

**Running during the global COVID-19 pandemic: A qualitative study examining
perceptions and behaviours for runners.**

by

Danielle Kent

Bachelor of Science in Kinesiology, Dalhousie University, 2019

A Thesis Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Applied Health Services Research

in the Graduate Academic Unit of Interdisciplinary Studies

Supervisors: Gabriela Tymowski-Gionet, Ph.D., Faculty of Kinesiology,
University of New Brunswick

Stephan U. Dombrowski, Ph.D., Faculty of Kinesiology,
University of New Brunswick

Examining Board: William Montelpare, Ph.D., Faculty of Applied Human Sciences,
University of Prince Edward Island

Gözde Özakinci, Ph.D., Department of Psychology, University of
Stirling

This thesis is accepted by the Dean of Graduate Studies

THE UNIVERSITY OF NEW BRUNSWICK

March 2022

© Danielle Kent, 2022

ABSTRACT

The COVID-19 global pandemic led to widespread public health measures that include social distancing and closures of many exercise and physical activity (PA) facilities, city parks, and playgrounds. Running may be a key form of PA for some Canadians as it is accessible, feasible, and convenient. Study objectives were to understand the perceived impacts of the COVID-19 pandemic and public health measures on runners; specifically, i) running behaviours, functions, and motives of running behaviours; ii) social aspects of running behaviours; and iii) other health-related behaviours. Eligibility criteria included: 19 years of age or older, living in Canada, could access Facebook Messenger, and were a runner. This was a deductive qualitative study using a thematic approach. Semi-structured interviews were conducted via an online instant messaging service. Twenty-nine runners (female= 17, male= 12, median age= 38) participated in the study. Three main themes were identified: *Shift*, *tension*, and *interconnectedness*.

ACKNOWLEDGEMENTS

Thank you to Brendan and Shayelin for your constant kindness, support, and encouragement throughout this journey. To my caring Aunt and Uncle, Judith and Paul, thank you for being there for me from start to finish. This research study would not have been possible without the enthusiasm of the running community. Thank you so much to each of the runners who shared their running stories during the midst of a pandemic. As well thank you to the Behaviour Change Lab and Master of Applied Health Services Students for listening to my findings and sharing feedback at our lab meetings. Finally, thank you so much to my exceptional supervisors, Dr. Gabriela Tymowski-Gionet and Dr. Stephan Dombrowski, for patiently helping me to complete my thesis. Thank you so much for guiding me through this entire process, always providing insightful advice, and keeping me on track.

DEDICATION

To my dad, who always lovingly encouraged my brothers and me to follow our passions and strive for our best.

Table of Contents

ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
DEDICATION	iv
Table of Contents	v
List of Tables	vii
List of Figures.....	viii
List of Symbols, Nomenclature or Abbreviations	ix
Chapter 1	1
Introduction	1
<i>Background</i>	1
<i>Significance</i>	5
<i>Purpose</i>	6
Chapter 2	7
Literature Review	7
<i>COVID-19</i>	7
<i>Physical Activity and Exercise</i>	13
<i>Running</i>	16
<i>Physical Activity and COVID-19</i>	19
Article Thesis	26
Chapter 3	27
Abstract	28
Introduction	30
Methods	32
<i>Design</i>	32
<i>Inclusion criteria</i>	32
<i>Recruitment and Procedures</i>	32
<i>Analysis and synthesis</i>	34
Results.....	34
<i>Participants</i>	34
<i>Major themes</i>	36
<i>Shift</i>	36
<i>Tension</i>	41
<i>Interconnectedness</i>	45
Discussion	47
<i>Principle findings</i>	47

<i>Strengths and weaknesses of the study</i>	48
<i>Relation to other studies</i>	49
<i>Implications and future research</i>	51
Conclusion	52
Acknowledgements	52
Funding	53
Disclosure Statement	53
Data Availability Statement	53
Chapter 4	54
Discussion	54
Bibliography	57
Appendix A	68
Appendix B.....	69
Appendix C.....	72
Curriculum Vitae.....	

List of Tables

Table 1: A comparison chart of lock-down regulations in different countries.....21

Table 2: Participant demographics split by gender35

List of Figures

Figure 1: Running behaviours and perceptions organizing framework including major themes and corresponding sub-themes.	36
Figure 2: Major theme ‘shift’ including the sub-themes: <i>external factors, self-care, adaptation, behaviour changes, and maintenance.</i>	37
Figure 3: Interconnectedness theme with the inclusion of no change or negative change to health behaviours and indicators.	46

List of Symbols, Nomenclature or Abbreviations

AB	Alberta
BC	British Columbia
BMI	Body Mass Index
CBC	Canadian Broadcasting Corporation
CHMS	Canadian Health Measures Survey
COVID-19	Coronavirus disease 2019
CR	Cardiorespiratory
CSEP	Canadian Society of Exercise Physiology
CVD	Cardiovascular Disease
Exercise	A type of physical activity that is planned, structured, repetitive, and purposeful
MB	Manitoba
MET	Metabolic equivalent of a task
NB	New Brunswick
NFL	Newfoundland and Labrador
NS	Nova Scotia
NU	Nunavut
NWT	Northwest Territories
ON	Ontario
PA	Physical activity (PA) is a bodily movement produced by skeletal muscles that require energy expenditure above a resting state.
PEI	Prince Edward Island
Physical distancing	Maintaining 6-ft or 2-metres distance between people outside your household both indoor and outdoor spaces.
QC	Quebec
SARS-CoV-2	Severe acute syndrome coronavirus 2
SD	Standard deviation
SK	Saskatchewan
US	United States
WHO	World Health Organization
YU	Yukon

Chapter 1

Introduction

Background

The Coronavirus disease 2019 (COVID-19), an infectious disease caused by severe acute syndrome coronavirus 2 (SARS-CoV-2), first emerged in Wuhan, China, in December of 2019 (Gabutti et al., 2020). Initially, the unknown virus quickly spread to different regions surrounding China, causing global concern (Lesser & Nienhuis, 2020; World Health Organization [WHO], 2020, April 27). With the sudden rise in cases across different countries, on March 11, 2020, the WHO classified COVID-19 as a global health pandemic and declared that countries should take pre-emptive measures to mitigate the viral spread (Lesser & Nienhuis, 2020; WHO, 2020, April 27). As of November 24, 2021, more than 259 million people have tested positive for COVID-19 in almost 220 countries worldwide, resulting in 5.1 million deaths (*Countries Where Coronavirus Has Spread - Worldometer*, 2021). A pandemic of this magnitude has not been seen since the Spanish influenza during World War I and has created dramatic challenges worldwide in terms of economy, social interactions, and individual behaviours (Woods et al., 2020).

On January 25, 2020, the Health Agency of Canada reported the first case of COVID-19 in Ontario in an individual who had recently travelled to Wuhan, China (Marchand-Sen cal et al., 2020). A few months later, in March, over the span of 10 days, the number of COVID-19 cases in Canada began to climb (Marchand-Sen cal et al., 2020). Between March 12 (Quebec) and March 22 (Nova Scotia), every Canadian

province and territory had declared a state of emergency, with gradually tightening public health restrictions (Scarabel et al., 2020). To varying degrees, provinces and territories implemented school and daycare closures, prohibited gatherings, closures of non-essential businesses, restricting entry into the country and between some provinces, and mandatory self-isolation for travellers (Scarabel et al., 2020). Due to restrictions, Canadians no longer had recreational and fitness facilities. Furthermore, some parks and trails had to be closed in cities due to people not following physical distancing rules. Those who did go out in public had to practice physical distancing by maintaining six feet or two metres away from others outside of their immediate household or referred to as a household bubble. In later months, provinces implemented wearing a non-medical mask or face-covering in indoor public areas. For most Canadian provinces and territories, there are four different phases of recovery, which impact the degree of physical distancing required with the aim of slowing the spread of COVID-19 (i.e., some COVID-19 restrictions going through waves for loosening and tightening depending on the phase of recovery in different provinces and regions). In provinces and territories, recovery phases may impact whether non-medical masks and face coverings are required in outdoor public areas. In particular, when two metres distance cannot be maintained between people outside of household bubbles.

Searching 'COVID-19 and recreational running' on the internet results in an abundance of articles about people beginning to run. Notably, in March 2020, news articles began noting the growing number or a 'boom' of people running outdoors. In an article *Running from Coronavirus: A Back-to-Basics Exercise Boom*, the New York Times wrote about the increased number of runners in the United States (US) (Minsberg,

2020). All exercise classes, road races and running events were cancelled or postponed (Minsberg, 2020). The article observed across the US that public parks, streets and trails began to fill with runners—with a wide range of running experience from those who had never run and others with 10-plus years' experience (Minsberg, 2020). The author speculated that running took off because runners only needed a pair of shoes and the ability to maintain six feet from other (Minsberg, 2020). In the article, commenters noted that they had “never seen so many people out walking and running in local parks,” and some runners felt that running is the “only normal thing” they have left to do (Minsberg, 2020). In the Canadian Running Magazine, they claimed an increase in running behaviours for Canadians in 2020 (Snider-McGrath, 2020). The article included data from Strava, an exercise tracking service, and reported an increase in outdoor running (Snider-McGrath, 2020). From April to June 2020, people uploaded 1.9 times more outdoor runs compared to the same period in 2019 (Snider-McGrath, 2020).

Some people in different countries have had concerns with runners breaking the COVID-19 rules. In Canadian Running Magazine, the article *Citizens are reporting runners who 'double run' in the UK*, talks about British citizens running twice a day (Kelly, 2020). The government lockdown rules only allow people to exercise once a day outdoors, but some have been running twice a day (Kelly, 2020). The police in the region have received numerous calls from residents reporting their neighbours are running twice a day and asking them “to come and arrest them” (Kelly, 2020). In another New York Times article, *The New Rules of Running Now*, the author refers to her mother feeling unsafe running outside based on how people did not respect social distancing protocols at a local park. Instead of stopping running altogether, she developed a new route and

changed her usual running time during the day (Miller, 2020). The behaviour change helped her physical distance and feel safer (Miller, 2020). Thus, demonstrating recreational runners' ability to adapt to hurdles, they may encounter with the COVID-19 pandemic.

Moreover, runners have shown their adaptability and endurance with different racing formats. Many races have pivoted to an online format, thus protecting the safety and health of runners and others. In a Global News article, *'I'm Hooked now': Runners take to virtual racing during COVID-19 pandemic*, one novice runner had no work-out equipment and decided to learn how to run during the pandemic (Ewing, 2020). He worked his way up and is racing in multiple virtual running distance events, including a five-kilometre, 10-kilometre, and half-marathon race (Ewing, 2020). Other family members were motivated to run themselves, including his three-year-old son (Ewing, 2020). These virtual events appear popular, with thousands of runners registering and some events selling out (Ewing, 2020).

At the beginning of the COVID-19 pandemic, many people across Canada were experiencing routines and schedules that were disrupted. There is an increased feeling of stress and anxiety in Canadians due to the unknown of the COVID-19 virus and when life will return to normal. The Public Health Agency of Canada has not limited outdoor exercise (Government of Canada, 2020a). At the start of the pandemic, Canadian runners had to follow public health guidance by remaining two metres apart and may run alone or with someone in their immediate household (some restrictions loosened depending on the phase of recovery, i.e., running groups could resume in regions where COVID-19 restrictions allowed). DeJong et al. (2021) conducted 1147 quantitative surveys with

runners across 15 states in the United States at the start of the pandemic between May and June 2020. The findings demonstrate that runners increased their number of runs per week, weekly mileage, and the number of times per day they ran, but many runners have reduced their run intensity. The researchers speculated the results were due to running's accessibility and physical and mental benefits (DeJong et al., 2021). Many participants' motives for running changed and were less focused on the competitive and the social aspect (DeJong et al., 2021). Instead, runners were seeking stress relief, occupying free time, and for fitness (DeJong et al., 2021).

Significance

The Public Health Agency of Canada and the Canadian Society for Exercise Physiology (CSEP) recommend that adults between 18-64 years of age accumulate at least 150 minutes of moderate-to-vigorous aerobic physical activity weekly (*CSEP Guidelines*, 2021). Promoting physical activity may have equal importance as physical distancing (Matias et al., 2020). Encouraging Canadians to be physically active during an extended period of isolation may protect mental health, especially if there is limited access to mental health services (Matias et al., 2020). Recreational running may be a key form of physical activity, as it is accessible and convenient for all ages. More research is necessary to understand running behaviours.

The COVID-19 pandemic is a new phenomenon, and it is an emerging area of research requiring urgent investigation. In the literature review, evidence will be presented on COVID-19 and physical activity in general. There is a general lack of understanding of many aspects of the virus, including running. Increasing our

understanding and knowledge around recreational running during the pandemic can help health services providers to promote safe and effective running practices. Further, clinicians may use the information on running behaviours and motivations to inform future physical activity programs during a pandemic.

Purpose

This study aims to understand the perceived impact of the global COVID-19 pandemic and public health restrictions on Canadian recreational runners at all participation levels. The specific objectives are to understand the perceived impact of COVID-19 related restrictions on changes in (i) running behaviours, and function and motives of running behaviour, (ii) social aspects of running behaviours, and (iii) other health-related behaviours.

Chapter 2

Literature Review

COVID-19

The Coronavirus disease 2019 (COVID-19) was first discovered in Wuhan, China, in December 2019; since then has spread to all continents across the world, causing a global scale pandemic (Chen et al., 2020). On January 25, 2020, the first positive case of COVID-19 presented itself in Canada (Marchand-Sen cal et al., 2020; Scarabel et al., 2020). As of November 23, 2021, more than 1.7 million Canadians tested positive for COVID-19, and over 29,000 deaths are attributed to the pandemic (Government of Canada, 2021d). The majority of reported cases and deaths in Canada are in the four largest provinces: British Columbia, Alberta, Ontario, and Quebec (Dougherty et al., 2020; Government of Canada, 2021d). In the absence of a vaccine at the start of the pandemic, all Canadian provinces and territories declared a state of emergency between March 12 and 22, 2020 (Scarabel et al., 2020). Due to the severity of the pandemic, the Prime Minister, Justin Trudeau, gave Canadians daily briefings on COVID-19 from mid-March to the end of June.

The federal and provincial governments issued several strict restrictions and recommendations to prevent the spread of COVID-19 (Scarabel et al., 2020). These included restricting unnecessary international travel since March 14, 2020 (Scarabel et al., 2020), depending on the COVID-19 phase of recovery. On March 16, 2020, only Canadian citizens, permanent residents, and US citizens were granted access into Canada; later, on March 18th, 2020, the US-Canada border announced its closure from March 20,

2020, onwards (Scarabel et al., 2020). The US border has since re-opened in November 2021 for Canadians entering into the US, and additional safety measures have been implemented when travelling between countries (Government of Canada, 2021c).

