Mental Health, Physical Activity Participation and Physical Activity Recommendation Habits of Medical Students

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ABSTRACT

The purpose of this doctoral dissertation was to investigate the relationships between mental health and physical activity participation of medical students, as well as their confidence, motivation and frequency in recommending physical activity in future medical practice. Moreover, this thesis involved the implementation and evaluation of a peer support walking intervention aimed at improving the mental health and physical activity participation of medical students. Two separate studies were conducted, including a cross-sectional correlational survey administered to medical students in all four years at three Canadian Universities (Study One; Articles One, Two and Three) and a single-subject study testing the impact of a two-month peer support walking intervention delivered to first and second year medical students at two Canadian universities (Study Two; Articles Four and Five). Article One examined relationships between physical activity, including mild and moderate-to-vigorous physical activity (MVPA), and mental health profiles in a sample of Canadian medical students using latent profile analysis. Three distinct mental health profiles emerged (*low*, *moderate* and *high* ratings of mental health) and individuals in the *high* mental health profile reported engaging in more mild physical activity than MVPA. Article Two investigated the underlying mechanism(s) contributing to frequency in recommending physical activity, to provide insight into how we can increase physical activity recommendations in future practice as physicians. Findings showed positive relationships between medical students' physical activity levels and their frequency recommending physical activity to patients. Results also revealed that medical students are significantly more motivated than they are confident to recommend physical activity to patients and only 52% of student participants were aware of and accurately able to recall the Canadian physical activity guidelines. Article Three examined demographic differences in medical students' motivation and confidence

to recommend physical activity to future patients. Results revealed differences according to gender, year of study and academic background. For instance, second year students were more motivated to assess a patients' level of physical activity compared to third and fourth year students. Article Four evaluated the impact of a two-month peer support walking intervention aimed at improving the mental health and physical activity participation of first and second year medical students using the RE-AIM framework. Findings showed that the peer support walking intervention was delivered as intended and may be an important proactive strategy for maintaining mental health and physical activity levels of medical students during stressful situations, including the COVID-19 pandemic. Finally, Article Five offered evidence-based strategies for conducting mental health research in medical professionals to optimize recruitment, engagement and retention. Ten strategies were provided to help inform the planning of future research aiming to support the mental health of medical professionals, including students. Taken altogether, findings from this dissertation show that peer support and incorporating mild physical activity may be an effective strategy to offer within medical student wellness programs. Additionally, results highlight the need to expand the medical curriculum to include physical activity education in order to prepare students to recommend physical activity to patients in future medical practice as an important preventive and therapeutic strategy for several chronic illnesses.

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I dedicate this thesis to you.

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LIST OF ABBREVIATIONS

ABIC: Adjusted Bayesian Information Criterion

AIC: Akaike Information Criterion

BIC: Bayesian Information Criterion

CET: Cognitive Evaluation Theory

CMA: Canadian Medical Association

MANOVA: Multivariate Analysis of Variance

MI: Motivational Interviewing

MVPA: Moderate-to-Vigorous Physical Activity

PA: Physical Activity

PSW: Peer Support Walking

SDT: Self-Determination Theory

WHO: World Health Organization

STATEMENT OF CONTRIBUTIONS

I, Taylor McFadden, was responsible for conceptualizing and designing each of the studies included in this thesis under the supervision of Dr. Michelle Fortier.

Article One: Physical activity participation and mental health profiles in Canadian medical students: Latent profile analysis using continuous latent profile indicators

Primary Author

I, Taylor McFadden, performed a literature review to inform the purpose of the study and design of the survey. I obtained ethics approval, distributed the survey, analyzed the data, drafted and revised the manuscript.

Co-Authors

Dr. Michelle Fortier, Dr. Shane Sweet and Dr. Jennifer Tomasone assisted with the study design and obtaining ethics approval, as well as edited the manuscript.

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Article Two: Canadian Medical Students' Perceived Motivation, Confidence and Frequency Recommending Physical Activity

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Article Four: Investigating the impact of a peer support walking intervention on mental health and physical activity in medical students: a multiple baseline single subject design

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I, Taylor McFadden, performed a literature review to inform the purpose of the study and design of the intervention. I obtained ethics approval, recruited participants, collected and analyzed the data, drafted and revised the manuscript.

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Article Five: Evidence-based strategies for conducting mental health research in medical professionals to optimize recruitment, engagement and retention

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I, Taylor McFadden, performed a literature review to support the evidence-based strategies presented in the manuscript. I drafted and revised the manuscript.

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CHAPTER ONE: INTRODUCTION

Attributable to a multitude of contributing factors, medical students are at a high risk for poor mental health. Indeed, research has shown that medical students have higher rates of burnout, depression and suicidal ideation compared to age- and education-matched peers in Canada (Maser & Houlton, 2017) and internationally (Rotenstein et al., 2016). Additionally, and related to mental health, the majority of medical students are not meeting the physical activity guidelines, and their physical activity levels have been shown to decrease upon entry into medical school (Morris et al., 2012).

This is concerning, as medical students will become physicians, and physician physical activity levels and mental health have been linked to patient care. For instance, active physicians are more likely to recommend physical activity to their patients (Lobelo & de Quevedo, 2016) which is an important preventive and therapeutic strategy for several chronic illnesses (Hoffmann et al., 2016). Despite the well known benefits of physical activity, it remains under-prescribed in medicine (Baillot et al., 2018; Bélanger et al., 2017). As such, further research investigating the mechanisms contributing to medical professionals' frequency in recommending physical activity to patients is necessary. Moreover, physician mental health has been linked to patient care such that mentally healthy physicians have been shown to make fewer medical errors and provide higher quality care to their patients (de Oliveira et al., 2013).

Peer support groups and physical activity interventions have been shown to be effective strategies to improve mental health and increase physical activity levels; however, they have yet to be integrated together into a single intervention nor tested in medical students. While medical student health merits attention in and of itself, there are also important implications related to the

quality of care provided to patients, which make medical student well-being not only an individual problem, but also a broader public health concern.

This doctoral dissertation investigates the relationships between mental health and physical activity participation of medical students, as well as their confidence, motivation and frequency in recommending physical activity in future medical practice (Study One). Moreover, this thesis involves the implementation of a peer support walking intervention aimed at improving the mental health and physical activity participation of medical students (Study Two). This research not only supports the mental health and physical activity participation of medical students, but may also correspond to the delivery of higher quality patient care in future medical practice.

CHAPTER TWO: REVIEW OF THE LITERATURE

Mental Health Concepts

When conducting psychological research, it is important to first conceptualize the pertinent variables, as they are often inappropriately used interchangeably. Indeed, the concepts of mental health, mental illness and psychological distress are related, yet unique phenomenon that should be considered individually (Payton, 2009). Mental health is defined by the World Health Organization (WHO, 2018) as, "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." This definition highlights the idea that mental health is not just the absence of a mental disorder, but also the presence of well-being. The concept of mental disorder (also called mental illness) lacks a concrete definition, but DSM-IV criteria describe it as a wide range of mental health disorders that affect your mood, thinking and behaviour (e.g., depression, anxiety disorders, substance abuse). Mental disorders are not an expected response to a stressor (e.g., loss of a loved one), but rather the result of a behavioural, psychological or biological dysfunction (Stein et al., 2010). In contrast, psychological distress is a natural human response to externally stressful situations, which may disappear when an individual learns to adapt to their circumstance (e.g. burnout, stress, grief; Horwitz, 2007). Previous research indicates that while mental disorder and psychological distress are unique concepts, they have a strong positive relationship, whereby distress sometimes leads to disorder (Payton, 2009; Phillips, 2009). Without proper support to facilitate appropriate coping skills, burnout has been shown to trigger or exacerbate depression and suicidal ideation (Pospos et al., 2017). Indeed, burnout was found to be an independent positive predictor of suicidal ideation in a sample of medical students (N = 4,287; Dyrbye et al., 2008).

The idea that mental health is not merely the absence of mental illness, and that they exist on separate but related continua, is in line with a model proposed by Keyes (2002). This model

includes three categories: ‘flourishing’ (high levels of mental health), ‘languishing’ (low levels of mental health), and ‘moderately mentally healthy’ (neither flourishing nor languishing). The present dissertation used Keyes’ model to investigate the mental health (total mental health and well-being subscales) of Canadian medical students (Studies One and Two).

Mental Health Status of Medical Students

Medical students take on significant stress and responsibility throughout their journey to becoming a doctor which contribute to the high rates of psychological distress and mental illness in this population. To illustrate, a national survey conducted by the Canadian Federation of Medical Students showed that 37.1% of Canadian medical students are burned out (compared to 17.4% of the general population), 9.7% have an anxiety disorder (compared to 4.0% of the general population), and 6.1% reported suicidal thoughts within the last twelve months (compared to 3.2 % of the general population; Maser & Houlton, 2017). Moreover, an international survey reported that 27% of medical students show symptoms of depression (Rotenstein et al., 2016). Indeed, compared to the general population, rates of psychological distress and mental disorders reported in Canadian medical students are higher than age-, gender- and education-matched peers (Maser & Houlton, 2017). The high prevalence of distress and disorder in medical students compared to the general population has been consistently shown worldwide (Ediz, Ozcakir, & Bilgel, 2017; Dyrbye, Thomas, & Shanafelt, 2006).

Poor medical student mental health has been attributed to a variety of factors including: heavy workload, strained relationships/isolation, lack of a work-life balance, financial stress, perfectionism, unrealistic expectations, high competition, and mistreatment from supervisors (Dyrbye & Shanafelt., 2016; Haglund et al, 2009). Research suggests that the prevalence of mental health issues in medical professionals is highest in students, compared to residents and

early career physicians (Dyrbye et al., 2014). Given that education appears to be the peak time for distress in the medical profession, this dissertation aimed to improve the mental health of medical students.

Physical activity is one strategy that offers innumerable psychological benefits (Aylett, Small, & Bower, 2018; Rosenbaum et al., 2016; Schuch et al., 2018); however, many medical students are not meeting the recommended physical activity guidelines [i.e., at least 150 minutes of moderate-to-vigorous physical activity (MVPA)/week; Ross et al., 2020]. Additionally, medical students' physical activity levels have been shown to significantly decrease after beginning medical school (Kanikowska et al., 2017).

Help-Seeking Behaviours of Students

Medical student mental health is of growing concern and further contributing to this issue is the lack of help-seeking reported in this population, specifically for mental health issues (Thistlethwaite, Quirk, & Evans, 2010). For instance, a survey of first and second year medical students found that 24% of students were depressed, and among them, only 22% were receiving counselling (Givens & Tjia, 2002). Dyrbye et al. (2015) found a similar pattern in help-seeking behaviours of medical students, with results from an online survey revealing that 52.7% of students were burned out, and only one third of them sought help in the last twelve months.

There are many factors which may contribute to a lack of help-seeking among medical students, including: concerns about confidentiality, stigma, fear of career consequences, cost, and lack of time (Pospos et al., 2017). Among medical students who do seek help, a study revealed that only 3% report seeking help from a professional for mental health issues, while 90% report that they would rather seek help from a peer (Hope, Dring, & Dring, 2005). Medical students'

preference for seeking support informally from family or friends is widely supported in the literature (e.g., Dyrbye et al., 2015; Gold et al., 2015; Thistlethwaite et al., 2010).

What can we do?

In response to the alarmingly high rates of psychological distress and mental illness in medical students, several programs have been developed, which include: mindfulness-based techniques, strengthening resiliency, and self-reflection web-based apps (Hassed, De Lisle, Sullivan, & Pier, 2009; Howe, Smajdor, & Stockl., 2012; Krasner et al., 2009; Pospos et al., 2017; Rakel & Hedgecock, 2008; Regehr, Glancy, Pitts, & LeBlanc, 2014; Warnecke et al., 2011). Recently, peer support groups have emerged as a promising approach, likely in response to the evidence suggesting that medical professionals prefer to seek informal help from peers.

