who could not be reached had telephone numbers that were not in service, or did not answer and return the calls. Third, the cohort was mainly from the province of Manitoba and may not be generalizable to other Canadian provinces nor to places outside of Canada. Although we do not know if our findings are generalizable, there are shared characteristics of youth and adolescents most at risk for the development of T2D, including membership in an ethnic minority group, high rates of poverty, food insecurity, parental unemployment and low parental education (38). Fourth, the survey was conducted during the first lockdown period and before the first COVID-19 epidemiologic wave in Canada, where Manitoba was largely unaffected compared with other provinces in Canada (1). Fifth, the degree of public health restrictions varied between the provinces and between regional health districts within a province, which changed over the course of the pandemic. This could result in school closures and limitations of gathering sizes in one district, but not in others. In addition, an increase or decrease in some parameters (i.e. impact on lifestyle, social connections and mental health) cannot be interpreted as a positive or negative change. Last, the survey instrument has not been validated.

Our study has revealed the various impacts of the COVID-19 pandemic on adolescents and young adults dealing with daily chronic disease management across Canada. Future research should include longitudinal studies of the health burden of the COVID-19 pandemic on this population, with a more in-depth evaluation of the mental health outcomes and clinical outcomes. Results from this project indicate that adolescents and young adults

increased their use of the internet for both educational and recreational purposes. These results can be used to support the continued use of technological platforms for the delivery of health-care services, but further studies are warranted to determine strategies to decrease isolation and improve activity level and overall mental health in youth and adolescents living with chronic diseases in the event of another infectious disease outbreak or epidemiologic wave of COVID-19.

### Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the *Canadian Journal of Diabetes* at [www.canadianjournalofdiabetes.com](http://www.canadianjournalofdiabetes.com).

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### Author Disclosures

Conflicts of interest: None.

### Author Contributions

A.D. and B.W. were responsible for the study design, with meaningful contributions from M.C. and Z.Q. Data collection was completed by M.C. and Z.Q., with the help of M.G., J.Ha., T.P., and M.J., and J.Ho. M.C. and Z.Q. interpreted the results. M.C. drafted the initial version of the manuscript, which was critically revised for content by each coauthor.

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