The public health guidelines recommend self-isolation for those in contact with a confirmed case of COVID-19, requesting people to stay home as much as possible to prevent community transmission and closing non-essential businesses (Government of Canada, 2020b). In addition, the government recommends that all Canadians wash their hands often with soap and water for 20-seconds, and if wash stations are not available, then hand sanitize frequently (Government of Canada, 2020b). Canadians are recommended to avoid touching their eyes, nose, or mouth; cough and sneeze into one's sleeve or elbow; physical distance (originally meaning maintaining six feet apart from others); limit contact with older individuals and those with poor health (or underlying medical conditions); avoiding common greetings (such as shaking hands and hugging); and avoiding crowded places and non-essential gatherings (Government of Canada, 2020b). In June 2020, the Government of Canada and the WHO encouraged people to wear a non-medical mask or face-covering in public areas, especially when social distancing cannot be maintained (Government of Canada, 2020b). Implementing these restrictions and recommendations aimed to prevent a sudden surge in the healthcare system and the number of COVID-19 cases over a short time.

Transmission of COVID-19.

COVID-19 may spread from an infected person's mouth or nose in small liquid particles when they sneeze, cough, speak, sing, or breathe heavily ("Modes of Transmission of

Virus Causing COVID-19,” 2020). These liquid particles are of different sizes, ranging from larger respiratory droplets to smaller aerosols (“Modes of Transmission of Virus Causing COVID-19,” 2020). Transmission may occur if an infected person were to sneeze or cough, and the infectious respiratory droplets came in contact with a non-infected person’s mouth, nose or eyes (Chaudhuri et al., 2020; Jayaweera et al., 2020; “Modes of Transmission of Virus Causing COVID-19,” 2020). The aerosol transmission may occur in specific settings, particularly in indoor, crowded and inadequately ventilated spaces, and where an infected person may spend extended periods with others (Jayaweera et al., 2020). Under optimal conditions (such as temperature, humidity, and lack of masks), the aerosol droplets may travel up to seven to eight metres and remain viable in the air for three-hours (Salian et al., 2021). Less commonly, the transmission of COVID-19 may also occur by indirect contact after an infected person sneezes, coughs on, or touches a surface (“Modes of Transmission of Virus Causing COVID-19,” 2020; Ong et al., 2020; Wu & McGoogan, 2020). Non-infected people may become infected by touching the contaminated surface and then touching their eyes, noses, or mouths without properly washing or sanitizing their hands first (“Modes of Transmission of Virus Causing COVID-19,” 2020; Ong et al., 2020; Wu & McGoogan, 2020). Transmitting the COVID-19 is more likely when a person is in close contact, or within one-metre, with someone who has COVID-19 (Chaudhuri et al., 2020; Jayaweera et al., 2020; “Modes of Transmission of Virus Causing COVID-19,” 2020). Furthermore, evidence suggests COVID-19 is not only spread symptomatically but also by pre-symptomatic and asymptomatic individuals (Moghadas et al., 2020).

The transmission rates of COVID-19 may be determined using the basic reproductive ratio (Heffernan et al., 2005). The basic reproductive ratio is commonly used to determine the expected number of secondary infections arising from a single person during their infectious period (Heffernan et al., 2005). During any viral pandemic, with a basic reproductive ratio of less than one, the virus is likely to die out on its own (Liu et al., 2020). In February 2020, data analysis was conducted on the Diamond Princess cruise ship with 3711 passengers to estimate the reproductive ratio of COVID-19 and predict the number of new daily cases (S. Zhang et al., 2020). Over 14 days between February 4 and 16, 2020, there were 355 individuals identified as having COVID-19 (S. Zhang et al., 2020). Evidence suggested human-to-human transmission of COVID-19 occurred due to limited space and a relatively high population density (S. Zhang et al., 2020). There was an estimated reproductive ratio of 2.28 (95% CI= 2.06-2.52) on the cruise ship (S. Zhang et al., 2020).

A systematic review conducted by Liu et al. (2020) estimated the average reproductive ratio of COVID-19. In total, 11 studies met the eligibility criteria and included a variety of study designs (stochastic, mathematical, and statistical methods of estimation) (Liu et al., 2020). All eligible studies were based in China and included COVID-19 infection rates between December 2019 and January 2020 when no public health restrictions were in place (Liu et al., 2020). In general, an average reproductive ratio of 3.28 and a median of 2.79 (IQR= 1.16) were estimated (Liu et al., 2020), which exceeded the Diamond Princess cruise ship estimates. When public health measures are not controlling the COVID-19 pandemic, there is a potential for the virus to spread rapidly.

COVID-19 Symptoms.

People who become infected with COVID-19 may exhibit various symptoms (that can vary depending on the COVID-19 variant), ranging from mild to severe. The severity of COVID-19 may be affected by age, body mass index, and underlying medical conditions (Wu & McGoogan, 2020; Yang et al., 2020). The classification of symptoms in most cases is mild (Wu & McGoogan, 2020). February 2020 in China, for example, 81% of people infected with COVID-19 were classified as having mild symptoms (Wu & McGoogan, 2020). Those who become infected usually experience mild-to-moderate symptoms, including coughing, fever, difficulty breathing, pneumonia in both lungs (Wu & McGoogan, 2020). The less common symptoms are sore throat, runny nose, headache, new onset of fatigue or muscle pain, diarrhea, loss of smell or taste, and children may have purple markings on their fingers and toes (Government of Canada, 2021b; Wu & McGoogan, 2020). The other 14% of COVID-19 patients in China were classified as severe cases, and 2.3% resulted in death (Wu & McGoogan, 2020); Patients categorized as severe have serious symptoms and may include difficulty breathing or shortness of breath, chest pain or pressure, and loss of speech or movement (Government of Canada, 2021b). Severe COVID-19 symptomatology often requires hospitalization and intensive care admission (Wu & McGoogan, 2020). Older individuals or those with underlying health conditions (hypertension, chronic respiratory disease, obesity, and cardiovascular disorder) are at high risk for severe COVID-19 symptoms and mortality (Yang et al., 2020).

In Canada, the majority of cases have been reported in Ontario (35.4%) and Quebec (25.0%) (Government of Canada, 2021d). The estimated death rate of Canadians

who have become infected with COVID-19 is approximately 1.7% (Government of Canada, 2021d). Of the COVID-19 cases reported in the country, about half are females (50.3%) (Government of Canada, 2021d). As of November 23, 2021, infection rates were highest for Canadians ages 19 years old and under (21.0%) and the lowest between 70-79 years old (4.1%) (Government of Canada, 2021d). Hospitalizations were highest in people over 80 years old (24.6%) and lowest in those under 19 years of age (2.1%) (Government of Canada, 2021d). The distribution of COVID-19 cases admitted to ICU was the highest for ages 60-69 years old (26.1%) and lowest for ages 0-19 years old (1.4%) (Government of Canada, 2021d). The proportion of COVID-19 cases who were hospitalized, admitted to ICU, and deceased was the highest for those over the age of 80 years old (62.9%) and lowest for those under 19 years old (0.1%) in Canada (Government of Canada, 2021d).

Mask Requirements.

At the beginning of the COVID-19 pandemic, the government information surrounding non-medical masks and face coverings was continuously evolving with new research. There was conflicting information in the research community on non-medical masks and face coverings while physically active and exercising. Some experts on social media and news outlets did not advise wearing masks while exercising (Pringle, 2020), while many researchers' findings encourage the use of non-medical masks or face coverings while being active (Nyenhuis et al., 2020; Wackerhage et al., 2020). Comparatively, some researchers found that non-medical masks should only be worn during low-to-moderate intensity exercise outdoors, as vigorous intensities can compromise breathing (El

Hamichi et al., 2020). For those exercising with masks on, some reported experiencing discomfort (such as feeling hot, humid, and breathing resistance) and increased their perceived exertion level (Poon et al., 2021). In many exercise facilities, people must wear a non-medical mask or face covering when entering and exiting the facility; it may only be taken off while exercising. There are mixed opinions on non-medical masks and face coverings while physically active and exercising. The lack of consensus may have led to confusion among the general public.

Physical Activity and Exercise

The definition of physical activity is a bodily movement produced by skeletal muscles that require energy expenditure above a resting state (Caspersen et al., 1985). The Public Health Agency of Canada and the Canadian Society for Exercise Physiology (CSEP) recommend that adults between 18-64 years of age should accumulate at least 150 minutes of moderate-to-vigorous aerobic physical activity weekly; with the addition of muscle and bone-strengthening activities two days per week (*CSEP Guidelines*, 2021). Physical activity intensities may be categorized by the estimated amount of energy required to accomplish an activity, referred to as the metabolic equivalent of a task (METs) (Caspersen et al., 1985). Moderate-intensity and vigorous-intensity physical activity are classified as expending between 3.0-6.0 METs and over 6.0 METs, respectively (Harvard Health Publishing, 2012). In contrast, sedentary behaviour is classified as any waking behaviour with an energy expenditure of 1.5 METs, while sitting, reclining or lying posture (Barnes, 2012; Rebar & Taylor, 2017; Tremblay et al., 2017). Moderate-intensity physical activities may cause sweating and breathing to

increase in rate and depth. Such activities may include a brisk walk or a bike ride. Vigorous-intensity physical activity may lead to further sweating and increased breathing. Such activities include jogging and cross-country skiing (*CSEP Guidelines*, 2021).

According to data from the 2016-2017 Canadian Health Measures Survey (CHMS), 16% of adults between 18-79 years old meet the Public Health Agency and CSEP guidelines for the physical activity (Statistics Canada, 2019). Moreover, adults were less likely to adhere to physical activity guidelines than children and youth (Statistics Canada, 2019). These findings suggest that most Canadians are physically inactive and sedentary for large portions of their day.

The terms physical activity and exercise are used interchangeably; although related, they are different from each other (Caspersen et al., 1985). Exercise has been defined as a type of physical activity that is planned, structured, repetitive, and purposeful in the sense that improvement or maintenance of one or more components of physical fitness is an objective (Caspersen et al., 1985; Rice & Howell, 2000). To describe exercise, the type or mode, frequency, duration, and intensity may be included (Dubbert & Stetson, 1995; Rice & Howell, 2000).

Physical Inactivity and Adverse Effects.

The consequences of physical inactivity and sedentary behaviours are detrimental to the population health (González et al., 2017). In Canada, physical inactivity and sedentary behaviour are a substantial public health burden and are estimated to contribute to 3.7% of overall healthcare costs (González et al., 2017; Janssen, 2012; Katzmarzyk & Janssen,

2004). In 2009, data suggested the annual economic burden of physical inactivity direct (\$2.4 billion), indirect (\$4.3 billion), and total health cost (\$6.8 billion) represented 3.7% of the overall health care costs in Canada (Janssen, 2012).

A classic study from the 1950s examined the adverse effects of physical activity between bus drivers and conductors (Morris & Crawford, 1958). The bus drivers, who sat during the workday, demonstrated higher coronary heart disease rates than the bus conductor who was physically active throughout the workday (Morris & Crawford, 1958). Similar findings were found among women and men in an Aerobic Center Longitudinal Study (Blair et al., 2001). Low levels of physical activity and maximal cardiorespiratory (CR) fitness were strong predictors of cardiovascular disease (CVD) morbidity and mortality (Blair et al., 2001). Participants with modest increases in physical activity and CR fitness exhibit a significantly reduced incidence of CVD and all-cause mortality at follow-up (Blair et al., 2001). The health consequences of physical activity have become increasingly apparent. Physical inactivity and sedentary behaviour may lead to an increase in the incidence of developing chronic health conditions, such as CVD, type-2 diabetes mellitus, some types of cancer, obesity, increased abdominal and visceral fat, and increased overall mortality (Biswas et al., 2015; Bowden Davies et al., 2021; Chakravarthy et al., 2002; González et al., 2017).

Physical Activity and Mental Health.

Physical activity may be a pivotal behaviour change target to improving mental health worldwide, as there is strong growing evidence that physical activity has mental health benefits for the non-clinical (Rebar & Taylor, 2017) and clinical (Pascoe et al., 2020;

Rebar & Taylor, 2017; Rosenbaum et al., 2014) populations. Physical activity and exercise positively affect the body and mind, including general well-being, mood, and anxiety (Ströhle, 2009). For example, Chekroud et al. (2018) conducted a longitudinal study with 1.2 million adults in the United States. The findings suggested that individuals who regularly exercise for 45-minutes three to five times per week had about 1.5 fewer days of poor mental health in a month on average than individuals who did not exercise (Chekroud et al., 2018). The strongest association was found in participants who exercised between 30 and 60 minutes per session, three to five times per week (Chekroud et al., 2018).

A systematic review examined 12 randomized clinical trials in which anxious adults between the ages of 19-64 years old were randomized to an exercise or non-exercise control condition (Stonerock et al., 2015). The majority of the studies concluded that, as a treatment for elevated anxiety or anxiety disorders, exercise offers benefits comparable to established treatments, including medications or behaviour therapy, and was more effective than a placebo (Stonerock et al., 2015). Some of the studies had significant limitations, including a small sample size, concurrent therapies, and inadequate adherence and fitness levels assessments.

Running

Running is one of the most common forms of physical activity worldwide (Kozlovskaja et al., 2017). According to the CSEP physical activity guidelines, running is considered a vigorous-intensity form of aerobic physical activity (*CSEP Guidelines*, 2021). Running may provide a relatively low-cost option for increasing physical activity without the

restrictive costs of specific equipment, sport club memberships, or training plans (Kozlovskaja et al., 2017; Lee et al., 2017). One of the main barriers to meeting the physical activity guidelines (*CSEP Guidelines*, 2021) is time constraints, as people may have to travel to exercise facilities or clubs; however, running may be done anywhere at any time (*CSEP Guidelines*, 2021; Lee et al., 2017).