Peer Support

Peer support is defined by the Mental Health Commission of Canada (MHCC) as, "a supportive relationship between people who have a lived experience in common" with the underlying philosophy that, "each individual has an innate desire to find a path towards recovery, improved health and well-being, and has within themselves the knowledge of what will work for them. The peer supporter assists the individual as they find that inner knowledge," (Sunderland & Mishkin, 2013, pp. 7). Furthermore, the MHCC conducted a comprehensive review of the literature which identified three primary values of peer support workers, including: 1) self-determination and equality (e.g., encouraging peers to come up with their own options and guiding them to taking steps forward); 2) mutuality and empathy (e.g., developing an honest, trusting, and non-judgemental relationship); and 3) recovery and hope (e.g., sharing lived experience and demonstrating compassion; O'Hagan, Cyr, McKee, & Priest, 2010).

Peer support groups have been recommended as an effective strategy to improve mental health, as they promote a social environment that reduces isolation and encourages people to share their thoughts, feelings, concerns, and coping strategies (Castelein et al., 2015; Lloyd-Evans et al., 2014). Talking to someone who is understanding and non-judgemental, has been shown to result in feelings of connectedness and empathy (Sunderland & Mishkin, 2013). Furthermore, connecting with someone who has overcome a similar challenge has been shown to bring about feelings of hope (Sunderland & Mishkin, 2013). It should be acknowledged that there is literature supporting mentorship as an effective strategy to improve the mental health of medical professionals (e.g., Daskivich et al., 2015; Wilkes & Feldman, 2017); however, this relationship differs from peer support. Mentorship typically involves a level of seniority between the mentor and mentee, whereas peer support is based on equality (Monk & Purnell, 2014). The present research (Study Two) involved medical students participating in one-on-one peer support walking sessions. Considering the definition and underlying values of peer support, Study Two included implementation measures of basic needs satisfaction (i.e., competence, autonomy, and relatedness) and perceived social support to ensure that the peer support intervention was delivered with high fidelity. This is in line with previous theory-based peer support research using the Self-Determination Theory (Cherrington et al., 2015; Moran, Russinova, Yim, & Sprague, 2014).

Peer support in general has been widely supported as an important strategy to prevent and treat mental health issues, and as such, several countries have established programs offered to a broad range of populations (see Forchuk, Solomon, & Viran, 2016 for examples in Ontario). A meta-analysis including twenty-three peer support interventions with adult participants, found that there were significant pre-post decreases in depressive symptoms, and improvements were

maintained at follow-up (Bryan & Arkowitz, 2015). Similar mental health benefits have been found in peer support interventions focussing on students (e.g., Byrom, 2018). However, there is limited research on the effectiveness of peer support programs offered to medical professionals (Horgan et al., 2016), and most of these articles focus specifically on physicians not on medical students which is when psychological distress begins to develop. (e.g., Brewster, Kaufmann, Hutchinson, & MacWilliam, 2008; Shapiro & Galowitz, 2016, West et al., 2014).

The first peer support program offered to physicians was implemented in 2008 by The Center for Professionalism and Peer Support (CPPS). The program provided support to a multidisciplinary group of health care professionals, including physicians. It has since been adapted following a survey evaluation conducted by Hu et al. (2012), which assessed participants' awareness, access, and barriers to seeking support. One important finding from this study was that physicians reported being uncomfortable showing emotional vulnerability in front of non-physicians, as they perceived it to be a sign of weakness. Indeed, physicians indicated they would prefer support for psychological distress from their physician colleagues. As a result, the newly adapted program provides support specifically to physicians following emotionally stressful events (e.g., medical error; Shapiro & Galowitz, 2016). Unfortunately, the effectiveness of this program in promoting physician mental health has not been reported.

West et al. (2014) provide an example of a randomized controlled trial evaluating a peer support intervention, involving biweekly facilitated physician discussion groups. The small discussion groups (four groups with 8-10 physicians in each; $N = 37$ intervention participants) incorporated elements of mindfulness, self-reflection, shared experience, and promoting collegiality and community at work. Discussion groups were facilitated by physicians with good communication skills who completed a 4-hour training session related to the topics of discussion.

These peer supporters met biweekly with one another to debrief and prepare for upcoming sessions together. Intervention and control participants completed online surveys assessing a variety of well-being and psychological distress measures at multiple time-points. Findings of this study revealed significant increases in well-being (i.e., meaning, empowerment, and engagement) and decreases in depersonalization (i.e., feelings of cynicism) in the intervention group compared to the control group. These results suggest that peer support groups may promote mental health and reduce psychological distress in physicians.

To date, only two studies have reported on peer support offered to medical students specifically (i.e., Abrams, Day, & Suprun, 2020; Moir et al., 2016). The first was an exploratory study by Moir and colleagues (2016) involving the delivery of peer support to medical students to improve their mental health. Medical students were nominated to receive formal training in peer support (N = 12) and following training, they provided the intervention to their peers (n intervention = 111; n control = 121). Results did not show statistically significant differences in mental health between the intervention and control groups. This may have been attributed to the duration and intensity of the intervention whereby participants in the intervention did not have specific requirements regarding level of engagement. As a result, participants reported approximately 1-2 hours of interaction with their peer supporter over a six-month period. The researchers recommended future studies incorporate a more intensive, controlled intervention. As such, this dissertation (Study Two) delivered a two-month intervention involving one-hour weekly peer support walking sessions (eight hours total).

Most recently, Abrams and colleagues (2020) published a short article describing a peer support program currently being offered at the University of Central Florida College of Medicine. This program includes 20 trained second, third and fourth year medical students who

provide non-clinical support to their peers. Each peer supporter holds weekly walk-in office hours where students are welcome to go for support on topics such as transitions, relationship problems, family issues, academic concerns, etc. While it is encouraging to see peer support being offered to medical students, only lessons learned and anecdotal feedback related to wellness improvements resulting from this program have been reported (Abrams et al., 2020).

The limited research available on the impact of peer support on the mental health of medical students is concerning, as poor mental health begins to develop in medical school, is at its highest in third and fourth year, and studies show that mental health issues continue into doctorhood if left untreated (Gentile & Roman, 2009). Additionally, medical students face their own unique challenges, and so the topics of discussion in peer support groups should be tailored accordingly. Another gap in the literature is that previous research typically takes a reactive approach, providing peer support to physicians after an adverse event. Peer support should also be viewed from a preventive approach, in which students support each other throughout medical school to thrive together as they make their way to doctorhood. Finally, previous peer support programs among medical professionals have not involved sharing strategies to become more active, nor while walking at the same time as talking.

The concept of walking and talking has been incorporated into traditional psychotherapy, and studies have reported positive client outcomes (e.g., Revell & McLeod, 2016). Research suggests that using exercise in therapy enhances the client-therapist relationship, because walking side by side promotes equality and some clients prefer to talk without eye contact (Revell & McLeod, 2016). The advantages of incorporating walking into peer support groups is that they are affordable, accessible, and have a greater reach than one-on-one psychotherapy, which are often costly and have long wait-lists (American Psychological Association, 2012).

Taken together, peer support groups are a cost-effective way to reach a large number of students, and the addition of a walking component could further promote mental health benefits in the same amount of time.

Physical Activity

Being physically active has been shown to offer physical health benefits (Hoffmann et al., 2016), as well as psychological benefits (Rebar et al., 2015; Rosenbaum et al., 2016; Schuch et al., 2018; Wegner et al., 2014; White et al., 2017). Indeed, a meta-analysis revealed that those engaging in high volumes of physical activity had significant lower odds of developing depression compared to those with low activity levels (Schuch et al., 2018). Moreover, systematic reviews have shown that even light-intensity physical activity, such as walking, can prevent future depression (Mammen & Faulkner, 2013; Robertson, Robertson, Jepson, & Maxwell, 2012). Accordingly, the most recent recommendations provided by the Canadian Network for Mood and Anxiety Treatments, support physical activity as a first-line monotherapy for mild to moderate depression (Ravindran et al., 2016).

A few cross-sectional studies have examined the relationship between physical activity and mental health in medical students and residents specifically, and most found positive associations (Lebensohn, Dodds, Benn, Brooks, & Birch, 2013; Peleias et al., 2017, Tol, Tavassoli, Shariferad & Shojaeezadeh, 2013). For example, Peleias et al. (2017) surveyed 1350 medical students and found a strong dose-effect relationship between volume of physical activity and quality of life in medical students. Specifically, results showed that low, moderate, and high volume physical activities positively predicted quality of life, with high volume being the strongest predictor. Previous research has suggested that intensity of physical activity is another factor that should be considered in the relationship between physical activity and mental health

(Fortier, McFadden, & Faulkner, 2020; Klavestrand & Vingård, 2009). For example, an inverse u-shaped relationship has been shown in adults, whereby mild and moderate intensity physical activity are positively associated with well-being and more vigorous physical activity is associated with decreased well-being (Panza, Taylor, Thompson, White, & Pescatello, 2017). However, some studies have found the contrary, showing that moderate and vigorous intensity physical activity correspond to the greatest reduction in depressive symptoms, compared to mild activity (Hughes et al., 2013). To my knowledge, these relationships have not been investigated previously among medical students. As such, this dissertation investigated the relationships between mild, moderate, and strenuous physical activity and mental health in medical students (Article One, Study One).

As mentioned previously, physical activity levels have been shown to decrease upon entry into medical school (Kanikowska et al., 2017), and despite the well documented benefits of being active, physical activity interventions have received significantly less attention within the medical community (Majeed, 2015). One example involved a one-group post-test-only design including second year medical students (N = 343) who took a 6-week, 12-hour Healthy Living course (Kushner, Kessler, & McGaghie, 2011). As part of the course, they were asked to make a behaviour change plan, in which they identified a certain behaviour they wanted to change (e.g., physical activity, nutrition, sleep, etc.), set individual goals, make a change plan, and perform self-monitoring by tracking their progress. Results of this study found that only 40.5% of students reported achieving their goals. This low success rate was attributed to the demanding nature of medical school (i.e., competing priorities) and high expectations from students (i.e., unrealistic goals). This intervention did not involve any interaction among peers when setting

goals, nor throughout the intervention. It is likely useful for peers to share their strategies on how to become more active and how to overcome barriers.

Another example of a physical activity intervention involving medical students was conducted by Morris et al. (2012). This involved a non-randomized trial which investigated the effectiveness of a seven-week fitness intervention on physical activity levels, positive affect (e.g., excited, alert), and negative affect (e.g., nervous, irritable) in first to fourth year medical students (*n* intervention = 71; *n* control = 29). The intervention involved a competition in which students were placed on teams and encouraged to exercise for 150 minutes per week. Teams achieving an average of 150 minutes per teammate were placed in weekly prize draws. Findings revealed significant increases in physical activity levels in the intervention group compared to the control group. Regarding mental health however, only irritability decreased. While this demonstrates a decent effort to get medical students moving, the incentive and competition aspect of the intervention promotes extrinsic motivation (Ryan & Deci, 2017), which is unlikely to support long term behaviour change. Indeed, a systematic review by Teixeira et al. (2012) showed that self-determined physical activity motivation (e.g., intrinsic motivation) is what leads to physical activity maintenance. Additionally, this intense and highly competitive physical activity intervention may not be the most conducive for promoting mental health in an already overburdened population. The authors concluded by recommending student-led interventions as an effective way for peers to promote healthy behaviours with fellow students, which is directly in line with peer support.

Incorporating peer support with physical activity/walking has not been done previously with medical students, or with any population. As such, this research sought to determine whether a peer support walking intervention could improve medical students' mental health

(psychological, emotional, and social well-being) and physical activity levels (Study Two), and in doing so, determine whether active peer support might be an important strategy for medical stakeholders to consider implementing into medical student wellness programs.

Why do we care?

Impact of Medical Professionals' Mental Health on Patient Care

Physician health has become a growing public health concern as it not only affects the individual physician, but also the quality and type of care provided to their patients, which has subsequent impacts on the health care system (West, Dyrbye, Erwin, & Shanafelt, 2016). Indeed, evidence suggests that physicians in good mental health are less likely to make medical errors (de Oliveira et al., 2013). This is important because medical errors are the third leading cause of death in the United States, costing an estimated 19.5 billion USD/year (Makary & Daniel, 2016). Additionally, physicians who are in good mental health are less likely to leave the profession or retire early (Dale et al., 2015; de Wind et al., 2014; Shanafelt, Goh, & Sinsky, 2017). On the other hand, evidence suggests that physicians who are burned out are more likely to reduce clinical hours or retire early, resulting in an estimated cost of over $213 million CAD in lost revenue (Dewa, Jacobs, Xuan & Loong, 2014). In sum, poor physician mental health can have negative consequences on patient safety and can take a major financial toll on the health care system.

Impact of Medical Professionals' Physical Activity on Patient Care

Research suggests that active medical professionals are more likely to counsel patients on physical activity in practice (Frank, Tong, Lobelo, Carrera, & Duperly, 2008; Lobelo & de Quevedo, 2016). This is important because physical inactivity increases the risk of many of the

most expensive medical conditions, resulting in an estimated total health care cost of 6.8 billion dollars (Janssen, 2012; Pratt, Norris, Lobelo, Roux, & Wang, 2014). Despite the evidence supporting the benefits of physical activity in the treatment of several physical and mental health chronic conditions, it remains under prescribed in practice (deJonge, Omran, Faulkner, & Sabiston, 2020; Hoffmann et al., 2016). Although research supports that active physicians are more likely to discuss physical activity with their patients, it remains unclear why. This doctoral research began by investigating the underlying mechanism(s) contributing to why active medical students are more likely to recommend physical activity in future practice, to provide further insight into how we can increase physical activity prescription. Specifically, mental health, confidence in recommending physical activity, and motivation in recommending physical activity were tested as mediators in the relationship between physical activity participation and frequency in recommending physical activity (Article Two, Study One). In addition, demographic differences in medical students' motivation and confidence to recommend physical activity were examined to help inform the development of educational efforts to incorporate physical activity training into the medical curriculum (Article Three, Study One).

Present Study

Purposes

The overall purpose of Study One was to investigate the relationships between mental health and physical activity participation of medical students, as well as their confidence, motivation, and frequency in recommending physical activity in future medical practice. Study One addresses several important gaps in the literature, as outlined above, and the findings from this study also helped to inform the design of Study Two. The overall purpose of Study Two was to implement

and evaluate a peer support walking intervention aimed at improving the mental health and physical activity participation of medical students.

The two overall purposes of this dissertation, described above, were examined via five research articles. The specific purposes of each article are outlined below:

1) The purpose of Article One, Study One was to examine relationships between physical activity and mental health profiles in a sample of Canadian medical students.
2) The purpose of Article Two, Study One was to investigate the underlying mechanism(s) contributing to frequency in recommending physical activity, to provide insight into how we can increase physical activity recommendations in future practice as physicians.
3) The purpose of Article Three, Study One was to investigate demographic differences in medical students' motivation and confidence to recommend physical activity.
4) The purpose of Article Four, Study Two was to implement and evaluate the impact of a two-month peer support walking intervention to improve the mental health and physical activity levels of medical students.
5) The purpose of Article Five, Study Two was to offer evidence-based strategies for conducting mental health research in medical professionals to optimize recruitment, engagement, and retention.

Note. The articles presented in this dissertation have been formatted according to journal requirements.

CHAPTER THREE: ARTICLE ONE, STUDY ONE

Physical activity participation and mental health profiles in Canadian medical students: Latent profile analysis using continuous latent profile indicators

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Abstract

Rates of mental illness among Canadian medical students are higher than age-, gender-, and education-matched peers. One predictor of mental health is physical activity; though the relationship between different intensities of physical activity and mental health has not been investigated in medical students. The purpose of this study was to examine relationships between physical activity and mental health profiles in a sample of Canadian medical students. A total of $N = 125$ students completed an online survey. Latent profile analysis was performed to identify distinct profiles using four continuous latent profile indicators (emotional well-being, social well-being, psychological well-being, resilience). Three mental health profiles emerged, showing *low* ($n = 18$), *moderate* ($n = 72$) and *high* ($n = 36$) self-reported ratings of mental health. The classification quality was good (entropy = 0.81). Individuals in the *high* mental health profile engaged in more mild physical activity ($M = 144.28$ mins/week; $SD = 22.12$) and less moderate-to-vigorous physical activity ($M = 195.86$ mins/week; $SD = 25.67$) compared to students in the *moderate* and *low* profiles, though not significantly. This suggests that mild physical activity might be the most effective intensity in supporting mental health among medical students; however, further research is recommended.

Keywords: mental health; resilience; physical activity intensity; medical students; latent profile analysis

Introduction

Training to become a physician can be deeply rewarding, however it also comes with significant stress and challenges that can have a negative impact on medical student mental health[1]. According to the most recent national survey conducted by the Canadian Federation of Medical Students, 37.1% of Canadian medical students are burned out, 9.7% have an anxiety disorder, and 14.1% report suicidal thoughts (Maser & Houlton, 2017). Moreover, a systematic review and meta-analysis, including international data, estimates that the prevalence of depression is 27.2% among medical students (Rotenstein et al., 2016). Relative to the general population, the rates of psychological distress and mental illness reported among Canadian medical students are higher than age-, gender-, and education-matched peers (Maser & Houlton, 2017); this trend is consistent worldwide (Ediz et al., 2017). To date, research on medical students' 'mental health' typically focuses on psychological distress (e.g., burnout) and mental illness, with minimal focus on positive mental health indicators, such as well-being and resilience. This is a current gap in literature, as the concepts of mental health, mental illness and psychological distress are a related, yet unique phenomenon that should be examined individually (Payton, 2009). Moreover, no studies have included multiple positive mental health indicators to provide a broader understanding of mental health in this population. The present study addresses these gaps by generating mental health profiles of Canadian medical students using multiple indicators of

[1] Mental health: a state of well-being in which the individual realizes his/her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to contribute to his or her community (World Health Organization, 2004). In line with this definition, the concept of mental health is operationalized in this study by subjective well-being (i.e., emotional, psychological and social well-being; Keyes, 2010) and resilience (i.e., personal qualities that enable one to thrive in the face of adversity; Connor & Davidson, 2003). These three facets of well-being and resilience are frequently used in research as indicators of mental health, including studies involving medical professionals (e.g., Lamers, Westerhof, Bohlmeijer, ten Klooster, & Keyes, 2011; Maser & Holton, 2017; McLuckie et al., 2018; Neufeld & Malin, 2019).

mental health including: emotional well-being, social well-being, psychological well-being and resilience.

One predictor of mental health is physical activity (PA; Ravindran et al., 2016; Schuch et al., 2016; Wegner et al., 2014). Cross-sectional studies have shown a positive association between PA and mental health in medical students and residents specifically (Lebensohn et al., 2013; Peleias et al., 2017; Tol et al., 2013). However, while we know that moderate-to-vigorous physical activity (MVPA) is the best intensity to achieve physical health benefits (Gebel et al., 2015), less is known about the optimal intensity to promote mental health (Helgadottie et al., 2016). Moreover, the literature in this area predominantly focuses on PA intensity and the negative aspects of mental health, such as depression (e.g., Cramer et al., 2013; Helgadóttir et al., 2016; Streeter et al., 2017).

A few studies have investigated the influence of PA intensity on mental health (e.g., Downward & Dawson, 2016; Loprinzi & Davis, 2016; Panza et al., 2017; Reed & Ones, 2006; Wicker & Frick, 2015); however, outcomes in healthy adults are somewhat inconsistent, and none have included a sample of medical students. For instance, a meta-analysis of 158 studies concluded that the highest improvements in positive affect immediately after engaging in PA occurred for the lowest intensity PA and were almost twice that of MVPA (Reed & Ones, 2006). More recently, Panza et al. (2017) showed that mild and moderate PA is positively associated, whereas vigorous PA is negatively associated, with psychological well-being in adults. This might be attributed to certain personality traits, such as perfectionism, which has been positively linked to poor mental health (Hu et al., 2019) and engagement in excessive PA (Miller & Mesagno, 2014). Previous research has not considered the influence of PA intensity on multiple

components of well-being, including emotional, social and psychological well-being, which is a limitation that the present study addresses.

The inconsistent findings on the relationship between PA intensity and mental health could be due to the different mental health outcomes measured (e.g., affect vs. well-being). Nonetheless, the lack of research in this area on medical students specifically, suggests that more research is needed to identify which PA intensity is best to promote mental health in this population. Indeed, the relationship between PA intensity and mental health in medical students, a particularly overburdened population, might differ from the general population. It is possible that medical students may achieve greater mental health benefits from participating in milder forms of PA, as they typically involve a fun or social component (Downward & Dawson, 2016).

The Present Study

The purpose of this study was to examine relationships between self-reported physical activity, including mild and MVPA, and mental health profiles in a sample of Canadian medical students. Mental health profiles were generated using four positive indicators (i.e., emotional well-being, social well-being, psychological well-being and resilience). It was hypothesized that medical students with profiles demonstrating higher levels of self-reported mental health would report engaging in significantly more mild PA and MVPA compared to profiles demonstrating lower mental health (Downward & Dawson, 2016; Panza et al., 2017; Reed & Ones, 2006; Wicker & Frick, 2015).

Methods

Study Design

This study follows a cross-sectional research design, involving an online survey composed of validated scales, distributed to medical students at two large Canadian universities (McGill University and Queen's University). The survey was open for three months and two reminders were sent during that time. This study is part of a larger project looking at the health behaviours and PA prescribing habits of medical students (McFadden et al., 2019; McFadden et al., 2019).

Participants and Procedures

Medical students in first, second, third and fourth years at two large Canadian medical schools were eligible to participate in this study. Approval from the research ethics board and the faculty of medicine from both institutions was obtained. The survey link was distributed via emails sent through the medical student society, Facebook posts, and class announcements. The survey link could have reached 1150 medical students. A total of $N = 130$ provided informed consent and completed the survey, for an 11% response rate. Fifty-five percent of the sample were female and ages ranged from 19 to 42 years old ($M = 24.8$; SD = 4.3). Half of the sample indicated white ethnicity and nearly a quarter reported Asian ethnicity (24%). See Table 1 for participant characteristics.

Measures

Well-Being. The Mental Health Continuum Short Form (MHC-SF; Keyes, 2002) is a valid and reliable scale, used to assess mental health. Participants were asked how often during the past month they felt 14 different items corresponding to three facets of well-being: **emotional** (3 items; e.g., *happy, interested in life*), **social** (5 items; e.g., *that you belonged to a community, that people are basically good*), and **psychological** (6 items; e.g., *that you like most parts of your personality, good at managing the responsibilities of your daily life*). Responses were measured

on a scale from 0 = *never* to 5 = *every day*. Scores for emotional, social and psychological well-being were calculated by summing the Likert-scored items corresponding to each facet of well-being. In the current study, the Cronbach alpha coefficients for emotional, social, and psychological well-being subscales were all considered acceptable (.86, .78 and .85 respectively).

Resilience. The two-item Connor-Davidson Resilience Scale (CD-RISC 2; Vaishnavi et al., 2007) was used to assess resilience. This scale has shown good test-retest reliability, as well as convergent and divergent validity (Vaishnavi et al., 2007). Participants were asked to indicate their level of agreement with respect to two items: 1) *I am able to adapt when changes occur*; and 2) *I tend to bounce back after illness, injury or other hardships.* Response options include a Likert scale ranging from 0 = *not true at all* to 4 = *true nearly all of the time* (maximum possible score of 8).

Physical Activity. The Godin Leisure-Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) was used to assess PA. This valid and reliable scale asks on average how many times a week an individual engages in vigorous (heart beats rapidly; e.g., running, hockey), moderate (not exhausting; e.g., fast walking, dancing) and mild (minimal effort; e.g., easy walking, golf) exercise. Additional follow-up questions were included, asking participants to indicate the average minutes per session for each intensity. Total minutes per week engaging in each intensity were calculated by multiplying times per week by minutes per session. Total minutes of MVPA per week was calculated by summing total minutes per week of moderate and vigorous PA.