Regular running is associated with a multitude of health benefits. In the Kozlovskaja et al. (2017) study, they used a cross-sectional design to assess the benefits of running and health. To be eligible for the study, participants had to be: 18 years of age or older, run more than 15-km per week, and self-describe their running behaviours throughout the study. The study included a total of 4720 participants. The results suggest that a large proportion of the participants may have reduced the five strongest contributors (including tobacco use, high body mass index (BMI), alcohol use, physical inactivity, and hypertension) to the burden of disease compared to people who did not meet the inclusion criteria in the country. The study suggests Australian runners met the physical activity guidelines by running (ranging from 20-40 km per week), and 76.1% of participants participated in an additional sport. The majority of participants had a BMI, which fell into the normal range (BMI= 23), and 40% of participants with two years of running experience-reported weight loss of more than five kilograms. The study indicated a reduction in hypertension associated with recreational runners; 6.2% of the participants reported having hypertension compared to Australia's national average of 32%. A small number of the participants (0.6%) reported smoking tobacco, and alcohol consumption was not reported (Kozlovskaja et al., 2017).

Evidence suggests that participants who run have reported mental and emotional benefits, including relief of tension, improved self-image, better mood, enhanced self-esteem, reduced stress and anxiety, and lowered blood pressure (Callen, 1983; Yeh et al., 2017). A recent scoping review examined the relationship between running and mental health, including 116 papers using a variety of designs (Oswald et al., 2020). The cross-sectional studies generally suggest that runners had lower levels of depression and anxiety, lower stress, higher psychological well-being, and better mood than non-runners (Oswald et al., 2020). Running interventions over two to twenty weeks and bouts of variable running lengths and intensities generally showed improved markers for a range of mental health outcomes compared to control participants (Oswald et al., 2020). Generally, the review found that a variety of running lengths and intensities were positively associated with the mental health (Oswald et al., 2020).

Running may allow individuals to interact with others and have a leisurely experience (Boullosa et al., 2020). In Malchrowicz-Mosko & Poczta's (2018) study, they examined the motives for participating in mass running events and surveyed runners after the event. The study found that runners' reason for participating were for increased physical activity, mental well-being benefits, and socio-psychological effects (Malchrowicz-Moško & Poczta, 2018). Many participants desired to feel unity and integration with other people. The runners experienced strong emotions, adrenaline, pleasure, relaxation, an escape from the responsibilities in life, and had built social relationships. Shipway and Holloway (2010) had similar findings in a two-year observation and life history interview study with 25 runners. The results suggest that

running may provide people with an outlet to cope with everyday problems and improve self-esteem (Shipway & Holloway, 2010).

Physical Activity and COVID-19

During the heaviest COVID-19 restrictions in March and April 2020, businesses and public places, including many exercise and physical activity facilities, city parks, and playgrounds, were closed (2020). For many, the new measures taken to reduce the spread of COVID-19 caused changes in everyday schedules. Canadians faced obstacles in their ability to be active, reach the recommended physical activity levels, and may have cascaded to other dimensions of well-being (Lesser & Nienhuis, 2020). In particular, Lesser & Nienhuis (2020) conducted an online survey that included 1098 participants in determining Canadians' physical activity behaviour, nature exposure, well-being, and anxiety levels during COVID-19. The results suggest that about 40.5% of inactive participants became less active, and 22.4% of active participants became less active. Alternatively, 33% of inactive participants became more active, and 40.3% of active individuals became more active. There were significant differences in well-being outcomes in the inactive population between those who were more active, the same or less active, but this was not seen in the active population. Overall, the results indicated that a greater proportion of inactive participants reported less physical activity (Lesser & Nienhuis, 2020). In contrast, active participants reported higher levels of physical activity (Lesser & Nienhuis, 2020). Amid the COVID-19 pandemic, the Canadian Government still urges citizens to remain physically active and exercise regularly, such as running, cycling, and walking (2020). In June 2020, some physical activity facilities and gyms

reopened in provinces. Albeit with shorter operation hours, reduced number of people allowed in the facility, and booking requirements. Depending on the number of COVID-19 cases and measures in provinces, some physical activity facilities may have experienced waves of closures and changing safety precautions against the transmission of COVID-19.

Research articles have suggested that two metres apart while being physically active is not enough. Notably, in an aerodynamic study, Blocken et al. (2020) suggested that the non-droplet exposure risks increase with physical activity speed and intensity, and thus recommend that people maintain a five-metres distance from others when walking fast 10-metres for running, and 20-metres for biking. The Canadian Broadcasting Corporation (CBC) wrote an article based on the research article outlining the findings alongside other expert opinions (NcNalty, 2020). The article included a comment section, with some readers stating that people who run or cycle outdoors “should be in line for some lengthy jail time” due to “their baffling ignorance.” Other responses further underlined the confusion around information: “Masks? No masks? One metre? Two meters? Six meters? No safe distance indoors? Exercise? Stay home? Isolate but stay connected? Here in Vancouver, people seem to have concluded no one knows what they’re talking about”. For some Canadians, the study and CBC comments may cause residents and runners to question if people should be running outdoors, wearing a mask while running, or if staying two metres apart from others is enough (NcNalty, 2020).

During the strictest COVID-19 lockdown in Canada, people could go outdoors for physical activity or exercise. The only guidelines were for Canadians to ensure they respected the social distancing guidelines and were not instructed to quarantine. In other

countries, such as Italy, the COVID-19 procedures differed from Canada. The COVID-19 guidelines for Italy and France were published in an article, *What Are the Lockdown Measures across Europe?* (2020). In Italy, once the epicentre for COVID-19, they issued a nationwide lockdown on March 9, 2020. The residents of Italy had to stay home and were only allowed to go outdoors to the grocery store, to see a doctor, or independently exercising close to home. Italians had to print out a certificate at home, declaring their reason for leaving the house, which police could check upon request. In France, the procedures in place were the same as in Italy, but France's residents could only exercise alone outdoors once per day for an hour. In France, families were allowed to take walks together within a one-kilometre radius of their homes; walking the dog was allowed, but owners had to write down the time they left to ensure it was within the hour. In Italy and France, residents who disobeyed the rules may face jail time or could be ticketed a fine of €400 to 3,000 (about \$620 to 4,680 CAD) and €135 to 3,700 (\$210 to 5770 CAD), respectively (“Coronavirus: What Are the Lockdown Measures across Europe?,” 2020).

Table 1: A comparison chart of lock-down regulations in different countries.

Source	Time period	Allowed running outdoors	Recommended social distancing*	Other relevant information
Canadian Government	March 2020-Current (January 2021)	Yes	Two metres	Canadians were allowed outdoors to exercise, social distancing had to be followed (except with household bubbles) (2020).
Italy Government	Lock-down 1: March 9-April 26, 2020	Yes	Two metres	Physical activity outdoors is permitted, social distancing must be maintained. Italians

	Lock-down 2: November 4, 2020- Current (January 2021)			must carry a filled-out certificate with their reason for being outdoors (health, work, and emergency); the police may ask to see the certificate (“Coronavirus: What Are the Lockdown Measures across Europe?,” 2020).
France Government	Lock-down 1: March 17- May 11, 2020 Lock-down 2: October 30- December 15, 2020	Yes	Two metres	Exercise is only permitted once a day and must be done alone and not exceed an hour. Residents must remain within 1-km of their homes and carry certificates with the time they left at (<i>Coronavirus COVID-19</i> , 2020).
	October 30- December 15, 2020	Yes	Two metres	Travel certificates are required Exercise is permitted within a 20-km radius, and for a maximum of 3-hours per day (<i>Coronavirus COVID-19</i> , 2020).

Note. *Recommended social distancing is the recommended distance citizens should maintain from others outside their household bubbles.

The federal rules and procedures changed with new emerging research-based findings in Canada. At the start of the COVID-19 pandemic, the Public Health Guidelines in Canada and the WHO did not recommend wearing a non-medical mask or face covering (Government of Canada, 2021a; Organization, 2020; Y. S. D. Zhang et al., 2021). On May 20, 2020, the Canadian Government changed its initial recommendation for the non-medical masks and face-coverings (Government of Canada, 2021a). The WHO did not change its recommendation on non-medical masks and face coverings until

later than Canada on June 5, 2020 (WHO, 2020). It has become a strong recommendation to wear for residents, especially those who cannot maintain social distancing. Many provincial governments implemented mandatory non-medical masks for citizens entering indoor spaces outside their home (schools, libraries, community centres, stores, and restaurants), public transit, and crowded areas (Chung, 2020). Some provinces require citizens to wear a mask while outdoors in public areas, such as sidewalks or parks, depending on the provincial regulations. People who exercise outdoors away from their homes may be required to wear a mask. Moreover, provincial regulations surrounding non-medical masks in outdoor places may quickly change from day to day depending on the region's COVID-19 phase of recovery.

Canadians are hearing and reading different information and advice worldwide and within their country. The different information and advice may conflict with one another and discourage people from being active or even cause social judgement or tensions between neighbours. For example, during the early lockdown in March 2020, Nova Scotia residents made 300-500 calls to the police per day due to citizens not complying with the social distancing regulations, showing the fear and anxiety about COVID-19 in Canadian communities (Thomson, 2020). However, running may be an excellent way for people to achieve moderate-to-vigorous physical activity outdoors to improve mental and physical health.

The impact of COVID-19 has had negative consequences for mental health and well-being in both the short and long term: There appears to be a significant increase in anxiety, depression and loneliness (Cénat et al., 2021; Galea et al., 2020). In China, Wang et al. (2020) conducted online surveys using snowball sampling between January

31 to February 2. The study included 1210 participants from 194 cities in China (Wang et al., 2020). The results found that the majority of participants (84.7%) spent 20-24 hours at home. Many of the participants rated the psychological impact of the outbreak as moderate to severe (54%). Moreover, participants reported moderate to severe depressive symptoms (17%), moderate to severe anxiety symptoms (29%), and moderate to severe stress levels (8%). Those with poor self-rated health status were significantly more likely to report higher levels of stress, anxiety, and depression during the COVID-19 pandemic than participants with high self-rated health status (Wang et al., 2020).

In Cénat et al. (2021) systematic review and meta-analysis, they included 55 studies, and of the studies, most were conducted in China. The study aimed to determine the prevalence of anxiety, depression, insomnia, post-traumatic stress, and psychological distress related to COVID-19 among different populations, gender, and healthcare workers. The review suggested that the prevalence of depression (15.97%), anxiety (15.15%), insomnia (23.87%), post-traumatic stress (21.94%), and psychological distress (13.29%) for short-term mental health consequences was equally high among populations and genders. Healthcare workers' prevalence of short-term mental health consequences was equally as high, and they reported significantly higher rates of insomnia compared to the general population (Cénat et al., 2021).

Evidence suggests social distancing can lead to profound effects over long-term confinement (Brooks et al., 2020). Brooks et al. (2020) conducted a rapid review including 24 studies analyzing quarantining in 10 countries. The study included people who had to quarantine due to Ebola, SARS, H1N1, Middle East respiratory syndrome, and equine influenza. The review suggested a wide range of adverse psychological

outcomes that may occur from quarantining, such as an increased prevalence of post-traumatic disorder symptoms, confusion, and anger. Evidence suggests people who have more extended periods of quarantine (over 10-days) resulted in more stressors, including infection fears, frustration, boredom, financial loss, and stigma (Brooks et al., 2020). Provinces have implemented a combination of quarantining with public health measures to combat a surge in COVID-19 cases. Depending on the current recovery phase for a province, travel, or COVID-19 symptoms, people may experience long periods of quarantining or isolation from others. Physical activity may be a tool to minimize the long-term decline of the mental health (Matias et al., 2020).

In Matias et al. (2020), the research suggests that a significant proportion of the population lives alone during lockdowns or are at risk of mental health problems. However, many people cannot use mental health resources; thus, many people may use self-help, self-medication, or self-care. During long periods of isolation, physical activity may have the capability to reset the body and mind at a state of equilibrium. The study suggests that physical activity may be as crucial as social distancing, as we need to protect the population's mental health to maintain isolation policies (Matias et al., 2020). During the COVID-19 pandemic, running may be promoted and encouraged as an intervention to improve mental and physical health conditions (Matias et al., 2020). Incorporating a daily routine of running may give people a more satisfying experience with a sense of choice and volition than others without a routine (Matias et al., 2020). Including physical activity may reinforce the individual's sense of autonomy and renew a sense of joy (Lee et al., 2017). It may alleviate mental health symptoms and improve positive mental health for Canadians (Ashdown-Franks et al., 2020). Running may be an

excellent outlet for the stressors associated with the current pandemic and improve the overall physical health (Ashdown-Franks et al., 2020; Shipway & Holloway, 2010).

Article Thesis

Chapter 3 of the thesis will be submitted to the International Journal of Sport and Exercise Psychology for publication. DK drafted the research ethics application, created the initial research materials (advertisement, topic guide, and information and consent form), collected the data, curated the data, conducted the data analysis, and prepared the manuscript with regular input from her supervisors. SUD and GTG conceptualized the research project and provided regular input.

Chapter 3

Title: Running during the global COVID-19 pandemic: A qualitative study examining perceptions and behaviours for runners

Manuscript type: Original research

Abstract word count: 244/250

Manuscript word count: 6412

Manuscript submission date: February 2022

¹Danielle Kent, ¹Gabriela Tymowski-Gionet, PhD, ¹Stephan U Dombrowski, PhD

¹Faculty of Kinesiology, University of New Brunswick, Canada

Danielle Kent - dkent@unb.ca

Gabriela Tymowski-Gionet - tymowski@unb.ca

Stephan Dombrowski - stephan.dombrowski@unb.ca

Corresponding author:

Stephan U. Dombrowski

90 Mackay Drive

Fredericton, New Brunswick,

Canada, E3B 5A3

Phone: (506) 453-4803

Email: stephan.dombrowski@unb.ca

Abstract

Background: The global pandemic COVID-19 led to widespread public health measures and influenced Canadians' opportunities for physical activity. Running may be a key form of physical activity for some Canadians as it is accessible, feasible, and convenient during a pandemic. Study objectives were to understand the impact of COVID-19 and public health measures on runners; specifically, i) running behaviours, functions, and motives; ii) social aspects of running behaviours; and iii) other health-related behaviours.

Methods: The deductive qualitative study used a thematic approach. Semi-structured interviews were conducted using synchronous typing via an online instant messaging service. Eligibility criteria included: ages 19 or older, living in Canada, could access Facebook Messenger, and runners at any level.

Results: Twenty-nine runners (female= 17, male= 12, mean age= 38 ± 10.8) participated in the study. Running experience was categorized by years actively running (beginner <3 years, n=3; intermediate= 3-10 years, n=14; and advanced >10 years, n=12). Three main themes were identified: *Shift*, *tension*, and *interconnectedness*. In general, most runners motivated by self-care and those that shifted their motives away from external reasons to run often maintained their running behaviours during the pandemic. Many runners experienced internal and external tension around their running behaviours. Most runners who experienced dips in their running initially and swiftly re-started running reported positive effects on mental health and other health behaviours.