Statistical Analysis

Prior to conducting statistical analysis, data were cleaned, and extreme outliers were removed (*n* = 4 participants removed). Latent profile analysis with continuous latent profile indicators using automatic starting values with random starts was performed in Mplus version 8 (Muthen & Asparouhov, 1998 – 2019). The indicator variables used to determine profiles were: emotional well-being, social well-being, psychological well-being, and resilience. The number of profiles was determined through an iterative process starting with two profiles. The models were evaluated based on fit criteria [i.e., models with the lowest Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and sample-size adjusted Bayesian Information Criterion (ABIC) values are preferred], the number of individuals in each profile (i.e., profiles should contain >5% of the total number of respondents) and the classification probabilities (i.e., the probability that an individual belongs to the assigned profile and not the remaining profiles should be greater than .70; Nylund et al., 2007; Stanley et al., 2017).

After the number of mental health profiles was determined, differences in PA intensities according to profile membership were tested using the AUXILIARY function. Specifically, the automatic BCH method (Bolck et al., 2004) was used to estimate the means of mild PA and MVPA between latent profiles. This method for determining differences in continuous outcomes between profiles has been recommended by several researchers (e.g., Bakk & Vermunt, 2016; Vermunt, 2010) including the creators of Mplus (Asparouhov & Muthén, 2014). Differences were deemed significant using a significance level of .05. See Appendix for Mplus syntax.

Results

Latent Profile Analysis with Continuous Latent Profile Indicators of Mental Health

Based on fit criteria, number of individuals in each profile and classification probabilities (see Table 2), three distinct mental health profiles were identified. The classification quality was good with an entropy value of 0.81.

The first profile of individuals (*n* = 18) had *low* ratings on all four indicators of mental health. The second profile of individuals (*n* = 72) had *moderate* ratings on all four indicators of mental health. The third profile of individuals (*n* = 36) had *high* ratings on all four indicators of mental health. Hereafter, profiles are named low, moderate and high mental health; however, these classifications are relative to the medical student sample included in this study. See Table 3 for means and standard errors of emotional well-being, social well-being, psychological well-being and resilience, according to profile membership. See Table 4 for specific characteristics of individuals, according to profile membership.

Differences in Physical Activity Intensities Across Different Latent Profiles

Results revealed no significant differences in mild PA and MVPA between profiles. However, individuals with high mental health (i.e., Profile 3) participated in more mild PA (*M* = 144.28 mins/week; *SD* = 22.12) and less MVPA (*M* = 195.86; *SD* = 25.67) compared to individuals with low and moderate mental health (i.e., Profiles 1 and 2 respectively; Table 5).

Discussion

The purpose of this study was to examine relationships between PA intensities and mental health profiles in a sample of Canadian medical students. Results identified three distinct profiles showing low, moderate and high levels of mental health. There have been a few studies investigating the ‘mental health’ status of medical students, but the majority (if not all) focus on negative indicators (e.g., burnout; Trockel et al., 2018). Moreover, no studies have included a

variety of positive indicators to form mental health profiles which provides a broader understanding of medical student mental health status. According to the World Health Organization, 'mental health is more than the absence of mental disorders' (World Health Organization, 2018). From a positive psychology perspective, it is important to understand the mental health of medical students and contributing factors, in order to develop proactive interventions that support positive mental health indicators, such as well-being and resilience. The dearth of research in this area might be attributed to the lack of mental health measures relevant to medical populations (Trockel et al., 2018), which is an area for future research to explore.

After generating mental health profiles, potential relationships between these profiles and PA intensities were examined. Results revealed that individuals in Profile 3 (high mental health) engaged in more mild PA/week and less MVPA/week compared to Profiles 1 (low) and 2 (moderate), though not significantly. However, a meta-analysis found that the greatest changes in mood and self-esteem occurred after five minutes of exercise, and the rate of change decreased for 10-60-minute durations (Barton & Pretty, 2010). Similarly, it has been shown that as little as 10-15 minutes of PA at a time corresponds to improvements in mental health and illness (Mayo Clinic, 2017). So, although not statistically significant, the differences in mild PA found in this study (~ 18-minute difference in mild PA/week between high and moderate mental health profiles) may be practically significant given the immediate mental health benefits of PA.

A few studies examining PA intensity and positive indicators of mental health support the findings of this study, although they were not conducted with medical students. For instance, Panza et al. (2017) examined a sample of healthy adults (N = 150) and found that self-reported mild PA had the most positive, significant association with psychological well-being (β = .192, p

= .02) compared to moderate PA (β = .013, p = .88) and vigorous PA (β = .119, p = .15). A cross-sectional survey (N = 14,913) also showed that mild PA had the strongest positive relationship with overall happiness, compared to moderate PA (Downward & Dawson, 2016). The positive relationship between mild PA and well-being has been attributed to the social and fun nature of mild forms of PA, which may not always be the case with MVPA. Though not comparing PA intensities, several studies support that mild forms of PA lead to mental health benefits. For example, light exercise in nature has been shown to have immediate, positive improvements on mental health (Barton et al., 2016). These improvements could be attributed to both PA intensity (i.e., light) and the environment, as exercising in nature has been shown to offer mental health benefits (e.g., Shanahan et al., 2016). Moreover, a review found that yoga offers significant improvements in mood, quality of life and anxiety (Govindaraj et al., 2016). It might be particularly important for medical students, an overburdened population, to incorporate enjoyable mild activities into their schedules versus pressuring themselves to engage in higher intensity PA. However, some studies do not support these findings, indicating that there are significant improvements in mental health indicators regardless of PA intensity (e.g., McAuley et al., 2000; Tsai et al., 2013; Zhang & Chen, 2019). These inconsistent results suggest that more research is needed to further identify the most effective intensity of PA to achieve psychological benefits. Moreover, future research should consider other factors, in addition to intensity, that may contribute to the mental health benefits of PA, such as type, volume, frequency, social component and perceived enjoyment.

Strengths, Limitations, Future Directions

There are many strengths associated with this study. While previous research has considered ‘mental health’ of medical students, the focus has been on negative indicators, such as burnout

and depression. This was the first study to define mental health profiles in medical students using a rigorous statistical approach. Moreover, multiple positive indicators were used, for a broader understanding of mental health in this population, including: emotional well-being, social well-being, psychological well-being, and resilience. Finally, this was the first study to consider the relationship between PA intensities and mental health profiles in medical students. Previous literature focusing on PA intensity and mental health has been among adult populations and results are inconsistent.

Study limitations should be taken into consideration when interpreting results. First, the present study was cross-sectional, so causality cannot be established. It is possible that the bidirectional relationship between PA intensity and mental health exists. That is, perhaps individuals who have better mental health are more likely to engage in mild PA while those who are in worse mental health are more likely to engage in more vigorous forms of PA. This hypothesis could be attributed to perfectionism, a common personality trait among medical students, which has been positively linked to both poor mental health (Hu et al., 2019) and engagement in excessive PA (Miller & Mesagno, 2014). Longitudinal randomized controlled trials are recommended, to determine cause-and-effect relationships. Second, self-selection bias may have resulted in higher levels of mental health in this sample compared to the medical student population at large, as those with lower mental health status may not have responded to the survey. Similarly, this bias may have contributed to a highly active sample of medical students responding to the survey which might explain why significant differences in PA intensities according to mental health profiles were not found. However, it should be noted that there are many factors that contribute to mental health, not only PA. Future intervention research should take a multidimensional approach to improving medical student mental health. For

example, including a nature component (e.g., green exercise) and a peer support component, in addition to PA. Indeed, nature and peer support have been shown in the literature to improve medical student mental health (Barton & Pretty, 2010; Shanahan et al., 2016; Shapiro & Galowitz, 2016; West et al., 2014).

Conclusion

Results of this study identified three distinct profiles showing low, moderate and high levels of mental health among a sample of Canadian medical students, as determined by four positive indicators: emotional well-being, social well-being, psychological well-being, and resilience. When comparing PA intensities with the identified mental health profiles, it was found that individuals in the high mental health profile participated in more mild PA and less MVPA compared to students in the moderate and low mental health profiles, though not significantly. This suggests that mild PA might be the most effective intensity in supporting mental health, though further research is required to confirm.

Disclosures and Declarations

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Appendix

Mplus Syntax

```
TITLE:      MH Profiles and PA;
DATA:       File is 'C:/Users/Taylor/Desktop/MPLUS3.dat';
VARIABLE:
NAMES ARE MILD_MIN MVPA RESILIENCE
EMO SOCIAL PSYCH;
MISSING ARE ALL (-999);
USEVARIABLES ARE EMO SOCIAL PSYCH RESILIENCE MILD_MIN;
CLASSES c(3);
AUXILIARY = MILD_MIN (BCH)
ANALYSIS:
TYPE = MIXTURE;
OUTPUT:
TECH1 TECH8 TECH11 TECH14;
SAVEDATA: FILE IS mhprofiles.csv;
FORMAT IS FREE;
SAVE = CPROBABILITIES;
```

Table 1. Participant characteristics (total sample).

Characteristic	Total Sample (N= 130)
Age, years	
Mean (SD)	24.8 (4.3)
Range	19 – 42
Gender, n (%)	
Male	53 (41)
Female	72 (55)
Other	1 (1)
Non-response	4 (3)
Ethnicity, n (%)	
White	73 (56)
Hispanic	1 (1)
Aboriginal Canadian	1 (1)
Black or African	4 (3)
Asian	32 (24)
Other	14 (11)
Non-response	5 (4)
University, n (%)	
McGill University	83 (64)
Queen's University	47 (36)
Year of Medical School, n (%)	
1st	65 (50)
2nd	30 (23)
3rd	19 (15)
4th	16 (12)
Physical Activity Minutes/Week, Mean (SD)	
Mild	131.26 (109.8)
Moderate	90.76 (74.5)
Vigorous	123.63 (111.8)
MVPA	213.55 (136.3)
Total	368.90 (218.9)
Well-Being, Mean (SD)	
Emotional	11.88 (2.5)
Social	16.22 (4.9)
Psychological	22.54 (5.0)
Resilience, Mean (SD)	6.19 (1.3)

Note. Maximum possible score of emotional well-being = 15; social well-being = 25; psychological well-being = 30; resilience = 8.

Table 2. Model fit statistics, profile distribution and classification probabilities.

	Fit Statistics			Classification Probabilities and Profile Distributions (*n*)							
Model	**AIC**	**BIC**	**ABIC**	**Profile 1**	***n (%)***	**Profile 2**	***n (%)***	**Profile 3**	***n (%)***	**Profile 4**	***n (%)***
Two-Profile	2435	2472	2431	0.983	101 (80)	0.900	25 (20)	-		-	
Three-Profile	2385	2436	2379	0.950	18 (14)	0.932	72 (57)	0.871	36 (29)	-	
Four-Profile	2365	2430	2357	0.880	20 (16)	0.916	67 (53)	0.971	7 (6)	0.907	32 (25)

Note. Classification probabilities are the probability that an individual belongs to the assigned profile and no other profile.

Table 3. Latent profile analysis with continuous latent profile indicators using automatic starting values with random starts (*N* = 126).

Means and standard errors associated with profile membership					
	n	**Emotional Well-being**	**Social Well-being**	**Psychological Well-being**	**Resilience**
Profile 1 (low)	18	7.80 (0.98)	10.98 (1.35)	13.77 (1.59)	4.88 (0.32)
Profile 2 (moderate)	72	11.83 (0.34)	14.98 (0.74)	22.13 (0.77)	6.19 (0.19)
Profile 3 (high)	36	13.88 (0.38)	21.03 (0.90)	27.40 (0.73)	6.80 (0.25)

Note. Maximum possible score of emotional well-being = 15; social well-being = 25; psychological well-being = 30; resilience = 8.

Table 4. Participant characteristics, according to profile membership.