Conclusion: Findings may inform runners and healthcare professionals to promote goals/motives adaptable to environmental changes and mitigate internal and external tensions.

Keywords: 2019 novel coronavirus disease (COVID-19); running; lifestyle restrictions; physical activity; well-being; mental health

Introduction

In January 2020, the coronavirus disease (COVID-19) was first discovered in Canada (Government of Canada, 2020a). By March 2020, COVID-19 was classified as a global pandemic by the World Health Organization (WHO), who urged pre-emptive measures to prevent a surge in infections (*WHO Announces COVID-19 Outbreak a Pandemic*, n.d.). In response, the Canadian government implemented public health measures, requesting that Canadians stay at home except for essential purposes, and closing most non-essential businesses, including exercise and physical activity (PA) facilities, city parks, and playgrounds (Government of Canada, 2020a). Furthermore, Canadians were requested to practice social distancing, avoid crowded areas and non-essential gatherings, limit contact with those in poor health, and avoid common greetings (Government of Canada, 2020a).

The public health measures may have impacted physical activity and exercise opportunities (Fallon, 2020). The Canadian Society of Exercise Physiology (CSEP) guidelines recommend that adults between ages 18-64 accumulate at least 150 minutes of moderate-to-vigorous aerobic PA per week, including bone and muscle strengthening exercises two days per week (*CSEP Guidelines*, 2021). Regular PA is associated with reduced all-cause mortality and several chronic conditions (Fallon, 2020), including cardiovascular disease, type-two diabetes, and hypertension (Reiner et al., 2013; Warburton & Bredin, 2017). COVID-19 related restrictions may prevent Canadians from reaching PA guideline recommendations, as most governmental directives restrict movement. During the initial stages of COVID-19, little emphasis was placed on PA.

Running is a common form of vigorous-intensity aerobic PA practiced worldwide (*CSEP Guidelines*, 2021; Kozlovskaia et al., 2017). Running may be a key form of PA

during a pandemic as it is accessible and convenient for all ages. It is feasible for most and provides a relatively low-cost option for PA without the need for specific equipment, sports club memberships, or training plans (Kozlovskaja et al., 2017; Lee et al., 2017). Running may be done almost anywhere at any time (Lee et al., 2017), and is associated with a multitude of benefits which include improved physical fitness, mental and emotional health, a positive coping outlet, improved self-esteem, maintenance of healthy body weight, and reduced hypertension (Callen, 1983; Kozlovskaja et al., 2017; Yeh et al., 2017). A scoping review of 116 papers using a variety of designs examined the relationship between running and the mental health (Oswald et al., 2020). The studies generally suggest that runners had lower levels of depression, anxiety, stress, higher psychological well-being, and better mood than non-runners (Oswald et al., 2020). In Pereira et al.'s systematic review, they had similar findings. The purpose of the systematic review was to determine the psychology and behavioural correlates of adult recreational runners (Pereira et al., 2021). The review included 58 papers using a variety of designs (Pereira et al., 2021). The study generally suggests that most papers reported that runners experienced improvements in mood and well-being and reductions in depression, anxiety, and stress compared to non-runners (Pereira et al., 2021).

Evidence suggests COVID-19 has had negative consequences for mental health and well-being in both short- and long-term (Galea et al., 2020). The constantly evolving nature of COVID-19 has resulted in changing information, recommendations, and guidelines from public health, which may have caused a heightened sense of fear, anxiety, and confusion (Gadermann et al., 2021). During the COVID-19 pandemic, running may improve mental and physical health conditions. Incorporating running into

one's daily routine may enhance the quality of life, sense of autonomy and joy, and improve the mental health (Ashdown-Franks et al., 2020). Running might be an outlet for stressors associated with COVID-19 (Shipway & Holloway, 2010).

The purpose of the research study is to understand the perceived impact of the global COVID-19 pandemic and public health restrictions on Canadian runners. Specific objectives are to understand the perceived impact of COVID-19 related restrictions on (i) running behaviours, functions, and motives, (ii) social aspects of running behaviours, and (iii) other health-related behaviours.

Methods

Design

A deductive qualitative design using semi-structured interviews.

Inclusion criteria

Individuals had to be aged 19 or older, live in Canada, have access to Facebook Messenger, and included runners at any level (beginner, intermediate, or advanced).

Recruitment and Procedures

Interviews took place during full COVID-19 lockdown across Canada in April and May 2020. Snowball and purposive sampling were used. Recruitment occurred through social media advertisements by posting flyers on Facebook running group pages, reading: 'How is the Coronavirus pandemic affecting your running?' and listing the inclusion criteria. Those interested in participating contacted the researchers through Instant Messenger or by e-mail. The researcher replied through Instant Messenger by sending an information

and consent form. Participants gave informed consent by typing: “I agree to participate in this study, <first and the last name>” in the chat-box, which indicated that they had read and understood the information and consent form and were willing to participate. A semi-structured topic guide was created *a priori* and included questions divided into three sections: i) running before the pandemic, ii) running during the pandemic, and iii) demographic information (see supplementary materials).

Interviews were completed virtually through an Instant Messaging service (Facebook Messenger). A trained female researcher (graduate student) conducted semi-structured interviews through synchronous typing in a single interaction and received ongoing supervision from an academic ethicist (G.T.G.) and an academic health psychologist (S.U.D.). Interview questions were copied one at a time into the Instant Messenger using the topic guide, and additional questions were asked based on the participant’s response. Participants typed their answers into the chat box and submitted their replies once the response was complete (either responses were one block of text or several sentences). Participants completed a short demographics questionnaire at the end of the interview. Interviews were downloaded as transcripts in a Word document and anonymized. After the interview was completed, the researcher took no formal notes, and transcripts were not returned to participants for comments. Data saturation was achieved when no further observations were made. This study received approval from the University of New Brunswick Research Ethics Board (#2020-039).

Analysis and synthesis

A thematic approach was used to deductively analyze the data (Thomas & Harden, 2008). One researcher (DK) familiarized themselves with the data through a close reading of all interviews until they had an in-depth understanding of the content. The interviews were then uploaded into the data analysis program, NVivo Version 12. The data was sorted and assigned class classifications for demographic and some running information. The interviews were coded line-by-line. The codes were discussed amongst the wider research team throughout the process, and descriptive themes were developed and reviewed. Through the process, significant themes and sub-themes emerged.

Results

Participants

A total of 54 people showed interest in the research study, and 29 participants participated in the study. The interview durations were on average 65 minutes (mean=65 ± 22). Table 1 displays participant demographics split by gender. Most participants were female (n=17), married or in a domestic relationship (n=18), and had completed some or all post-secondary education (n=14). Most lived in Atlantic Canada (n=22) and were in an urban location (n=17). Weight status based on body mass index (BMI kg/m²) was classified as a healthy weight for most (n=18). Participants running levels were classified based on years actively running and were either beginner (<3 years, n=3), intermediate (3-10 years, n=14) or advanced (>10 years, n=12) levels.

Table 2: Participant demographics split by gender

Participant Characteristics	Male N (%)	Female N (%)	Total N (%)
	12 (41.4)	17 (58.6)	29 (100)
Age (mean, SD)	37 ± 10.3	40 ± 11.4	38 ± 10.8
<i>Relationship status</i>			
Married/Domestic	7	11	18
Widowed/Divorced/Separated	1	0	1
Single	4	6	10
<i>Education</i>			
High School	0	1	1
Post-secondary/College	8	6	14
Some graduate	0	2	2
Completed graduate	4	8	12
<i>Environment</i>			
Urban (>50,000)	6	11	17
Suburban (30,000-49,999)	3	2	5
Rural (<29,999)	3	4	7
<i>Location</i>			
West Coast (BC, AB)	0	2	2
Prairies (SK, MB)	1	0	1
Central (ON, QC)	0	4	4
Atlantic Canada (NB, NS, PEI, NFL)	11	11	22
Territories (YT, NU, NWT)	0	0	0
<i>BMI (Kg/m²)</i>			
Underweight (<18.5)	0	1	1
Healthy weight (18.5-24.9)	6	12	18
Overweight (25.0-29.9)	5	2	7
Obese (>30.0)	1	1	2
Unknown	0	1	1
<i>Running Experience</i>			
Beginner (<3 years)	1	2	3
Intermediate (3-10 years)	7	7	14
Advanced (>10 years)	4	8	12

Note. AB = Alberta, BC= British Columbia, ON= Ontario, MB= Manitoba, NB= New Brunswick, NFL= Newfoundland and Labrador, NS= Nova Scotia, NU= Nunavut, NWT= Northwest Territories, PEI= Prince Edward Island, QU= Quebec, SK= Saskatchewan, YU= Yukon.

Note. SD= Standard deviation.

Major themes

Three major themes were identified and developed into an organizing framework: *shift*, *tension*, and *interconnectedness* (see Figure 1). Each major theme consists of sub-themes derived from the data.

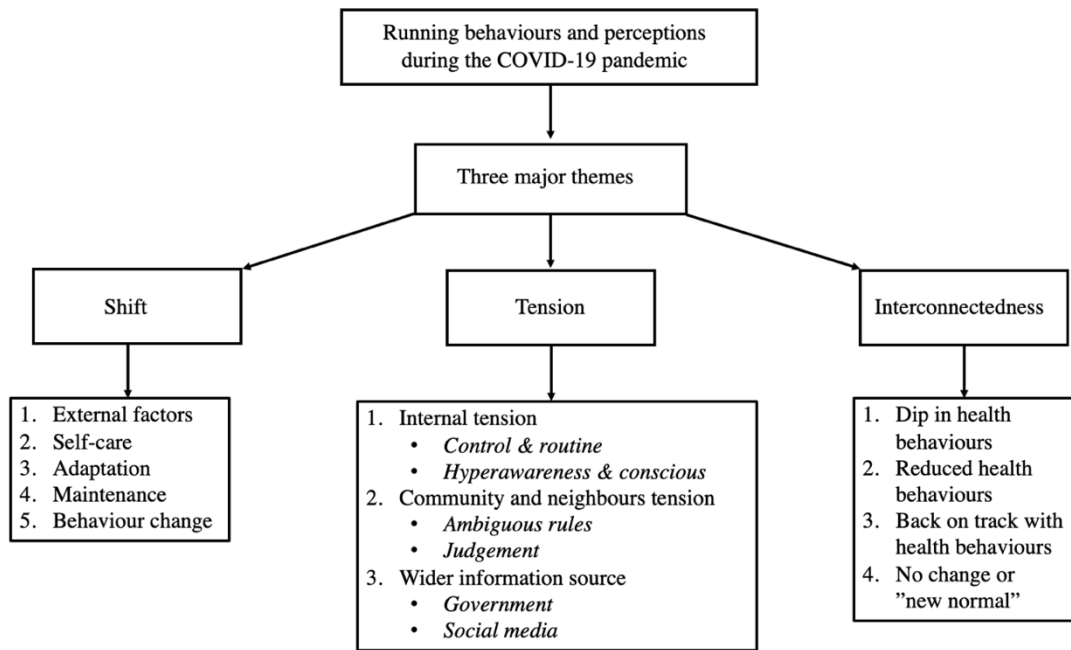


Figure 1: Running behaviours and perceptions organizing framework including major themes and corresponding sub-themes.

Shift

The theme shift describes changes in running motivations (“*Re-focus[‘ing’] on why I was running in the first place*”) and behaviours (“*I’m running [‘to’] show people it’s ok*”).

Five sub-themes were identified: external factors, self-care, adaptation, maintenance, and behaviour change (see Figure 2).

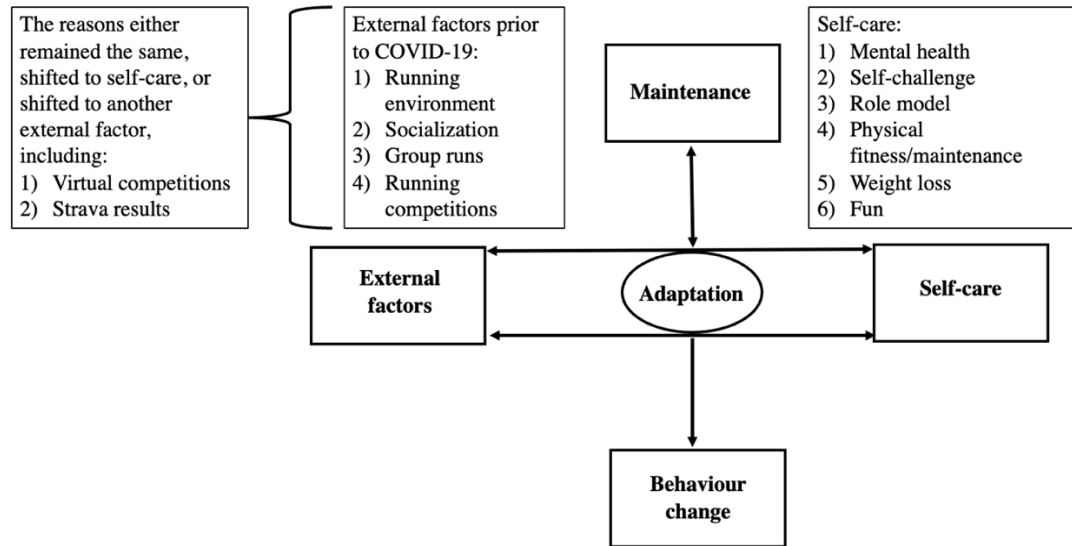


Figure 2: Major theme ‘shift’ including the sub-themes: *external factors, self-care, adaptation, behaviour changes, and maintenance.*

External factors.

External factors were the environmental factors that impacted why the participants were motivated to run. Several external factors affecting running motivation reported by participants included running environment (“*I haven’t been able to run in my favourite places*”), socialization (“*...[‘running’] used to be social*”), running in a group or with others (“*I do all... my training alone [‘now’]*”), and training for competitions and competing (“*[‘I am not’] able to sign up for races*”). Many participants who reported external factors as their primary reason for running seemed to be most impacted at the

start of the COVID-19 pandemic. Some runners reported that running became more challenging and *“less consistent.”*

Self-care.

Self-care was the internal factor that impacted why the participants were motivated to run. Participants reported internal factors such as: challenging oneself or a *“sense of accomplishment”*, being a *“good role model”*, physical *“fitness”*, *“weight loss”* and maintenance, *“personal enjoyment”*, and *“mental health”*. When participants reported they primarily run for self-care appeared to be less of a shift in running behaviours compared to participants motivated by external factors:

“[‘I run for’]...the same reason as in the beginning, [‘to be’] healthier”
(Participant 7).