Characteristic	**Profile 1 (*n* = 18)**	**Profile 2 (*n* = 72)**	**Profile 3 (*n* = 36)**
Age, years			
Mean (SD)	26.3 (5.14)	24.4 (4.14)	25.1 (3.93)
Range	21 – 42	19 – 40	20 – 37
Gender, n (%)			
Male	7 (39)	31 (43)	15 (42)
Female	10 (56)	41 (57)	21 (58)
Other	1 (5)	0	0
Ethnicity, n (%)			
White	8 (44)	42 (58)	23 (64)
Hispanic	0	1 (2)	0
Aboriginal Canadian	0	1 (2)	0
Black or African	2 (11)	2 (3)	0
Asian	8 (44)	15 (21)	9 (25)
Other	0	11 (14)	3 (8)
Non-Response	0	0	1 (3)
University, n (%)			
McGill University	14 (78)	45 (63)	20 (56)
Queen's University	4 (22)	27(37)	16 (44)
Year of Medical School, n (%)			
1st	9 (50)	37 (51)	15 (42)
2nd	5 (28)	15 (21)	10 (28)
3rd	4 (22)	13 (18)	2 (5)
4th	0	7 (10)	9 (25)

Table 5. Differences in PA intensities across profiles using BCH method with 2 degrees of freedom for the overall test.

	Mean	**S.E.**
Mild Physical Activity (minutes/week)		
Profile 1 (low)	128.10	27.84
Profile 2 (moderate)	126.18	14.31
Profile 3 (high)	144.28	22.12
	Chi-Square	**P-Value**
Overall Test	0.43	0.81
Profile 1 vs. Profile 2	0.004	0.95
Profile 1 vs. Profile 3	0.21	0.65
Profile 2 vs. Profile 3	0.41	0.52
MVPA (minutes/week)	**Mean**	**S.E.**
Profile 1	220.86	38.82
Profile 2	224.14	17.93
Profile 3	195.86	25.67
	Chi-Square	**P-Value**
Overall Test	0.74	0.69
Profile 1 vs. Profile 2	0.006	0.94
Profile 1 vs. Profile 3	0.29	0.59
Profile 2 vs. Profile 3	0.70	0.40

CHAPTER FOUR: ARTICLE TWO, STUDY ONE

Canadian Medical Students' Perceived Motivation, Confidence and Frequency Recommending Physical Activity

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Abstract

Despite the evidence supporting the benefits of physical activity in the prevention and treatment of most medical conditions, physical activity remains under-prescribed by physicians. Medical students will form habits during training that they are likely to maintain as future physicians. The overall purpose of this study was to investigate the underlying mechanism(s) contributing to frequency in recommending physical activity, to provide insight into how we can increase physical activity recommendations in future practice as physicians. First to fourth year medical students at three Canadian universities responded to an online survey (N = 221; 12% response rate) between November 2017 and January 2018. Results revealed that engaging in strenuous physical activity was a strong predictor for frequency in recommending physical activity to patients ($p < .001$). Confidence in recommending physical activity mediated the relationship between strenuous physical activity and frequency recommending physical activity ($p = 0.005$); motivation did not mediate this relationship. Students were more motivated, than they were confident, to assess, advise, counsel, prescribe and refer patients regarding physical activity ($p < .05$). While 70% of students stated they are aware of the Canadian physical activity guidelines, only 52% accurately recalled them. Findings suggest that increased training related to physical activity should be included in the medical school curriculum to increase students' confidence to recommend physical activity. Another way to increase confidence and frequency in recommending physical activity is to help students engage in more strenuous physical activity themselves, which will ultimately benefit both medical students and their future patients.

Keywords: preventive medicine; medical students; physical activity prescription

Introduction

The physical and mental health benefits associated with physical activity (PA) have long been established [Public Health Agency of Canada (PHAC), 2018; Ravindran et al., 2016; Schuch et al., 2016]. Unfortunately, only 20% of Canadians are accumulating enough PA to reap these health benefits (Statistics Canada, 2015). This is concerning as physical inactivity increases the risk of poor overall health and many of the most expensive chronic illnesses (González et al., 2017; Pedersen and Saltin, 2015). This has placed an ever-increasing strain on the healthcare system with an estimated total cost of 6.8 billion Canadian dollars per year (Janssen, 2012). Despite the strong evidence supporting the use of PA in the prevention and treatment of chronic disease, it remains under prescribed by physicians (Baillot et al., 2018; Bélanger et al., 2017; Hoffmann et al., 2016). Given that physicians are often a preferred source of health information and 80% of Canadians visit a physician every year, they have a unique opportunity to influence a large portion of the population (Canadian Medical Association, 2015; Thornton et al., 2016; Tulloch et al., 2006). As future physicians, it is critical to understand what factors determine a medical students' frequency recommending PA in order to work towards reducing physical inactivity among the population.

There are many levels of actions that can be taken by a physician to promote PA, not just prescription. For example, the 5 A's model includes recommendations for physicians to: Ask (identify current PA behaviour), Advise (recommend that the patient would benefit from increased PA), Assess (determine a patients' readiness to change current PA), Assist (develop goals and/or an action plan to increase PA) and Arrange (establish a follow-up to track progress; Carroll et al., 2011). Referral to an exercise specialist (e.g., registered Kinesiologist) is a different action that has shown to improve patients' PA levels (Baillot et al., 2018; Fortier et al.,

2006; Sørensen et al., 2008). However, previous research focuses primarily on PA prescription and/or PA counselling, with other actions being largely under investigated. The present study will address this gap by examining five different actions (modified from the 5 A's model) that can be taken to increase a patients' level of PA including: assess, advise, counsel, prescribe, and refer. These five actions are hereafter collectively termed ‘PA recommendations’. The present study will also consider the factors contributing to the frequency of performing these actions.

One potential factor contributing to the lack of PA prescription in practice is inadequate training during medical school and residency (Hoffmann et al., 2016; Holtz et al., 2013; Solmundson et al., 2016; Stoutenberg et al., 2015). For instance, Holtz and colleagues (2013) found that 69% of medical students viewed exercise counselling as highly relevant, but 86% indicated that their training was less than extensive. Inadequate PA training in medical school may result in a reduced likelihood to promote PA to patients.

Prior work has determined that physicians' PA recommendation practices often align with their own activity habits, such that more-active medical professionals are more likely to counsel patients on PA (Frank et al., 2008; Holtz et al., 2013; Lobelo et al., 2008; Lobelo and de Quevedo, 2016; Ng and Irwin, 2013). As future physicians, Frank et al. surveyed U.S. medical students three separate times over their four years of medical school ($N = 971$ for full cohort) (Frank et al., 2008). Results revealed a significant association between frequency of providing physical activity counselling to patients and whether a student complied with exercise recommendations. Patients are also more likely to adhere to PA recommendations from their physician when the practitioner themselves is active, as they are perceived to be a more credible and motivating role model (Frank et al., 2013). As future physicians, Holtz and colleagues (Holtz et al., 2013) surveyed Canadian medical students ($N = 546$ in British Columbia) and results

showed that students who perceived exercise counselling to be highly relevant, engaged in significantly more strenuous PA compared to those who perceived it to be somewhat or not at all relevant. Distinguishing PA intensities has become a recent trend in the literature (Helgadottir et al., 2016; Panza et al., 2017; Richards et al., 2015). As such, the present study will consider how mild, moderate and strenuous PA relate to medical students' frequency in recommending PA, which has not been done previously. Although there is evidence supporting that active medical students are more likely to perceive counselling on PA as highly relevant, and that active students discuss PA more frequently with their patients, we do not specifically know why.

Several frameworks underpinning human behaviour (e.g., Motivational Interviewing, Theory of Planned Behaviour), include motivation and confidence as consistent predictors of behaviour (Dixon, 2008). While low confidence has been found to be a barrier to the delivery of PA counselling and prescription in primary care (Baillot et al., 2018; Fowles et al., 2018; Hébert et al., 2012), motivation has been overlooked. For instance, Fowles et al. (2018) evaluated the impact of a training workshop on several different PA actions. The workshop led to increased confidence and frequency to prescribe PA; however, the influence of motivation on frequency was not examined. This knowledge gap could be filled by understanding the differences between motivation and confidence to recommend PA, and how they might predict frequency recommending PA differently. Understanding these differences will help inform future efforts aimed at increasing PA promotion in future practice. For example, if medical students lack both motivation and confidence, it will be important to teach them the importance of PA as preventive and therapeutic medicine and how to promote behavioural changes among patients. However, if students are motivated but lack confidence, future efforts may focus less on why it is important, and more on how to do it.

The overall purpose of the present study is to investigate the underlying mechanism(s) contributing to frequency in recommending physical activity, to provide further insight into how we can increase physical activity recommendations in future practice as physicians. The specific research questions are:

1. a. What is the relationship between PA participation and frequency recommending PA?
   b. What are the direct relationships between motivation recommending PA and frequency recommending PA, and between confidence recommending PA and frequency recommending PA?
   c. Does motivation and/or confidence recommending PA mediate the relationship between PA participation and frequency recommending PA?
2. Are there differences between medical students' motivation and confidence to recommend PA?

   Lastly, as an exploratory research question:

3. a. What percent of medical students are aware of the Canadian Physical Activity Guidelines?
   b. What percent of medical students accurately recall the Canadian Physical Activity Guidelines?

Methods

Participants and Procedure

Research ethics approval was obtained from three Canadian medical schools. While the length of medical school varies internationally, the Canadian structure typically involves a four-year program. As such, electronic surveys were distributed amongst first to fourth year medical students over three months. The survey link was distributed to students via e-newsletters,

Facebook posts, and announcements in mandatory class. Two reminders were sent. A total of 221 medical students responded, out of a possible 1810 (12% response rate). This response rate is typical of online surveys conducted by external researchers (Fryrear, 2015) and comparable to a recent survey involving medical students (Matthew Hughes et al., 2017).

Measures

Demographics. Students reported their gender, age, ethnicity, academic background, year in medical school, and university of enrollment.

Physical Activity. The Godin Leisure-Time Exercise Questionnaire (LTEQ; Godin and Shepard, 1985) is a valid and reliable scale, used frequently (Joseph et al., 2014). This scale asks on average how many times a week an individual engages in strenuous, moderate and mild exercise. Scores for each intensity are calculated by multiplying strenuous activity by 9, moderate by 5, and mild by 3. A score for each intensity was generated, as well as a total PA score by summing the products of all three intensities. Students were asked about the average minutes per activity session. From this, total minutes of strenuous and moderate PA/week was calculated to determine whether the student was meeting the Canadian Physical Activity Guidelines[1] (hereafter referred to as 'PA guidelines').

Physical Activity Recommendations. The 5 A's model was modified to measure five actions that can be taken to promote PA (i.e., assess, advise, counsel, prescribe, refer). The modification was necessary for relevancy to clinical settings, and similar actions related to promoting physical activity have been used previously in primary care research (e.g., Fowles et al., 2018).

[1] Canadian physical activity guidelines recommend adults accumulate 150 minutes of moderate- to vigorous- PA per week. Throughout this paper the term strenuous is used to describe vigorous physical activity, for consistency with the language used in the LTEQ.

Motivation. Students were asked "How motivated are you to…" 1) assess a patient's level of PA; 2) advise a patient to increase their PA levels; 3) counsel a patient about PA; 4) provide a patient with a PA prescription; 5) provide a patient with a referral to an exercise specialist. Response options included a 5-point Likert scale, ranging from 0 = "not at all motivated" to 4 = "very motivated".

Confidence. Students were asked "How confident are you to…" 1) assess a patient's level of PA; 2) advise a patient to increase their PA levels; 3) counsel a patient about PA; 4) provide a patient with a PA prescription; 5) provide a patient with a referral to an exercise specialist. Students rated their confidence using a 5-point Likert scale, ranging from 0 = "not at all confident" to 4 = "very confident".

Frequency. Students were asked "How frequently do you …" 1) assess a patient's level of PA; 2) advise a patient to increase their PA levels; 3) counsel a patient about PA; 4) provide a patient with a PA prescription; 5) provide a patient with a referral to an exercise specialist. Students rated their frequency with a 7-point scale (0 = "never" to 6 = "always").