Participants that were motivated by self-care were often intermediate and advanced runners rather than beginner runners:

“I think had this happened a few years ago, I might have struggled more with the motivation to run without the bling and the social aspect of races”
(Participant 10).

Adaptation.

The process of adaptation is a shift in factors that influence running motivations. During the initial phase of the COVID-19 pandemic, the majority of participants motivated by external factors as their primary reason to run shifted and became more motivated by self-care:

“Now my schedule is better, and it is easier to get runs in. Still making long days, so it requires additional willpower to get out and run. Especially when there is no main goal... Now I run for my mental health” (Participant 8).

Most participants motivated by external factors reported shifting their primary reason for running to self-care. Although, some runners motivated by external factors either reported no shift occurred or changed to another external reason, including “*virtual runs*” and competitions, “*virtual challenges*”, and fitness tracking results (“*I have a graph indicating my progress*”). Participants registering for virtual competitions indicated that the decision was spontaneous and inexpensive, unlike before the COVID-19 pandemic when participants planned for running competitions months in advance and often paid higher racing fees. A few participants reported using the fitness tracking app, Strava, to receive feedback from other runners. One participant, for example, noted that they were involved in a team sport. They were highly motivated to train hard in a group setting and receive feedback. Due to the COVID-19 pandemic, many team sports were halted, and the participant used a fitness tracking app to receive feedback:

“I... follow my rowing teammates on Strava, and we keep tabs on each other’s runs. The distances and paces my teammates are running keep me motivated” (Participant 9).

Behaviour change.

Behaviour change is modifying regular running practices (such as running load and intensity), resulting in a positive or negative change. The greatest changes in running behaviours were reported by participants primarily motivated by external factors and beginner runners. Many of these participants mentioned that they had decreased or stopped running during the initial part of the COVID-19 pandemic:

“Since starting lockdown... I have stopped running completely... I was just depressed and didn't feel like running... when my run[‘ing competition’] got cancelled I just kind of lost my motivation” (participant 22).

Participants that reduced their running behaviours mainly reported fear of COVID-19 transmission in the community or a lack of motivation to run. Generally, participants that initially stopped running started again after a few weeks, as many reported the decrease in their running led to mental health declines:

“I’m ... [an] essential worker, so I felt nervous running, especially on the trails I wanted to limit any potential risk to exposure” (Participant 24).

Some participants indicated a positive change to their running behaviour, commonly reported as an increased number of runs per week. These participants were often advanced, experienced, or motivated by self-care:

“I am on track to blow my records for distance out of the water” (Participant 20).

Maintenance.

Maintenance refers to the process of maintaining the running behaviour or fitness level during the initial phase of the COVID-19 pandemic. Some participants maintaining their running behaviour indicated no change in their primary reason to run (*“just following my normal cycle”*). In contrast, other participants stated a ‘shift’ in running goals. Some participants reported being in a maintenance phase to preserve their fitness level (*“I don’t want to lose any of my fitness”*), especially for future running competitions. Participants frequently mentioned there was more time for running and maintaining a training schedule, as many were working from home and had more flexibility (*“I’ve been working from home on the computer all day... [I run to] get some fresh air”*). A few participants reported maintaining their running behaviours as one form of PA is *“simple and accessible”* and has remained *“pandemic proof”*.

Tension

Tension refers to the runner's perceived strain that could be internal (*"I feel guilty being out on the streets"*), external (*"I was getting unnecessary looks"*), and from a wider information source (*"[my friend was] told online... 'she was part of the problem' [for continuing to run]"*). Three sub-themes were identified under the theme tension: *Internal tension, community and neighbours' tension, and wider information source.*

Internal tension.

Internal tension refers to strain that may be perceived or experienced by participants internally while running during COVID-19. Two identified sub-themes were control and routine (*"there is no structure"*), and hyperawareness and conscious (*"I'm very aware of people"*).

Control and routine were the participants' perceptions of their running behaviours. This meant that during the initial part of the COVID-19 pandemic, participants wanted a sense of *"somewhat normal"* when many aspects of the pandemic were unknown. Before the COVID-19 pandemic, most participants followed running schedules and routines. While during the COVID-19 pandemic, many participants indicated more *"flexibility [that] has allowed"* them *"to run at more convenient times"*. Some participants that experienced negative behaviour changes or falling out of a routine reported re-establishing a new normal to regain control, especially when faced with many unknowns:

"The first couple of weeks being home were sliding towards depression, but now we're getting into a routine, so the running is a big part of my coping"
(Participant 13).

Hyperawareness and conscious were the heightened sense of awareness that participants felt towards their communities' surroundings and overall well-being. Commonly, participants reported maintaining social distancing from people in their community and outside of their immediate household (“*I give [‘others’] more space*”) and avoiding running during peak hours. Although Canadian public health guidelines allowed people to be physically active outdoors (with some restrictions), some reported feeling guilty for continuing to be active outside:

“I felt like I was just failing the society... I felt judged because I thought people might be thinking that I wasn't doing my part while they were” (Participant 28).

Most participants indicated a hyperaware of their surroundings as they did not want to transmit the virus to others. A minority of participants reported reducing their running behaviour because they perceived this as pre-cautionary to heighten their immune system and to prevent illness:

“I decided to cut back [‘on running’] to maintain my strength to fight COVID-19 if the need arose” (Participant 21).

Community and Neighbours’ Tension.

At the start of the COVID-19 pandemic, the public health recommendations changed regularly as new research was published. Provinces and countries implemented various guidelines to minimize the spread of COVID-19. Guidelines were perceived differently by each runner, which influenced how they felt community members should follow guidelines. Perceptions about how rules should be followed led some runners to sense and pass judgment towards others. The perceived rules by participants caused some tension between themselves and others, which will be referred to as community and neighbours’ tension. The sub-theme was broken into two sub-groups: ambiguous rules

(“*the etiquette of... running has changed*”) and judgment (“*I see people complaining about runners*”).

Ambiguous rules refer to public health’s changing and evolving recommendations. Most participants indicated they followed the rules while running. However, some perceived the recommendations differently, resulting in either hyper-following (i.e., over-following public health recommendations by people formulating their restrictive version of the guidelines) or straying away from the intended rules. Some participants noted hyper-following the regulations because they did not “*want to lose the privilege to run*” or protect themselves or others from COVID-19. In response, some moved their running indoors if a treadmill was available or ran in a limited radius from their home.

“I try to give as much distance as physically possible; if it’s on the road, I will cross so that I am on the other side. If it’s a trail, I will push as far to one side as the trees allow. If it’s a narrow trail, I’ll often reroute or delay so that I am not near the person” (Participant 15).

Some participants stopped running altogether as they perceived this as an appropriate response to COVID-19 (“*I stopped after the trails were closed*”). In contrast, some participants continued to “*run with a friend*” every week.

Judgement indicated how the participants perceived others while running and how people in the community perceived them. Generally, participants did not report having experienced judgement or perpetuated judgement towards community members:

“Folks understand that you need to get out of your house... [‘and’] the benefits of exercise” (Participant 18).

Some participants mentioned judgement towards other people in the community. They felt people were picking busy times and not socially distancing during walks.

“I try my best to stay away from crowds... which is why the walking bridge is a mess. I think I'm judging them” (Participant 23).

Wider Information Sources.

People had access to wider information sources about COVID-19, such as social media, news articles, and government recommendations. There was contrasting information between the public health guidelines, research articles, news articles and guidelines set out in different countries. Some participants read different information and guidelines about COVID-19 than those released by public health. In particular, some participants indicated they read news articles stating the physical distancing measures were not enough. While being physically active, some perceived the social distancing guidelines at the time as insufficient and leading to some runners giving others additional space (more than six feet) while running past others:

“Reading some of the studies with the distance required to avoid droplets for runners being further than 6 ft it takes some planning, changing of pace, rerouting to avoid people and chokepoints” (Participant 10).

Many people posted on community pages (such as running group pages) about those who continued to run on social media. Some participants felt these posts were passing judgment towards runners. Though most participants did not perceive judgement while running, they mentioned reading or hearing from a friend about social media posts judging runners:

“I see people complaining about runners [‘on social media’] not giving them the appropriate space and doing a lot of heavy breathing as they zip past” (Participant 13).

Interconnectedness

The theme interconnectedness describes the effects that health behaviours and indicators (health indicators refer to a behaviour-related outcome, such as mental health) may have on other aspects of health. A positive change to one health behaviour and indicator may positively affect another one, or vice versa. The four subthemes included a dip in health behaviours, reduced health behaviours, back on track, and no change or “new normal”. Seven main health behaviours and indicators reported by participants included: running behaviours (“*I have stopped running completely*”), other forms of PA (“*I’m strength training and weightlifting more often*”), sleeping routines (“*I sleep way more*”), alcohol and cannabis consumption (“*[‘alcohol consumption’] has increased*”), food choices and consumption (“*not... eating as healthy*”), and mental health (“*I struggle with isolation*”) (see Figure 3).

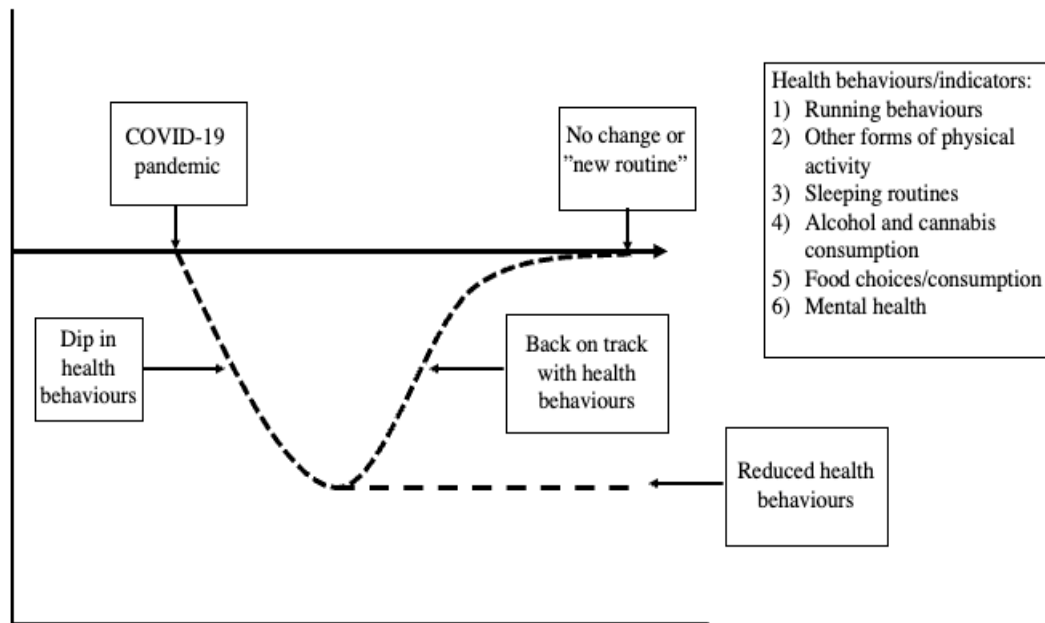


Figure 3: Interconnectedness theme with the inclusion of no change or negative change to health behaviours and indicators.

Dip in Health Behaviours.

During the initial phase of COVID-19, some experienced dips in health behaviours, which refers to decreases in one or more health behaviours and indicators. The majority of participants that experienced a dip in health behaviours were often beginner or primarily runners motivated by external factors:

“I for sure have gained weight and haven’t been eating as healthy”
(Participant 24).

Reduced Health Behaviours.

Participants who experienced a dip in one health behaviour may have experienced negative changes to other health behaviours and indicators, referred to as reduced health

behaviours. In some cases, runners who experienced reduced health behaviours may have stopped running and not get back into a routine or re-start running.

“I have suffered from anxiety in the past but managed to completely control it without the use of medications, during this pandemic it has started to come back and caused me a lot of stress... [‘I’ve’] been staying up much later than usual... [‘and my alcohol consumption’] has increased” (Participant 7).

Back on Track.

After a few weeks, many participants who reported dips in health behaviours could get back on track with health behaviours. Many mentioned they needed to improve health behaviours and indicators *“to increase their mental health”*.

“I’m back to the focus on physical health being improved by running, but I’m also noticing that it’s helping my mental health more now as well” (Participant 13).

No Change or “New Normal”.

The sub-theme no change or new normal refers to participants either maintaining health behaviours and indicators from the start of the pandemic or creating a new sense of normal after adjusting to COVID-19. The majority of those motivated by self-care or intermediate and advanced runners indicated they had little change, while a minority reported having a positive change to their health behaviours and indicators:

“we’re eating better these days [‘and’] have the time to cook more homemade food” (Participant 4).

Discussion

Principle findings

This study identified three major themes about running behaviours during the early stages of the COVID-19 pandemic. First, runners who reported a shift in running behaviours were primarily motivated by external factors and beginner runners than those primarily

motivated by self-care and intermediate or advanced runners. The runners who were motivated mainly by external factors and beginner runners were more likely to dip in health behaviours and indicators but were often able to create a sense of “new normal” and modify their goals to fit the environment. Second, tension was reported by many runners, and this may have included internal, community and neighbour, and wider information source tension. Overall, most runners and community members wanted to protect themselves and others from being infected with COVID-19. This caused runners to perceive more internal tension and hyperawareness of their surroundings and behaviours in public areas than pre-pandemic times. Third, runners reported on the interconnectedness of their behaviours. The impact of one change to health behaviour and indicators tended to cascade to others. Generally, runners indicated that the COVID-19 pandemic impacted their health behaviours and indicators, whether the change was positive or negative. After a while, runners felt the need to regain control and create a new sense of normal by finding new goals and motivations.

Strengths and weaknesses of the study

Several strengths of the current study were identified. Conducting interviews using an Instant Messaging service through real-time synchronous chat may have engaged participants who would not otherwise participate in an in-person or audio call interview (Quayyum & Dombrowski, 2021). The anonymity of the chat function might have provided a comfortable environment for participants to express their views (Quayyum & Dombrowski, 2021). Interviews in written form may have allowed participants to formulate thoughts coherently and reflectively in response to the question asked by the

researcher (Quayyum & Dombrowski, 2021). The study was conducted during the early lockdown and created a unique time for data collection that may provide information for public health behaviours that can be performed during a global pandemic. Additional strengths were the spread across age groups and varying experience levels.

Several limitations should be considered when interpreting the findings. The written-based interviews may have limited spontaneity and length of responses than in-person or audio call interviews (Quayyum & Dombrowski, 2021). Although all emerging themes were discussed with a research team, there was no independent double coder.

Relation to other studies

DeJong and colleagues surveyed 1,147 runners (96% of whom were in the United States) during the COVID-19 pandemic (DeJong et al., 2021) to assess the influence on running volumes, behaviours, motives, and running injury risks changes. Similar to this study, DeJong and colleagues identified shifts in running motives during the pandemic and decreases in competitions, races, and socialization as runners' primary reasons to run. Moreover, more participants indicated they were motivated to run to occupy free time, as well changes to running behaviours were related to experience and age (DeJong et al., 2021). In the current study, many participants reported having shifts in running motivations from external factors to self-care goals, as many runners indicated competitions and groups runs were cancelled. Additionally, some participants noted they had more flexibility and free time in their daily schedules to run.

Another study conducted telephone and videoconferencing interviews during the COVID-19 pandemic with 12 adults in Calgary, Canada, between June and October 2020

(Petersen et al., 2021). The objectives were to determine participants' perceptions of their PA and health changes during COVID-19. The study found that participants faced changes to their daily routines, and PA could adapt. These findings are similar to the current study as many runners described adapting their daily routines to the new normal that followed the public health guidelines. In this study, the participants were runners before the pandemic thus few participants needed to adapt their primary form of PA, as most participants were mainly runners. In contrast, some runners reported that their primary form of PA was another type of exercise than running; however, the main participant's form of PA transitioned into running during the COVID-19 pandemic.

The self-determination theory is a central theoretical concept of psychology that has been used to explain health behaviours (Deci & Ryan, 2012). In particular, the theory can identify contextual and environmental factors that may increase or decrease an individual's motivation (Chirico et al., 2020; Ryan & Deci, 2000). These factors are often referred to as intrinsic and extrinsic factors (Chirico et al., 2020; Ryan & Deci, 2000). Intrinsic motivation usually pertains to specific activities that one engages in for pleasure and satisfaction (Ryan & Deci, 2000). Whereas, external factors are activities that are performed for separable outcomes (Ryan & Deci, 2000). Chan et al. (2021) proposed that the theory could be used to predict preventative behaviours during the COVID-19 pandemic, such as physical activity. Evidence suggests that intrinsically motivated people tend to report sustained physical activity goals and maintain behaviours over time than extrinsically motivated people (Ryan et al., 2009). There may be similarities between this study and the self-determination theory. In this study, runners motivated by internal

factors (referred to as self-care) were more likely to maintain their running behaviours (and other health behaviours) than those motivated by environmental factors.

Implications and future research

Evidence suggests that climate change (increasing ocean temperatures and changing air quality impacting the ecosystem) may increase the number of infectious diseases and cause larger-scale infectious outbreaks (El Hamichi et al., 2020; Hoberg & Brooks, 2015). Considerations may be made by public health in response to future pandemics. Public health may consider providing more PA information and better promotion to enhance overall well-being for Canadians. Running may be a form of PA that could be promoted to Canadians during future pandemics.

This study's findings may inform healthcare clinicians, public health, and the public on the impact of running, running perceptions, motives, and health behaviours and indicators during the COVID-19 pandemic. These findings may be helpful for health service providers to promote safe and effective running practices. Although the study's findings directly relate to running during the COVID-19 pandemic, they may be considered for individuals undergoing drastic changes to their environment. The drastic change may affect usual routines, health behaviours and indicators, and motives. The individual may consider shifting their motivations, managing their internal and external tensions, and conflicting information in the environment. This may help to re-connect with a new daily practice and routine. Future research may study running behaviours and perceptions at the initial onset and a follow-up once more are known about the pandemic.

This may allow a better understanding of running behaviours and perceptions over an extended period.

Conclusion

This study sought to understand the perceived impact of the global COVID-19 pandemic and public health restrictions on Canadian runners during the early months of social isolation restrictions. The COVID-19 pandemic has influenced runners' behaviours, functions and motives, social aspects of running, and other health-related behaviours. Generally, primarily motivated by external factors and beginner runners were at higher risk of decreasing their running behaviours with the lack of running groups, the social aspect of running, various running locations (trails and parks), and in-person competitions. Runners who reported a decline in one health behaviour were more likely to reduce other health behaviours and indicators than those motivated by self-care and intermediate/advanced runners who set routines. Additionally, most runners who reduced or stopped running behaviours early on in the pandemic reported adverse effects on their mental health. Although most runners with no change or an increase in their running behaviours mentioned the protective benefits to their mental health. The findings may inform runners and healthcare professionals to promote goals and motives that may be adaptable to different changes in the environment and mitigate internal and external tensions.

Acknowledgements

The authors would like to thank all participants who volunteered to participate in this research.

Funding

This research received no external funding.

Disclosure Statement

The authors declare no conflict of interest.

Data Availability Statement

Data are available on reasonable request. Access to data can be arranged through the corresponding author Dr. Stephan Dombrowski (University of New Brunswick, stephan.dombrowski@unb.ca), to discuss data sharing, data requirements and conflicts of interest in line with relevant regulations, including ethics approvals.

Chapter 4

Discussion

The scope of this study relates to the healthcare system and the Master of Applied Health Services Research program. The results capture the interwovenness of health behaviours and indicators, motivations, and interpersonal and intrapersonal tensions. These findings encompass mental health, community health, physical activity, and strategies for protecting and promoting health.

Evidence suggests adults have decreased their level of physical activity and are spending more time sedentary during the COVID-19 pandemic in Canada (Lesser & Nienhuis, 2020; Manuel et al., 2021). Canadians with unhealthy lifestyles, chronic health conditions, or overweight are more likely to experience complications if they become infected with COVID-19 than those with healthier lifestyles (Government of Canada, 2020). Furthermore, evidence suggests that physical activity levels and other health behaviours (such as smoking, sedentary behaviours, alcohol consumption, diet, and obesity) may have a critical role in preventing chronic disease and mortality (Arora & Grey, 2020). These health behaviours can also directly impact the mental health (Arora & Grey, 2020).

The COVID-19 pandemic has impacted many Canadians' mental health, although the study findings suggested runners who maintained their health behaviours protected their mental health. Mammen and Faulkner (2013) conducted a systematic review that examined physical activity as a preventative measure against depression. The review suggested that 25 out of the 30 studies included physically active participants at baseline

were less likely to have depressive symptoms at follow-up; physical activity reduced depressive symptoms, and any level of physical activity may prevent future depression (Mammen & Faulkner, 2013).

The COVID-19 pandemic revealed how fragile the healthcare system is in Canada. Innovative approaches need to be used to decrease the demand for health services and tackle critical health care policies. There is a greater need for public health policies, measures, and media to promote greater self-awareness, self-help, and self-care, especially within a home setting to prevent further strain on the healthcare system (Arora & Grey, 2020). Canadians should be encouraged to be more physically active as a strategy to reduce the demand for healthcare services.

The findings from the study may inform the promotion of goals and motives that may be adaptable to different changes in the environment, meaning disruptive events in someone's life, such as retirement or divorce. Findings can also help to mitigate internal and external tensions. Furthermore, the interviews from each participant may help healthcare providers, researchers, and runners understand better how environmental changes may impact individuals. These environmental changes may include a crisis in an individual's life, either by choice or unexpectedly. In response, to assist individuals or groups in adapting to change and build resilience. The assistance may help individuals get back on track and create a new sense of normal.

This study examined running perceptions and behaviours during the initial stages of the COVID-19 pandemic in April and May 2020. Future research may consider studying running perceptions and behaviours at the initial onset and follow-up once more is known about the pandemic (i.e., longitudinal study). Additionally, more questions

regarding shifts in motivations may be beneficial to understand better how runners adapt to changes in their environment; Thus, allowing researchers to better understand running perceptions and behaviours over an extended period.

Bibliography

- Arora, T., & Grey, I. (2020). Health behaviour changes during COVID-19 and the potential consequences: A mini-review. *Journal of Health Psychology, 25*(9), 1155–1163. <https://doi.org/10.1177/1359105320937053>
- Ashdown-Franks, G., Firth, J., Carney, R., Carvalho, A. F., Hallgren, M., Koyanagi, A., Rosenbaum, S., Schuch, F. B., Smith, L., Solmi, M., Vancampfort, D., & Stubbs, B. (2020). Exercise as Medicine for Mental and Substance Use Disorders: A Meta-review of the Benefits for Neuropsychiatric and Cognitive Outcomes. *Sports Medicine, 50*(1), 151–170. <https://doi.org/10.1007/s40279-019-01187-6>
- Barnes, A. S. (2012). Obesity and Sedentary Lifestyles. *Texas Heart Institute Journal, 39*(2), 224–227.
- Biswas, A., Oh, P. I., Faulkner, G. E., Bajaj, R. R., Silver, M. A., Mitchell, M. S., & Alter, D. A. (2015). Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: A systematic review and meta-analysis. *Annals of Internal Medicine, 162*(2), 123–132. <https://doi.org/10.7326/M14-1651>
- Blair, S. N., Cheng, Y., & Holder, J. S. (2001). Is physical activity or physical fitness more important in defining health benefits? *Medicine and Science in Sports and Exercise, 33*(6), 379–399. <https://doi.org/10.1097/00005768-200106001-00007>
- Boston, 677 Huntington Avenue, & Ma 02115 +1495-1000. (2012, October 21). *Examples of Moderate and Vigorous Physical Activity*. Obesity Prevention Source. <https://www.hsph.harvard.edu/obesity-prevention-source/moderate-and-vigorous-physical-activity/>
- Boullosa, D., Esteve-Lanao, J., Casado, A., Peyré-Tartaruga, L. A., Gomes da Rosa, R., & Del Coso, J. (2020). Factors Affecting Training and Physical Performance in Recreational Endurance Runners. *Sports, 8*(3), Article 3. <https://doi.org/10.3390/sports8030035>
- Bowden Davies, K. A., Pickles, S., Sprung, V. S., Kemp, G., Alam, U., Moore, D. R., Tahrani, A. A., & Cuthrtson, D. J. (2021). Reduced physical activity in young and older adults: Metabolic and musculoskeletal implications. *Therapeutic Advances in Endocrinology and Metabolism, 10*. <https://journals.sagepub.com/doi/full/10.1177/2042018819888824>
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *The Lancet, 395*(10227), 912–920. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)

- Callen, K. E. (1983). Mental and emotional aspects of long-distance running. *Psychosomatics*, 24(2), 133–134. [https://doi.org/10.1016/S0033-3182\(83\)73239-1](https://doi.org/10.1016/S0033-3182(83)73239-1)
- Government of Canada. (2020, September 14). *People who are at risk of more severe disease or outcomes from COVID-19* [Education and awareness]. <https://www.canada.ca/en/public-health/services/publications/diseases-conditions/people-high-risk-for-severe-illness-covid-19.html>
- Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports (Washington, D.C.: 1974)*, 100(2), 126–131.
- Cénat, J. M., Blais-Rochette, C., Kokou-Kpolou, C. K., Noorishad, P.-G., Mukunzi, J. N., McIntee, S.-E., Dalexis, R. D., Goulet, M.-A., & Labelle, P. R. (2021). Prevalence of symptoms of depression, anxiety, insomnia, posttraumatic stress disorder, and psychological distress among populations affected by the COVID-19 pandemic: A systematic review and meta-analysis. *Psychiatry Research*, 295. <https://doi.org/10.1016/j.psychres.2020.113599>
- Chakravarthy, M. V., Joyner, M. J., & Booth, F. W. (2002). An obligation for primary care physicians to prescribe physical activity to sedentary patients to reduce the risk of chronic health conditions. *Mayo Clinic Proceedings*, 77(2), 165–173. <https://doi.org/10.4065/77.2.165>
- Chan, D. K. C., Zhang, C.-Q., & Weman-Josefsson, K. (2021). Why people failed to adhere to COVID-19 preventive behaviors? Perspectives from an integrated behavior change model. *Infection Control and Hospital Epidemiology*, 42(3), 375–376. <https://doi.org/10.1017/ice.2020.245>
- Chaudhuri, S., Basu, S., Kabi, P., Unni, V. R., & Saha, A. (2020). Modeling ambient temperature and relative humidity sensitivity of respiratory droplets and their role in Covid-19 outbreaks. *Physics of Fluids*, 32(6), 063309. <https://doi.org/10.1063/5.0015984>
- Chekroud, S. R., Gueorguieva, R., Zheutlin, A. B., Paulus, M., Krumholz, H. M., Krystal, J. H., & Chekroud, A. M. (2018). Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: A cross-sectional study. *The Lancet. Psychiatry*, 5(9), 739–746. [https://doi.org/10.1016/S2215-0366\(18\)30227-X](https://doi.org/10.1016/S2215-0366(18)30227-X)
- Chen, P., Mao, L., Nassis, G. P., Harmer, P., Ainsworth, B. E., & Li, F. (2020). Coronavirus disease (COVID-19): The need to maintain regular physical activity while taking precautions. *Journal of Sport and Health Science*, 9(2), 103–104. <https://doi.org/10.1016/j.jshs.2020.02.001>

- Chirico, A., Lucidi, F., Galli, F., Giancamilli, F., Vitale, J., Borghi, S., La Torre, A., & Codella, R. (2020). COVID-19 Outbreak and Physical Activity in the Italian Population: A Cross-Sectional Analysis of the Underlying Psychosocial Mechanisms. *Frontiers in Psychology, 11*, 2100. <https://doi.org/10.3389/fpsyg.2020.02100>
- Chung, E. (2020). Mandatory mask laws are spreading in Canada. *CBC*. <https://www.cbc.ca/news/health/mandatory-masks-1.5615728>
- Coronavirus COVID-19: The situation in France*. (2020). Explore France. <https://uk.france.fr/en/holiday-prep/information-coronavirus-france>
- Coronavirus: What are the lockdown measures across Europe? (2020). *Deutsche Welle*. <https://www.dw.com/en/coronavirus-what-are-the-lockdown-measures-across-europe/a-52905137>
- Countries where Coronavirus has spread—Worldometer*. (2021, November 24). <https://www.worldometers.info/coronavirus/countries-where-coronavirus-has-spread/>
- CSEP Guidelines*. (2021, January 11). CSEP. <https://csepguidelines.ca>
- Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In *Handbook of theories of social psychology, Vol. 1* (pp. 416–436). Sage Publications Ltd. <https://doi.org/10.4135/9781446249215.n21>
- DeJong, A. F., Fish, P. N., & Hertel, J. (2021). Running behaviors, motivations, and injury risk during the COVID-19 pandemic: A survey of 1147 runners. *PLOS ONE, 16*(2), e0246300. <https://doi.org/10.1371/journal.pone.0246300>
- Dougherty, B., Smith, B., Carson, C., & Ogden, N. (2020). Exploring the percentage of COVID-19 cases reported in the community in Canada and associated case fatality ratios. *Infectious Disease Modelling, 6*. <https://doi.org/10.1016/j.idm.2020.11.008>
- Dubbert, P. M., & Stetson, B. A. (1995). Exercise and Physical Activity. In A. J. Goreczny (Ed.), *Handbook of Health and Rehabilitation Psychology* (pp. 255–274). Springer US. https://doi.org/10.1007/978-1-4899-1028-8_13
- El Hamichi, S., Gold, A., Murray, T. G., & Graversen, V. K. (2020). Pandemics, climate change, and the eye. *Graefe's Archive for Clinical and Experimental Ophthalmology, 1–5*. <https://doi.org/10.1007/s00417-020-04947-7>