Students in all years were asked about motivation and confidence; only third and fourth year students were asked about frequency given that these years represent the core clinical clerkship years. Individual scores and total scores (summation of all five actions) of motivation, confidence and frequency were calculated. This framework has been used in previous research measuring PA counselling in primary care (Carroll et al., 2011).

Knowledge of Physical Activity Guidelines. Students were asked if they were aware of the PA guidelines (yes/no). If they indicated yes, they were asked "According to the Canadian Physical Activity Guidelines, how many minutes per week of moderate- to vigorous- intensity

PA is recommended for adults aged 18-64?" Students responded using an interactive slider ranging from 0 – 200 (minutes per week).

Statistical Analyses

To address research question 1a, correlation and hierarchal multiple regression analysis were run in SPSS version 25 (IBM, 2017). Preliminary analyses checked for violations of assumptions. For the regression analysis, the independent variables were age, ethnicity, gender, year, university and strenuous physical activity and the dependent variable was total frequency recommending physical activity. Categorical variables were dummy coded. Age, ethnicity, gender, year, and university were entered simultaneously into the regression at step 1, followed by strenuous physical activity at step 2. To address research question 1b three separate two-factor models were tested using path analysis. Strenuous physical activity, total motivation to recommend physical activity and total confidence recommending physical activity were the independent variables, and total frequency recommending physical activity was the dependent variable in all three models (Figure 1). These direct pathways needed to be significant to proceed with research question 1c, testing indirect relationships. To address research question 1c, two separate three-factor models were tested using path analysis. Both models included strenuous physical activity as the independent variable and total frequency recommending physical activity as the dependent variable. Total motivation to recommend physical activity and total confidence recommending physical activity were tested as mediators. Additionally, a bootstrap method was used to determine mediation in SPSS AMOS. Bootstrap selection was set at 1000 samples and bias corrected-confidence level set at 95% (Cheung and Lau, 2008; IBM, 2018). Pertaining to the second research question, five paired-samples t-tests were used to assess for differences in motivation and confidence to assess, advise, counsel, prescribe and refer. Preliminary analyses

ensured that all assumptions were met, including the additional assumption that the difference between motivation and confidence scores for each participant were normally distributed. A Bonferroni adjustment was applied for multiple comparisons ($p < .01$). Effect sizes (d) were calculated and interpreted using Cohen's cut-points: 0.2 (small), 0.5 (medium), 0.8 (large; Cohen, 1988). Descriptive statistics were generated to address research question 3.

Results

Participant Characteristics

Table 1 provides demographic information for all participants included in this study. Participants ranged from 19 to 46 years old ($M = 24.7$, $SD = 3.91$) and the majority were female (61%). Regarding knowledge of PA guidelines, 70% of students indicated "yes" to being aware of them ($n = 155$). However, over a quarter inaccurately recalled the guidelines, indicating a number other than 150 minutes of MVPA/ week ($n = 39$). This means that only 52% of students actually knew the PA guidelines ($n = 116$); that is, they answered "yes" to the first question and "150 minutes" to the follow-up question. Among those who were aware and accurately recalled the PA guidelines, 21 had completed a Kinesiology degree and 7 of them a Physiotherapy degree. In contrast, among those who were not aware or who inaccurately recalled the PA guidelines, only 5 of them indicated completing a Kinesiology degree and 2 of them a degree in Physiotherapy.

Relationship Between PA Participation and Frequency Recommending PA

Pearson correlation analyses revealed that strenuous PA was significantly associated with the frequency of assessing, advising, counselling, and prescribing PA to patients, as well as total frequency recommending PA. Table 2 provides information on all of the observed associations.

Hierarchal multiple regression assessed the relationship between PA on total frequency recommending PA (summation of all five actions)[2], after controlling for age, ethnicity, gender, year, and university. Originally, the regression model was to include all three PA intensities as predictor variables, however there was a high correlation (>.70) between these three variables, violating the assumption of multicollinearity. Given that strenuous PA had the strongest, significant correlation with total frequency recommending PA, it was included in the regression analyses. Demographic variables were entered at Step 1, explaining 19% of the variance in total frequency recommending PA. After entering strenuous PA at Step 2, the total variance explained by the model as a whole was 32%, F (6, 60) = 4.74, p = .001. Strenuous PA explained an additional 13% of the variance in frequency after controlling for demographics, R squared change = 0.13, F change (1, 60) = 11.89, p = .001. In the final model, year (β = .42, p = .001) and strenuous PA (β = .37, p = .001) made a statistically significant contribution (Table 3). In line with this, a secondary analysis revealed a significant difference in frequency scores, whereby medical students who engaged in ≥ 150 minutes of MVPA/ week recommended PA more frequently (M = 11.9; SD= 4.2) than students who did not meet the PA guidelines, M = 7.8; SD = 3.9; t (65) = -4.02, p < .001. The magnitude of the difference was large (eta squared = .20).

Motivation and Confidence as Mediators

First, three separate 2-factor path models were tested in AMOS to investigate direct relationships between variables, and results revealed significant, positive standardized regression coefficients for all models (p < .05; Figure 1). The strongest relationship was between confidence

[2] Total frequency recommending physical activity was used as the dependent variable for regression and path analyses. These analyses were also run individually for all five actions (frequency to assess, advise, counsel, prescribe, refer), but due to length restrictions and similar significant results being found for all five actions, total frequency recommending physical activity results are reported.

recommending PA and frequency recommending PA (r = 0.46, p < .001), whereby greater confidence was associated with a higher frequency in recommending PA.

Next, two separate 3-factor path models were tested in AMOS using bootstrapping to test potential mediators (i.e., confidence and motivation) for the indirect effect of strenuous PA on frequency recommending PA. The standardized regression coefficient between strenuous PA and confidence recommending PA was significant (r = 0.29), as was the coefficient between confidence recommending PA and frequency recommending PA (r = 0.37; Figure 2). Bootstrapping results revealed a significant indirect effect of strenuous PA on frequency recommending PA, through confidence recommending PA (r = 0.33, p = 0.005, 95% CI: .024 ~ .243).

Although the effect of strenuous PA on frequency recommending PA remained significant after controlling for confidence recommending PA in the 3-factor model (r = 0.33, p = .002; Figure 2), the effect was reduced compared to the 2-factor model including only strenuous PA and frequency recommending PA (r = 0.44, p <.001; Figure 1). These results support partial mediation. That is, students who engaged in strenuous PA reported an increased confidence recommending PA, which corresponded to an increased frequency recommending PA. Bootstrapping results testing motivation to recommend PA as a mediator for the indirect effect of strenuous PA on frequency recommending PA were not significant (r = 0.39; p = .16, 95% CI: -.008 ~ .148).

Differences in Motivation and Confidence to Recommend PA

Results of paired-samples t-tests revealed that students reported significantly greater motivation, compared to confidence, for all five actions (Table 4). Effect sizes were large (d > 0.80). Students reported the greatest motivation to advise a patient to meet the PA guidelines, and the

lowest motivation to assess a patient's level of PA. Students reported the greatest confidence to advise, and the lowest confidence to prescribe PA.

Discussion

Results from this study provide further insight into how we can increase PA recommendations, as an important preventive and therapeutic strategy for several chronic illnesses. It is important to understand these mechanisms, and guide medical students to form positive, evidence-based habits during training that they will carry with them throughout their careers. However, interpretation of these findings should be taken with caution, due to the low response rate. As it relates to medical students' own PA behaviours, results revealed that strenuous PA was a significant predictor of frequency recommending PA. This is consistent with previous work which found a relationship between engaging in strenuous PA and perceiving exercise counselling to be highly relevant (Holtz et al., 2013). It is possible that those who engage in more strenuous types of PA experience health benefits in themselves, making them more likely to recommend PA to their patients. The concept of exercise identity (i.e., defining oneself as an 'exerciser'; Burke and Stets, 2013) provides another possible explanation for the relationship between engaging in strenuous PA and frequency recommending PA. Previous research has suggested that individuals who engage in more PA (i.e., frequency, duration, and intensity) have a stronger PA identity (Strachan and Whaley, 2013) and those who identify with PA are more likely to discuss activity pursuits with others (Perras et al., 2016). Taken together, it is possible that medical students who engage in strenuous PA, have a strong PA identity, resulting in more frequent discussions related to PA with patients.

Next, several models were tested to explore direct and indirect relationships between the dependent variables and frequency recommending PA. Results revealed that motivation and

confidence were both positively related to frequency recommending PA; however, only confidence significantly mediated the relationship between strenuous PA and frequency recommending PA. While previous research has shown a direct relationship between a provider's own activity levels and their confidence in counselling (Howe et al., 2010) and between a provider's own activity levels and frequency of counselling (Frank et al., 2000), this is the first study to our knowledge to consider confidence as a mediator in the relationship between activity levels and frequency in recommending PA.

These results show that one potential way to increase confidence levels, and in doing so, frequency in recommending PA, is to help medical students engage in PA themselves. Ultimately, this will benefit both medical students' own health, and increase their confidence and frequency in recommending PA to the general population. Future research should implement PA interventions tailored specifically for medical students. Moreover, universities should consider ways to promote PA among students, such as offering free classes over lunch (e.g., yoga, martial arts, running group) and/or providing students access to a PA counsellor.

The second research question investigated whether there are differences in medical students' motivation and confidence to recommend PA. Results revealed that medical students are significantly more motivated than they are confident for all five actions. This lack of confidence is likely due to inadequate training on how to promote PA to specific patients, including those who are healthy and those with multiple comorbidities. Low level of confidence to counsel and prescribe PA has been found previously among medical professionals, despite their perception that PA is important (Solmundson et al., 2016; Howe et al., 2010; Kennedy and Meeuwisse, 2003; Rogers et al., 2006). Fowles et al. (2018) provide support for a training workshop to increase confidence and frequency recommending PA. However, this is the first

study to compare motivation and confidence to recommend PA, and how they might predict frequency recommending PA differently. Regarding motivation, results of this study showed that medical students had high levels of motivation for all five actions related to recommending PA. This is encouraging, as it suggests that students want to do it and that they see the value in it, but they lack the confidence to do so.

Descriptive statistics were generated to answer the third research question, which sought to determine what percent of medical students are aware of the PA guidelines and what percent can accurately recall them. Results revealed that only 52% of students in this study were aware of and accurately able to recall the PA guidelines (18% inaccurately recalled the guidelines, 30% stated they did not know them). This low level of knowledge related to PA guidelines has been found previously (Douglas et al., 2006), and is not overly surprising, as previous research has suggested that there is a lack of training related to PA in the Canadian medical school curriculum (Holtz et al., 2013).

Taken together, the lack of knowledge related to the PA guidelines, and the low confidence to recommend PA to patients, shows that there is insufficient exposure to PA training in medical school. The medical school curriculum should incorporate training related to PA as preventive and therapeutic medicine, including information on the PA guidelines. Although significant strides have been made to do so, including a motion to include PA education in Canadian medical schools proposed by Dr. Jane Thornton and passed at CMA's 2016 General Council (Canadian Medical Association, 2016), these proposed changes have yet to be formally implemented into the medical curriculum.

Study Strengths and Limitations

There were several strengths associated with this study. First, the sample included in this study is generally representative of the Canadian medical school population. Indeed, data from the Association of Faculties of Medicine of Canada show that in 2016/17 first year medical students were predominantly female (58%) and between the ages of 20-25 (The Association of Faculties of Medicine of Canada, 2017). Second, previous research has not investigated the mediating role of motivation and confidence in recommending PA in the relationship between PA participation and frequency recommending PA. It is important to understand the mechanisms contributing to frequency to promote PA recommendations with patients and work towards improving the overall health of the population. Third, previous research has focused solely on PA prescription and/or counselling among medical professionals, neglecting other actions that can be taken to promote PA with patients. This study included five different levels of action related to PA, for a more comprehensive understanding of medical student's confidence, motivation and frequency in recommending PA. Finally, this study focused on medical students specifically, which is important because learners have shown to be more open to learning new strategies and changing their behaviour, compared to practicing physicians (Solmundson et al., 2016).