- Ewing, L. (2020). *'I'm hooked now': Runners take to virtual racing during coronavirus pandemic*. Global News. <https://globalnews.ca/news/7335579/runners-virtual-racing-coronavirus-pandemic/>
- Fallon, K. (2020). Exercise in the time of COVID-19. *Australian Journal of General Practice*, 49. <https://doi.org/10.31128/AJGP-COVID-13>
- Gabutti, G., d'Anchera, E., Sandri, F., Savio, M., & Stefanati, A. (2020). Coronavirus: Update Related to the Current Outbreak of COVID-19. *Infectious Diseases and Therapy*, 1–13. <https://doi.org/10.1007/s40121-020-00295-5>
- Gadermann, A. C., Thomson, K. C., Richardson, C. G., Gagné, M., McAuliffe, C., Hirani, S., & Jenkins, E. (2021). Examining the impacts of the COVID-19 pandemic on family mental health in Canada: Findings from a national cross-sectional study. *BMJ Open*, 11(1). <https://doi.org/10.1136/bmjopen-2020-042871>
- Galea, S., Merchant, R. M., & Lurie, N. (2020). The Mental Health Consequences of COVID-19 and Physical Distancing: The Need for Prevention and Early Intervention. *JAMA Internal Medicine*, 180(6), 817. <https://doi.org/10.1001/jamainternmed.2020.1562>
- González, K., Fuentes, J., & Márquez, J. L. (2017). Physical Inactivity, Sedentary Behavior and Chronic Diseases. *Korean Journal of Family Medicine*, 38(3), 111–115. <https://doi.org/10.4082/kjfm.2017.38.3.111>
- Government of Canada. (2020a, July 13). *Physical distancing: How to slow the spread of COVID-19* [Education and awareness]. Government of Canada. <https://www.canada.ca/en/public-health/services/publications/diseases-conditions/social-distancing.html>
- Government of Canada. (2020b, September 14). *Coronavirus disease (COVID-19): Prevention and risks* [Education and awareness]. <https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/prevention-risks.html>
- Government of Canada. (2020, October 5). *Community-based measures to mitigate the spread of coronavirus disease (COVID-19) in Canada* [Guidance]. Government of Canada. <https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/public-health-measures-mitigate-covid-19.html>
- Government of Canada. (2021a, April 15). *Regulatory considerations on the classification of non-medical masks or face coverings: Notice to industry* [Guidance]. <https://www.canada.ca/en/health-canada/services/drugs-health->

products/covid19-industry/medical-devices/personal-protective-equipment/medical-masks-respirators/face-covering-classifications-notice.html

- Government of Canada. (2021b, September 24). *Coronavirus disease (COVID-19): Symptoms and treatment* [Education and awareness]. <https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms.html>
- Government of Canada. (2021c, November 5). *Travel Advisory: REMINDER – Travelling to the U.S.? COVID-19 border measures and testing requirements remain in place when you come home* [News releases]. <https://www.canada.ca/en/border-services-agency/news/2021/11/travel-advisory-reminder--travelling-to-the-us-covid-19-border-measures-and-testing-requirements-remain-in-place-when-you-come-home.html>
- Government of Canada. (2021d, November 23). *COVID-19 daily epidemiology update*. <https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html>
- Heffernan, J. M., Smith, R. J., & Wahl, L. M. (2005). Perspectives on the basic reproductive ratio. *Journal of the Royal Society Interface*, 2(4), 281–293. <https://doi.org/10.1098/rsif.2005.0042>
- Hoberg, E. P., & Brooks, D. R. (2015). Evolution in action: Climate change, biodiversity dynamics and emerging infectious disease. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 370(1665), 20130553. <https://doi.org/10.1098/rstb.2013.0553>
- Jang, D., Kim, I., & Kwon, S. (2021). Motivation and Intention Toward Physical Activity During the COVID-19 Pandemic: Perspectives From Integrated Model of Self-Determination and Planned Behavior Theories. *Frontiers in Psychology*, 12. <https://www.frontiersin.org/article/10.3389/fpsyg.2021.714865>
- Janssen, I. (2012). Health care costs of physical inactivity in Canadian adults. *Applied Physiology, Nutrition, and Metabolism*, 37(4), 803–806. <https://doi.org/10.1139/h2012-061>
- Jayaweera, M., Perera, H., Gunawardana, B., & Manatunge, J. (2020). Transmission of COVID-19 virus by droplets and aerosols: A critical review on the unresolved dichotomy. *Environmental Research*, 188. <https://doi.org/10.1016/j.envres.2020.109819>
- Katzmarzyk, P. T., & Janssen, I. (2004). The economic costs associated with physical inactivity and obesity in Canada: An update. *Canadian Journal of Applied Physiology*, 29(1), 90–115. <https://doi.org/10.1139/h04-008>

- Kelly, M. (2020). *Citizens are reporting runners who “double run” in the UK*. Canadian Running Magazine. <https://runningmagazine.ca/the-scene/citizens-are-reporting-runners-who-double-run-in-the-uk/>
- Kozlovskaja, M., Vlahovich, N., Rathbone, E., Manzanero, S., Keogh, J., & Hughes, D. (2017). A profile of health, lifestyle and training habits of 4720 Australian recreational runners-The case for promoting running for health benefits. *Health Promotion Journal of Australia*, 30. <https://doi.org/10.1002/hpja.30>
- Lee, D.-C., Brellenthin, A. G., Thompson, P. D., Sui, X., Lee, I.-M., & Lavie, C. J. (2017). Running as a Key Lifestyle Medicine for Longevity. *Progress in Cardiovascular Diseases*, 60(1), 45–55. <https://doi.org/10.1016/j.pcad.2017.03.005>
- Lesser, I. A., & Nienhuis, C. P. (2020). The Impact of COVID-19 on Physical Activity Behavior and Well-Being of Canadians. *International Journal of Environmental Research and Public Health*, 17(11), Article 11. <https://doi.org/10.3390/ijerph17113899>
- Liu, Y., Gayle, A. A., Wilder-Smith, A., & Rocklöv, J. (2020). The reproductive number of COVID-19 is higher compared to SARS coronavirus. *Journal of Travel Medicine*, 27(taaa021), Article taaa021. <https://doi.org/10.1093/jtm/taaa021>
- Malchrowicz-Moško, E., & Poczta, J. (2018). Running as a Form of Therapy Socio-Psychological Functions of Mass Running Events for Men and Women. *International Journal of Environmental Research and Public Health*, 15(10). <https://doi.org/10.3390/ijerph15102262>
- Mammen, G., & Faulkner, G. (2013). Physical Activity and the Prevention of Depression. *American Journal of Preventive Medicine*, 45(5), 649–657. <https://doi.org/10.1016/j.amepre.2013.08.001>
- Manuel, D., Eddeen, A., Colley, R., Tjepkema, M., Garner, R., Bennett, C., & Bernier, J. (2021, June 25). *The effect of COVID-19 on physical activity among Canadians and the future risk of cardiovascular disease*. Government of Canada. <https://www150.statcan.gc.ca/n1/pub/45-28-0001/2021001/article/00019-eng.htm>
- Marchand-Sénécal, X., Kozak, R., Mubareka, S., Salt, N., Gubbay, J. B., Eshaghi, A., Allen, V., Li, Y., Bastien, N., Gilmour, M., Ozaldin, O., & Leis, J. A. (2020). Diagnosis and Management of First Case of COVID-19 in Canada: Lessons Applied From SARS-CoV-1. *Clinical Infectious Diseases*, 71(16), 2207–2210. <https://doi.org/10.1093/cid/ciaa227>

- Matias, T., Dominski, F. H., & Marks, D. F. (2020). Human needs in COVID-19 isolation. *Journal of Health Psychology, 25*(7), 871–882. <https://doi.org/10.1177/1359105320925149>
- Miller, J. A. (2020). *The New Rules of Running Now*. The New York Times. <https://www.nytimes.com/2020/03/28/well/move/the-new-rules-of-running-now.html>
- Minsberg, T. (2020). *Running From Coronavirus: A Back-to-Basics Exercise Boom*. The New York Times. <https://www.nytimes.com/2020/03/19/sports/running-exercise-coronavirus.html?referringSource=articleShare>
- Modes of transmission of virus causing COVID-19: Implications for IPC precaution recommendations: scientific brief, 27 March 2020. (2020). *World Health Organization*. <https://apps.who.int/iris/handle/10665/331601>
- Moghadas, S. M., Fitzpatrick, M. C., Sah, P., Pandey, A., Shoukat, A., Singer, B. H., & Galvani, A. P. (2020). The implications of silent transmission for the control of COVID-19 outbreaks. *Proceedings of the National Academy of Sciences, 117*(30), 17513–17515. <https://doi.org/10.1073/pnas.2008373117>
- Morris, J. N., & Crawford, M. D. (1958). Coronary Heart Disease and Physical Activity of Work. *British Medical Journal, 2*(5111), 1485–1496.
- McNalty, S. (2020). *Keeping a distance: How safe are running and cycling amid COVID-19 measures?* [New Article]. CBC. <https://www.cbc.ca/news/technology/what-on-earth-newsletter-cycling-covid-19-physical-distancing-1.5534086>
- Nyenhuis, S. M., Greiwe, J., Zeiger, J. S., Nanda, A., & Cooke, A. (2020). Exercise and Fitness in the Age of Social Distancing During the COVID-19 Pandemic. *The Journal of Allergy and Clinical Immunology. in Practice, 8*(7), 2152–2155. <https://doi.org/10.1016/j.jaip.2020.04.039>
- Ong, S. W. X., Tan, Y. K., Chia, P. Y., Lee, T. H., Ng, O. T., Wong, M. S. Y., & Marimuthu, K. (2020). Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient. *JAMA, 323*(16), 1610. <https://doi.org/10.1001/jama.2020.3227>
- Organization, W. H. (2020). Advice on the use of masks in the context of COVID-19: Interim guidance, 5 June 2020. *WHO*. <https://apps.who.int/iris/handle/10665/332293>
- Oswald, F., Campbell, J., Williamson, C., Richards, J., & Kelly, P. (2020). A Scoping Review of the Relationship between Running and Mental Health. *International*

Journal of Environmental Research and Public Health, 17(21), E8059.
<https://doi.org/10.3390/ijerph17218059>

- Pascoe, M., Bailey, A. P., Craike, M., Carter, T., Patten, R., Stepto, N., & Parker, A. (2020). Physical activity and exercise in youth mental health promotion: A scoping review. *BMJ Open Sport & Exercise Medicine*, 6(1), e000677. <https://doi.org/10.1136/bmjsem-2019-000677>
- Pereira, H. V., Palmeira, A. L., Encantado, J., Marques, M. M., Santos, I., Carraça, E. V., & Teixeira, P. J. (2021). Systematic Review of Psychological and Behavioral Correlates of Recreational Running. *Frontiers in Psychology*, 12, 1162. <https://doi.org/10.3389/fpsyg.2021.624783>
- Petersen, J. A., Naish, C., Ghoneim, D., Cabaj, J. L., Doyle-Baker, P. K., & McCormack, G. R. (2021). Impact of the COVID-19 Pandemic on Physical Activity and Sedentary Behaviour: A Qualitative Study in a Canadian City. *International Journal of Environmental Research and Public Health*, 18(9), 4441. <https://doi.org/10.3390/ijerph18094441>
- Poon, E. T.-C., Zheng, C., & Wong, S. H.-S. (2021). Effect of Wearing Surgical Face Masks During Exercise: Does Intensity Matter? *Frontiers in Physiology*, 12, 775750. <https://doi.org/10.3389/fphys.2021.775750>
- Pringle, J. (2020, July 14). *You don't need to wear a mask while exercising at the gym: Dr. Etches*. CTV News. <https://ottawa.ctvnews.ca/you-don-t-need-to-wear-a-mask-while-exercising-at-the-gym-dr-etches-1.5023275>
- Quayyum, F., & Dombrowski, S. U. (2021). Barriers to nutritional pregnancy preparation and support needs in women and men: Qualitative study based on the Theoretical Domains Framework. *Women's Health*, 17, 17455065211042182. <https://doi.org/10.1177/17455065211042182>
- Rebar, A. L., & Taylor, A. (2017). Physical activity and mental health; it is more than just a prescription. *Mental Health and Physical Activity*, 13, 77–82. <https://doi.org/10.1016/j.mhpa.2017.10.004>
- Reiner, M., Niermann, C., Jekauc, D., & Woll, A. (2013). Long-term health benefits of physical activity – a systematic review of longitudinal studies. *BMC Public Health*, 13(1), 813. <https://doi.org/10.1186/1471-2458-13-813>
- Rice, M. H., & Howell, C. C. (2000). Measurement of physical activity, exercise, and physical fitness in children: Issues and concerns. *Journal of Pediatric Nursing*, 15(3), 148–156. <https://doi.org/10.1053/jn.2000.6019>