There were also some limitations that should be considered. For instance, there was a low response rate and relatively fewer third and fourth year students completed the survey, compared to first and second. This may speak to the increased time demands that clerkship students face. This limited the sample size for the path analyses, as only third and fourth year students were asked about frequency. Future research should use additional recruitment methods, and should target third and fourth year students specifically (e.g., announcements and/or advertisements in hospitals). Another limitation is self-report measures and using recall to assess frequency

recommending physical activity, which may result in bias. Future research should consider using accelerometers to track PA and review electronic medical records to measure frequency recommending PA. Finally, there may have been self-selection bias in this study, whereby students who are interested in the promotion of PA responded to the survey. This may have resulted in an over-estimation of motivation, confidence and frequency recommending PA, as well as increased awareness of the PA guidelines in our sample.

Conclusion

Overall, results of this study show that medical students are highly motivated to recommend PA, but often lack the knowledge and confidence necessary to assess, advise, counsel, prescribe and refer. This highlights the need for increased training related to PA as preventive and therapeutic medicine in medical school so that students gain positive, evidence-based habits moving forward in their career. Increased training may correspond to an increased confidence, and thus frequency recommending PA in future medical practice. Another way to increase confidence and frequency is to encourage students to engage in more strenuous PA themselves, which will ultimately benefit both medical students and their future patients.

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Table 1. Demographic information of medical student participants.

Characteristic	**Total Sample (N= 221)**
Age, years	
Mean (SD)	24.7 (3.9)
Range	19-46
Gender, n (%)	
Male	70 (31)
Female	135 (61)
Other	1 (1)
Non-response	15 (7)
Ethnicity, n (%)	
White	133 (60)
Hispanic	1 (1)
Aboriginal Canadian	2 (1)
Black or African	5 (2)
Asian	41 (19)
Other	16 (7)
Non-response	23 (10)
University, n (%)	
University of Ottawa	84 (38)
McGill University	89 (40)
Queen's University	48 (22)
Year of Medical School, n (%)	
1st	91 (41)
2nd	54 (24)
3rd	31 (14)
4th	37 (17)
Non-response	8 (4)
Academic Background, n	
General Sciences	108
Health Sciences	73
Social Sciences	13
Kinesiology	26
Physiotherapy	9
Other	33
Non-response	12
Physical Activity Guidelines, n (%)	
Meeting Physical Activity Guidelines	137 (62)
Not Meeting Physical Activity Guidelines	72 (33)
Non-response	12 (5)
Physical Activity Scores, Mean (SD)	
Mild Physical Activity	16.0 (19.2)
Moderate Physical Activity	20.5 (52.6)
Strenuous Physical Activity	25.2 (39.4)
Total Physical Activity	61.7 (105.3)
Frequency Recommending Physical Activity, Mean (SD)	
Assess	2.40 (1.24)
Advise	2.61 (1.37)

Counsel	2.70 (1.19)
Prescribe	1.36 (1.14)
Refer	1.48 (1.32)
Total	10.40 (4.53)
Motivation to Recommend Physical Activity, Mean (SD)	
Assess	2.91 (0.92)
Advise	3.16 (0.80)
Counsel	3.08 (0.83)
Prescribe	3.00 (0.98)
Refer	3.10 (0.92)
Total	15.24 (3.76)
Confidence to Recommend Physical Activity, Mean (SD)	
Assess	2.04 (1.03)
Advise	2.31 (0.97)
Counsel	2.12 (1.05)
Prescribe	1.67 (1.23)
Refer	1.93 (1.32)
Total	10.07 (4.61)

Note. Participants were able to select more than one option for academic background.
Note. Physical activity scores were assessed and calculated according to the LTEQ.
Note. Likert scale for frequency recommending physical activity: 0 = *never*, 1 = *very rarely*, 2 = *rarely*, 3 = *occasionally*, 4 = *frequently*, 5 = *very frequently*, 6 = *always*.
Note. Likert scale for motivation and confidence to recommend physical activity: 0 = *not at all*, 1 = *a little*, 2 = *somewhat*, 3 = *quite*, 4 = *very*.

Table 2. Pearson correlation between physical activity participation and frequency recommending physical activity (5 actions: assess, advise, counsel, prescribe, refer).

Scale	1	2	3	4	5	6	7	8	9	10
(1) Assess	-	.591**	.521**	.410**	.334**	.818**	.412**	.426**	.305*	.045
(2) Advise		-	.595**	.421**	.037	.763**	.308*	.338**	.130	.152
(3) Counsel			-	.404**	.063	.730**	.242	.293*	.043	.159
(4) Prescribe				-	.268*	.699**	.250*	.281*	.079	.153
(5) Refer					-	.494*	.124	.177	.104	-.103
(6) Total Frequency						-	.236	.346**	.027	.097
(7) Total PA score							-	.947**	.978**	.861**
(8) Strenuous PA								-	.881**	.726**
(9) Moderate PA									-	.815**
(10) Mild PA										-

Note. * Level of significance at $p < .05$; ** Level of significance at $p < .01$
Note. PA= physical activity

Table 3. Summary of hierarchal regression analyses assessing the ability of strenuous physical activity to predict frequency recommending physical activity, after controlling for gender, age, ethnicity, university and year.

	Independent Variable	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
Step 1	Gender	1.10	1.08	.12	1.02	.31
	Age	.02	.14	.02	.17	.87
	Ethnicity	-.001	.31	-.001	-.005	.99
	University	-.51	.46	-.13	-1.12	.27
	Year	1.64	.50	.41	3.27	.002
Step 2	Gender	.96	1.0	.10	.97	.34
	Age	.06	.13	.05	.44	.66
	Ethnicity	-.04	.28	-.02	-.14	.89
	University	-.61	.42	-.16	-1.45	.15
	Year	1.67	.46	.42	3.61	.001*
	Strenuous PA	.04	.01	.37	3.45	.001*

Note. *$p < .01$; PA = physical activity

Table 4. Differences in medical students' motivation and confidence to recommend physical activity (5 actions: assess, advise, counsel, prescribe, refer).

Dependent Variable	Independent Variables	n	Mean	Std. Dev.	95% Confidence Interval of the Difference		t	df	Sig.	Effect Size *d*
					Lower	Upper				
Assess	Motivation	212	2.91	0.92	-1.02	-.72	-11.37	211	.000*	.89
	Confidence	212	2.04	1.03						
Advise	Motivation	212	3.16	0.80	-.98	-.72	-12.92	211	.000*	.95
	Confidence	212	2.31	0.97						
Counsel	Motivation	212	3.08	0.83	-1.11	-.83	-13.46	211	.000*	1.01
	Confidence	212	2.12	1.05						
Prescribe	Motivation	210	3.00	0.98	-1.51	-1.14	-14.20	209	.000*	1.19
	Confidence	212	1.67	1.23						
Refer	Motivation	212	3.10	0.92	-1.34	-.99	-12.93	211	.000*	1.01
	Confidence	212	1.93	1.32						

Note. 0 = *not at all*, 1 = *a little*, 2 = s*omewhat*, 3 = *quite*, 4 = *very*
Note. *$p < .01$

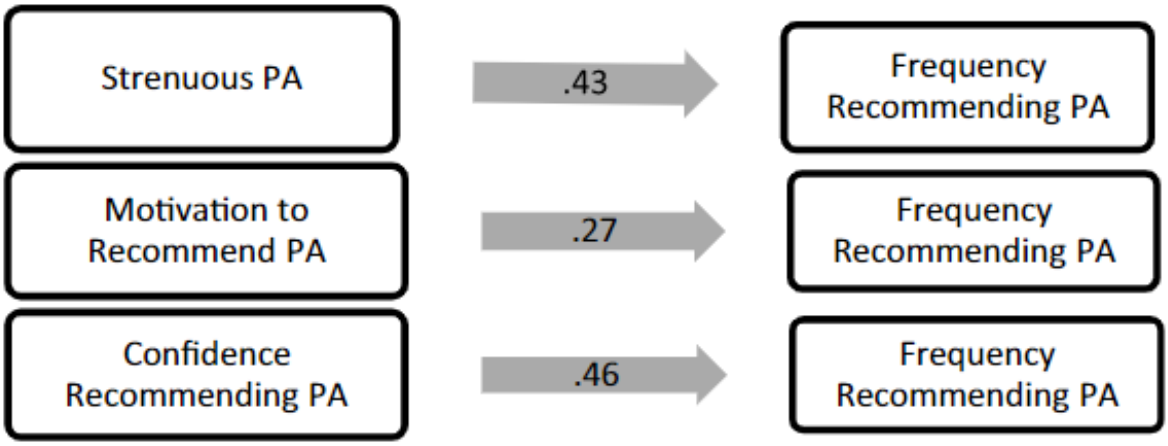

Figure 1.

Statistically significant direct pathways, as determined by path analysis.

Note: $p < .05$ in all three pathways; PA = physical activity.

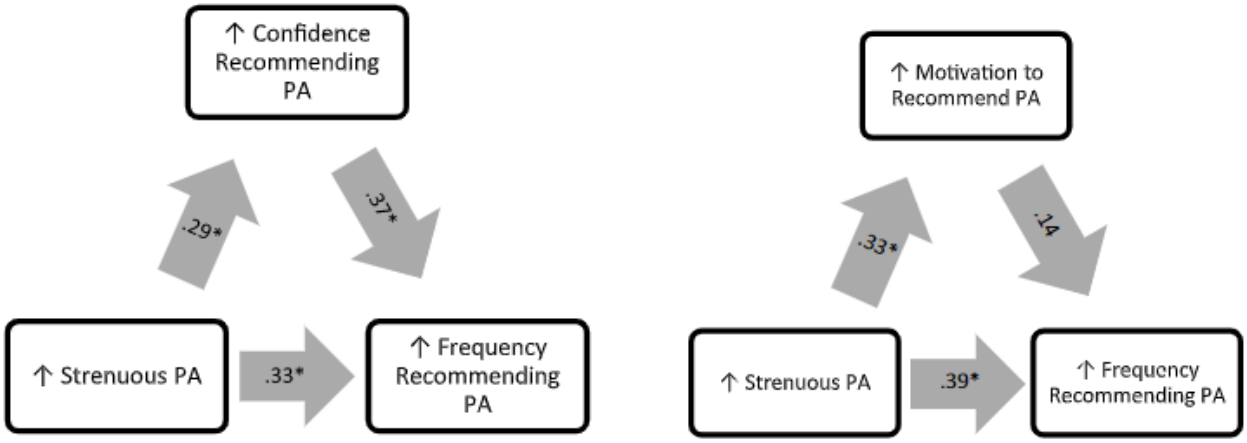

Figure 2.

Testing indirect pathways with path analysis and bootstrap approximation using two-sided bias corrected confidence intervals.

Note: * $p < .05$; PA = physical activity.

CHAPTER FIVE: ARTICLE THREE, STUDY ONE

Demographic Differences in Canadian Medical Students' Motivation and Confidence to Promote Physical Activity

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Abstract

Background. Physical activity (PA) remains under prescribed by physicians. Motivation and confidence are clear drivers of frequency of promoting physical activity. Research shows demographic differences in physicians' preventive practices, yet none have included medical students who form habits during training.

Objectives. Study objectives were to (1) Examine how Canadian medical students' motivation to recommend PA to future patients differs according to six demographic variables (i.e., gender, ethnicity, year of study, university, proposed specialty and academic background); and (2) Examine how Canadian medical students' confidence to recommend PA to future patients differs according to these same demographic variables.

Methods. A cross-sectional design was used. First to fourth year medical students from three medical schools responded to an online survey ($N = 221$).

Results. Female participants were more motivated to counsel patients on PA and refer to an exercise specialist compared to males ($p < .01$). Second year students were more motivated to assess a patients' level of PA compared to third and fourth year students ($p < .01$). Students pursuing family medicine were more confident to assess and counsel compared to students pursuing paediatrics ($p < .01$).