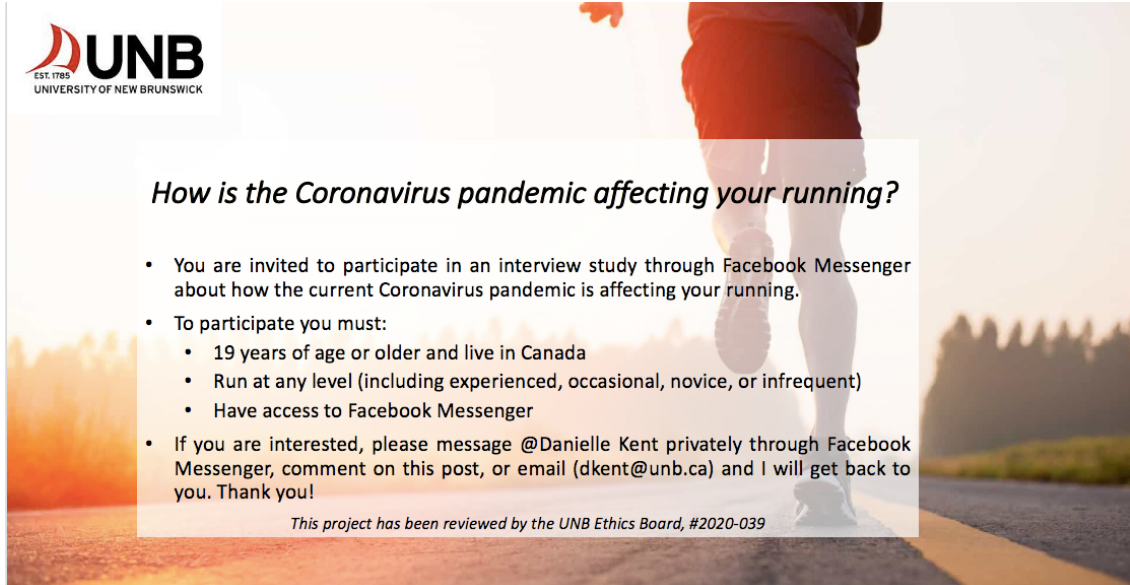
- Rosenbaum, S., Tiedemann, A., Sherrington, C., Curtis, J., & Ward, P. B. (2014). Physical activity interventions for people with mental illness: A systematic review and meta-analysis. *The Journal of Clinical Psychiatry*, *75*(9), 964–974. <https://doi.org/10.4088/JCP.13r08765>
- Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, *25*(1), 54–67. <https://doi.org/10.1006/ceps.1999.1020>
- Ryan, R. M., Williams, G. C., Patrick, H., & Deci, E. L. (2009). Self-determination theory and physical activity: The dynamics of motivation in development and wellness. *Hellenic Journal of Psychology*, *6*(2), 107–124.
- Salian, V. S., Wright, J. A., Vedell, P. T., Nair, S., Li, C., Kandimalla, M., Tang, X., Carmona Porquera, E. M., Kalari, K. R., & Kandimalla, K. K. (2021). COVID-19 Transmission, Current Treatment, and Future Therapeutic Strategies. *Molecular Pharmaceutics*. <https://doi.org/10.1021/acs.molpharmaceut.0c00608>
- Scarabel, F., Pellis, L., Bragazzi, N. L., & Wu, J. (2020). Canada needs to rapidly escalate public health interventions for its COVID-19 mitigation strategies. *Infectious Disease Modelling*, *5*, 316–322. <https://doi.org/10.1016/j.idm.2020.03.004>
- Shipway, R., & Holloway, I. (2010). Running free: Embracing a healthy lifestyle through distance running. *Perspectives in Public Health*, *130*(6), 270–276. <https://doi.org/10.1177/1757913910379191>
- Snider-McGrath, B. (2020, December 20). *Strava's Year in Sport report tells the story of running during COVID-19*. Canadian Running Magazine. <https://runningmagazine.ca/the-scene/stravas-year-in-sport-report-tells-the-story-of-running-during-covid-19/>
- Statistics Canada. (2019, April 17). *The Daily—Tracking physical activity levels of Canadians, 2016 and 2017*. Government of Canada. <https://www150.statcan.gc.ca/n1/daily-quotidien/190417/dq190417g-eng.htm>
- Stonerock, G. L., Hoffman, B. M., Smith, P. J., & Blumenthal, J. A. (2015). Exercise as Treatment for Anxiety: Systematic Review and Analysis. *Annals of Behavioral Medicine*, *49*(4), 542–556. <https://doi.org/10.1007/s12160-014-9685-9>
- Ströhle, A. (2009). Physical activity, exercise, depression and anxiety disorders. *Journal of Neural Transmission (Vienna, Austria: 1996)*, *116*(6), 777–784. <https://doi.org/10.1007/s00702-008-0092-x>

- Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, 8(1), 45. <https://doi.org/10.1186/1471-2288-8-45>
- Thomson, A. (2020, March 27). *Nova Scotia police grapple with influx of COVID-19 compliance calls*. CBC. <https://www.cbc.ca/news/canada/nova-scotia/nova-scotia-police-grapple-covid-19-compliance-calls-1.5512182>
- Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., Latimer-Cheung, A. E., Chastin, S. F. M., Altenburg, T. M., Chinapaw, M. J. M., Altenburg, T. M., Aminian, S., Arundell, L., Atkin, A. J., Aubert, S., Barnes, J., Barone Gibbs, B., Bassett-Gunter, R., Belanger, K., Biddle, S., ... Wondergem, R. (2017). Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. *International Journal of Behavioral Nutrition and Physical Activity*, 14(1), 75. <https://doi.org/10.1186/s12966-017-0525-8>
- Wackerhage, H., Everett, R., Krüger, K., Murgia, M., Simon, P., Gehlert, S., Neuberger, E., Baumert, P., & Schönfelder, M. (2020). Sport, exercise and COVID-19, the disease caused by the SARS-CoV-2 coronavirus. *German Journal of Sports Medicine*, 71(5), E1–E12. <https://doi.org/10.5960/dzsm.2020.441>
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. *International Journal of Environmental Research and Public Health*, 17(5), Article 5. <https://doi.org/10.3390/ijerph17051729>
- Warburton, D. E. R., & Bredin, S. S. D. (2017). Health benefits of physical activity: A systematic review of current systematic reviews. *Current Opinion in Cardiology*, 32(5), 541–556. <https://doi.org/10.1097/HCO.0000000000000437>
- WHO announces COVID-19 outbreak a pandemic*. (n.d.). Retrieved October 26, 2021, from <https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/3/who-announces-covid-19-outbreak-a-pandemic>
- Woods, J. A., Hutchinson, N. T., Powers, S. K., Roberts, W. O., Gomez-Cabrera, M. C., Radak, Z., Berkes, I., Boros, A., Boldogh, I., Leeuwenburgh, C., Coelho-Júnior, H. J., Marzetti, E., Cheng, Y., Liu, J., Durstine, J. L., Sun, J., & Ji, L. L. (2020). The COVID-19 pandemic and physical activity. *Sports Medicine and Health Science*, 2(2), 55–64. <https://doi.org/10.1016/j.smhs.2020.05.006>
- Wu, Z., & McGoogan, J. M. (2020). Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA*, 323(13), 1239. <https://doi.org/10.1001/jama.2020.2648>

- Yang, J., Zheng, Y., Gou, X., Pu, K., Chen, Z., Guo, Q., Ji, R., Wang, H., Wang, Y., & Zhou, Y. (2020). Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: A systematic review and meta-analysis. *International Journal of Infectious Diseases*, *94*, 91–95. <https://doi.org/10.1016/j.ijid.2020.03.017>
- Yeh, H.-P., Stone, J. A., Churchill, S. M., Brymer, E., & Davids, K. (2017). Physical and Emotional Benefits of Different Exercise Environments Designed for Treadmill Running. *International Journal of Environmental Research and Public Health*, *14*(7), E752. <https://doi.org/10.3390/ijerph14070752>
- Zhang, S., Diao, M., Yu, W., Pei, L., Lin, Z., & Chen, D. (2020). Estimation of the reproductive number of novel coronavirus (COVID-19) and the probable outbreak size on the Diamond Princess cruise ship: A data-driven analysis. *International Journal of Infectious Diseases*, *93*, 201–204. <https://doi.org/10.1016/j.ijid.2020.02.033>
- Zhang, Y. S. D., Young Leslie, H., Sharafaddin-zadeh, Y., Noels, K., & Lou, N. M. (2021). Public Health Messages About Face Masks Early in the COVID-19 Pandemic: Perceptions of and Impacts on Canadians. *Journal of Community Health*, 1–10. <https://doi.org/10.1007/s10900-021-00971-8>

Appendix A

Study Advertisement



The advertisement features a background image of a person running on a path during a sunset or sunrise. The UNB logo is in the top left corner. The main text is centered in a white box with a semi-transparent background.

UNB
EST. 1785
UNIVERSITY OF NEW BRUNSWICK

How is the Coronavirus pandemic affecting your running?

- You are invited to participate in an interview study through Facebook Messenger about how the current Coronavirus pandemic is affecting your running.
- To participate you must:
 - 19 years of age or older and live in Canada
 - Run at any level (including experienced, occasional, novice, or infrequent)
 - Have access to Facebook Messenger
- If you are interested, please message @Danielle Kent privately through Facebook Messenger, comment on this post, or email (dkent@unb.ca) and I will get back to you. Thank you!

This project has been reviewed by the UNB Ethics Board, #2020-039

Appendix B

Information and Consent Form

Study title: *Running during the global COVID-19 pandemic: A qualitative study examining perceptions and behaviours in recreational runners.*

Introduction:

Researchers at the University of New Brunswick invite you to participate in an interview study about running. This study asks questions through Facebook Messenger, and you may answer them by typing in your answers. We want to learn about how the current Coronavirus (COVID-19) pandemic is affecting your running. This study will take about 30-minutes to complete.

You may take part in the study if you are:

- Over 19 years of age and live in Canada
- A runner at any level (including experienced, occasional, novice, or infrequent)
- Able to access Facebook Messenger

The research study is being conducted by Danielle Kent, and supervised by Dr. Gabriela Tymowski-Gionet and Dr. Stephan Dombrowski in the Faculty of Kinesiology Department at the University of New Brunswick in Fredericton (see below for contact information).

Participation:

Participation in the study is **completely** voluntary. You may leave the study at any time, or afterward without giving any reason. If you do not feel comfortable answering a question, leave it unanswered.

Confidentiality:

All answers provided during the interview will remain confidential and are read only by the interviewer and the research team. The data will be anonymized, and any of your identifiable information will be removed once the interview is finished. The original answers on Facebook Messenger will be deleted.

Quotations from the interview may be used in disseminating the findings but will not have any identifying information: any quotations will be anonymous. The research will be used for a thesis at the University of New Brunswick. The findings may be made available in a scientific journal and at scientific meetings, to contribute towards a better understanding of how COVID-19 affects running behaviours.

Contact:

If you have any questions about this research study or the procedure, you may contact one of the research team members, Dr. Gabriella Tymowski-Gionet, via phone at 1 (506) 447-3231 or email at tymowski@unb.ca; or Dr. Stephan Dombrowski via phone at 1 (506) 453-4803 or e-mail at stephan.dombrowski@unb.ca.

The UNB Fredericton Research Ethics Board may be contacted if you have any concerns about the project, the researcher, or supervisors. These concerns might include rights which have not been honoured, questions and concerns, or complaints. The Chair of the UNB Research Ethics Board is Dr. David Coleman, and he may be contacted at Sir Douglas Hall, 3 Bailey Drive, Fredericton, NB, or by email at ethics@unb.ca.

Electronic Consent:

I have read and agree with the consent form and agree to participate in this study.

Please type in the Messenger chat the following:

“I agree to participate in this study, <first and last name>”

This project has been reviewed by the UNB Research Ethics Board and is on file as REB 2020-039.

Thank you for your interest in our study, “Running during the global COVID-19 pandemic: A qualitative study examining perceptions and behaviours in runners”.

Appendix C

Semi-Structured Interview Schedule

The goal of the research is to study how the Coronavirus (COVID-19) pandemic restrictions have affected your running. The interview questions will be about your running before the COVID-19 pandemic and how your running has changed. If you do not feel comfortable answering a question, it may be left unanswered. As well, you may leave the study at any time, or afterward without giving any reason.

In the first section, the questions are about your running behaviour before the COVID-19 pandemic. Questions will be open-ended with additional prompts.

- Before COVID-19, did you consider yourself to be an experienced, a recreational, a novice runner, or were you not running?
- How long have you been running for?
- How many times per week do you normally run on average?
- On average, how far or long do you run for?
- Where do you usually run during the week? On the weekend?
- With whom do you usually run, if anyone? Or with a dog?

The current COVID-19 pandemic has brought some restrictions, as Canadians are physically (or known as social) distancing to prevent the spread of the virus. For many of us, this means that non-essential businesses have been closed, including parks, gyms, and other exercise facilities; and we must keep our distance from others. However, the Government of Canada is still urging Canadians to go outside for some fresh air and to be

active. These questions will be concerning how COVID-19 has impacted your running. The questions will be open-ended with additional prompts.

- How has the COVID-19 impacted your running? (Prompt: cancelled group runs, running with groups, a partner, or runs alone?)
- Has your running changed at all? (Prompts: increased, decreased, or remained the same?)
- How has the COVID-19 pandemic impacted your motivation to run?
- Why do you run during the COVID-19 pandemic? Have the reasons why you run changed during the COVID-19 pandemic (follow-up prompts: coping, stress, boredom)
- Have you started to run with a dog? If so, will you continue once the physically distancing period is over?
- Has the COVID-19 pandemic had an impact on any of your other healthy behaviours? (Prompt: sleeping, eating, and alcohol/drug/cannabis consumption)
- Is there anything else you would like to mention about your running during the COVID-19 pandemic?

For the last section of the interview, the questions will be about your background information. Please answer the questions to the best of your ability.

Demographic Questionnaire:

- How old are you?
- Where do you currently live?
- How tall are you?
- What is your current weight?
- What is your relationship/marital status?
- What is your gender?
- What is your occupation?
- What is your highest level of education?

Thank you for your interest in the study, as it is much appreciated. Your answers will help us better understand the impact the restrictions of COVID-19 have had on individuals' running. Please stay safe and healthy.

We will give participant ID numbers, and the demographic data will be collected anonymously.

Curriculum Vitae

Candidate's full name: Danielle Marie Kent

Universities attended (with dates and degrees obtained):

University of New Brunswick | Master of Applied Health Services Research | In Study

Dalhousie University | BSc in Kinesiology | MAY 2019

Publications:

Thesis will be submitted for publication.

Conference Presentations:

Kent, D. (Presenter). Tymowski-Gionet, G., & Dombrowski, SU. (2021, November 18-19). *Running during the global COVID-19 pandemic: A qualitative study examining perceptions and behaviours for runners* [Abstract presentation]. New Brunswick Health Research Conference.

Ellis, K., Ryan, A., **Kent, D.**, Dornan, G., Nieman, D., Donovan, C., Lignos, N., Smirle, M., Reed, M. (2021, November 18-19). *NB HEARS: Trial of a community-based approach to hearing health equity in New Brunswick population* [Abstract presentation]. New Brunswick Health Research Conference.