Conclusion. Given that motivation and confidence have a positive influence on frequency promoting PA, these results suggest where future efforts should focus, to improve PA promotion in medical practice. Physical inactivity continues to be a major issue worldwide, and medical students as future physicians have a unique opportunity to enhance PA amongst the population.

Keywords: behavioral medicine; gender; health promotion; physical activity/exercise; prevention; primary care

Introduction

Physical activity (PA) is beneficial for overall health and is a primary, secondary and tertiary prevention strategy for several chronic illnesses.[1-3] For instance, a meta-epidemiological study revealed that the mortality benefits of PA were similar and, in some cases, better than pharmaceuticals for the prevention and treatment of several diseases (e.g., stroke, heart failure and diabetes).[2] Unfortunately, 80% of Canadian adults are not meeting the recommended PA guidelines to achieve these benefits.[4] Physicians are in a privileged position to promote PA as they form therapeutic patient-physician relationships with a large segment of the population.[5,6] Physicians can engage in different actions to influence their patients' PA levels. They can assess a patient's level of PA, advise a patient to become more active, counsel a patient on how to increase PA, prescribe PA and refer patients to exercise specialists (five actions modified from the 5 A's framework: assess, advise, counsel, prescribe, refer).[7-9] Unfortunately, physicians seldom perform these actions.[7,8]

One potential reason for low frequency of promoting PA is inadequate training in medical school.[3,10,11] Preference is often afforded to other prevention and treatment strategies, which may lead medical students to perceive PA as less important, thereby contributing to low motivation for its promotion. Alternatively, perhaps medical students see the benefits in recommending PA and are motivated to do it, but lack the confidence due to inadequate training. Indeed, medical students consider PA counselling to be highly relevant but inadequately taught,[10,11] and indicate that they would like more training.[11] Taken together, motivation and confidence are clear predictors of behaviour, including the promotion of PA, [11,12] and better understanding these relationships may help to increase PA promotion in medical practice.

Demographic factors may also contribute to motivation and confidence to recommend PA. Previous research has found differences in the frequency of providing preventive care according to gender and specialty.[13-18] For example, females and internal medicine physicians are more likely to have positive beliefs about PA promotion, corresponding to an increased likelihood to deliver such care.[15] Similarly, a survey found that family physicians were more likely than obstetrician-gynecologists to provide PA counselling.[16]

Previous research has considered differences in preventive practices according to gender and specialty, with less focus on other demographic variables, warranting more research on this topic. Additionally, limited research in this area involves medical students, who are important to target as they form habits during training that may influence their future practice. Finally, studies have not considered the association between demographics, and individuals' motivation and confidence to recommend PA. As clear drivers of frequency, it is important to identify demographic differences, to help inform the design and implementation of targeted PA promotion interventions and educational efforts to incorporate PA training into the medical curriculum. Ultimately, these intervention and educational efforts may lead to increases in activity levels of the population at large.

The primary purpose of this article is to investigate demographic differences in medical students' motivation and confidence to recommend PA. Specific objectives are to: (1) Examine how Canadian medical students' motivation to recommend PA to future patients (i.e., assess, advise, counsel, prescribe, refer) differs according to six demographic variables (i.e., gender, ethnicity, year of study, university, proposed specialty and academic background); and (2) Examine how Canadian medical students' confidence to recommend PA to future patients (i.e., assess, advise, counsel, prescribe, refer) differs according to these same demographic variables.

Methods

Study Design

This study is a secondary analysis of data from a larger study looking at health behaviours and prescribing habits of medical students.[19] A cross-sectional design was used, whereby students responded to an online survey (November 2017 – January 2018). During this time, two reminders were sent.

Participants and Procedure

Canadian medical students in first to fourth year at the University of Ottawa (English and French streams), McGill University and Queen's University were eligible to participate in the study. Ethics and Faculty of Medicine approval were obtained. The survey link was distributed via announcements in mandatory classes, e-newsletters and Facebook groups. Out of 1810 medical students enrolled at these universities, N = 221 students provided informed consent and completed the survey (12% response rate). This is typical of large-scale medical student surveys,[20] although lower than the survey response rate of one Canadian medical student study.[11] Ages ranged from 19 – 46 years old (M = 25.0; SD = 3.9). Participant characteristics are provided in Table 1. With respect to the Canadian medical student population at large, national data indicates that in 2016/2017, first year Canadian medical students were between the ages of 20- 25.5 and 58% were female.[21]

Measures

Demographics. Age, gender, ethnicity, year of study, university, proposed specialty and academic background.

Five Actions to Promote PA. The 5 A's framework, which is rooted in behaviour change theory and used frequently in primary care research,[9] was modified for relevancy to

clinical practice. The five actions included in this study have been used in previous research investigating PA promotion by medical professionals and have been shown to effectively increase PA among patients.[22] Medical students were asked "How confident are you" and "How motivated are you" to : 1) assess a patient's level of PA with respect to the Canadian Physical Activity Guidelines; 2) advise a patient to meet the Canadian Physical Activity Guidelines; 3) counsel a patient about PA; 4) provide a patient with a written PA prescription; 5) provide a patient with a referral to an exercise specialist. Response options ranged from 0 = "not at all" to 4 = "very".

Data Analyses

Multivariate analysis of variance (MANOVA) was used to compare demographic differences in medical students' motivation and confidence to assess, advise, counsel, prescribe and refer. Multivariate tests, combining all dependent variables, were deemed significant at $p < .05$. Tests of between-subjects effects, considering the five dependent variables separately, were deemed significant using a Bonferroni adjustment ($p = 0.05/5 = 0.01$). Partial eta squared (η^2) effect size was used and interpreted using Cohen's (1988) criteria: small = 0.01; medium = 0.06; large = 0.138. When significant differences were found for demographic variables with ≥ 3 levels, one-way ANOVAs with *post hoc* comparisons were run. Before proceeding with MANOVA, assumptions were tested. When homogeneity of variance-covariance matrices was violated, Pillai's Trace was reported instead of Wilks' Lambda. Non-response data were excluded from the analyses.

Results

The average motivation for the entire sample to perform all five actions to promote PA (composite score, ranging from 0 to 4) was $M = 3.05$, $SD = 0.10$; average confidence was $M = 2.01$, $SD = 0.24$. See McFadden et al. (2019) for further details.[19]

Differences in Motivation

Results revealed a significant difference for gender on the combined dependent variables, F (5, 197) = 4.50, $p = 0.001$; Wilks' Lambda (λ) = 0.90; $\eta 2 = 0.10$. Female participants indicated being significantly more motivated to counsel [F (1, 201) = 9.07, $p = 0.003$; $\eta 2 = 0.04$], and refer [F (1, 201) = 5.93, $p = 0.01$; $\eta 2 = 0.029$], compared to males.

A significant difference was also found for year of study, F (15, 612) = 2.07, $p = 0.01$; Pillai's Trace = 2.07; $\eta 2 = 0.05$. Second year students were more motivated to assess PA [F (3, 206) = 4.23, $p = 0.006$; $\eta 2 = 0.06$] compared to third and fourth year students. First and second year students were also more motivated to refer [F (3, 206) = 6.31, $p < 0.001$; $\eta 2 = 0.08$] compared to fourth year students.

Finally, significant differences were found for academic background F (5, 172) = 2.05, $p = 0.03$; Pillai's Trace = 0.07; $\eta^2 = 0.07$. Students who completed a degree in kinesiology and/or physiotherapy reported greater motivation to assess [F (1, 176) = 11.12, $p = 0.001$; $\eta 2 = 0.06$], prescribe [F (1, 176) = 6.88, $p = 0.009$; $\eta 2 = 0.04$] and refer [F (1, 176) = 7.72, $p = 0.006$; $\eta 2 = 0.04$], compared to students who completed a degree in general, health and/or social sciences. There were no significant differences in motivation according to university, ethnicity or specialty (Table 2).

Differences in Confidence

Results revealed a significant difference in confidence according to university, F (15, 564) = 1.88, p = 0.02; Wilks' λ = 0.87; $\eta 2$ = 0.04. University of Ottawa (French) students were more confident to advise [F (3, 208) = 3.26, p = 0.02; $\eta 2$ = 0.05] compared to University of Ottawa (English) and McGill University students. University of Ottawa (French) students were also more confident to refer [F (3, 208) = 5.10, p = 0.002; $\eta 2$ = 0.07] compared to McGill, Queen's and University of Ottawa (English) students.

Differences in confidence were found for specialty, F (20, 654) = 1.62, p = 0.04; Wilks' λ = 0.85; η^2 = 0.04. Students pursuing family medicine, were more confident to assess [F (4, 201) = 3.61, p = 0.007; $\eta 2$ = 0.07] compared to students pursuing internal medicine and paediatrics, and more confident to counsel [F (4, 201) = 3.63, p = 0.007; $\eta 2$ = 0.07] compared to students pursuing paediatrics.

Lastly, differences in confidence according to academic background were found F (5, 173) = 10.59, $p < 0.001$; Pillai's Trace = 0.23; η^2 = 0.23, for all five PA promotion actions. Students who completed a degree in kinesiology and/or physiotherapy were more confident to assess [F (1, 177) = 37.74, $p < 0.001$; $\eta 2$ = 0.18], advise [F (1, 177) = 21.17, $p < 0.001$; $\eta 2$ = 0.11], counsel [F (1, 177) = 24.02, $p < 0.001$; $\eta 2$ = 0.12], prescribe [F (1, 177) = 39.25, $p < 0.001$; $\eta 2$ = 0.18] and refer [F (1, 177) = 24.62, $p < 0.001$; $\eta 2$ = 0.12] compared to those who completed a degree in general, health and/or social sciences. There were no differences in confidence, according to gender, year of study or ethnicity (Table 3).

Discussion

This study revealed significant demographic differences in medical students' motivation and confidence to recommend PA. Regarding motivation, females were more motivated to counsel

and provide a referral compared to males. This is in line with previous work showing that female physicians are more prevention-oriented compared to males.[15,18,23] For instance, a national survey of Canadian physicians (n = 3213) found that women were significantly more likely to counsel patients on PA, compared to men.[18] Moreover, some studies have reported that female physicians are more knowledgeable about PA guidelines compared to male physicians,[24] which may contribute to their increased motivation to provide counselling. In line with this, the larger component of the present study considered medical student knowledge of the Canadian PA Guidelines; among those who were able to accurately recall the guidelines, over 75% were female.[19] This suggests that it might be important to provide male students with additional support, such as offering online modules focusing on the benefits of PA for preventive and therapeutic medicine, to increase motivation to promote PA.

Considering year of study, second year students were significantly more motivated to assess, compared to third and fourth years, and first and second year students were significantly more motivated to refer, compared to fourth year students. Students are exposed to many different treatment options throughout medical school, and inadequate training dedicated to PA promotion[8] may result in the perception that PA is less important than other strategies, contributing to decreased motivation over time. Another potential reason could be that third and fourth year students have experienced patient-provider interactions and realize how challenging it is to get patients to comply with their recommendations. Research shows that there is a lack of patient adherence to lifestyle recommendations,[25] with less than 10% compliance in some cases.[26] General practitioners report feeling discouraged when their patients are non-compliant,[27] likely contributing to a lack of motivation.

Additionally, students in clerkship may be realizing the limited time they have to promote PA. Students in first and second year may not have experienced challenges with adherence and time pressures, potentially making them more motivated to promote PA. Educating medical students on how to counsel patients on PA in a time-efficient manner, including the use of motivational interviewing (MI) and behaviour change techniques,[28] may make them more motivated to counsel patients and may lead to better adherence outcomes. It may be important to harness this early motivation by providing PA education during first and second years, which may lead to greater motivation in clerkship years. This could involve educating students on the benefits of PA for a variety of chronic conditions, providing them with a simple and efficient protocol on how to recommend PA to patients and having students practice with peers using mock scenarios during class. Additionally, during third and fourth year when motivation is lowest, students could be provided exercise prescription pads[29] as a reminder to incorporate PA into their practice.

Students who completed a degree in kinesiology and/or physiotherapy were significantly more motivated to assess, prescribe and refer compared to those who completed a degree in general, health and/or social sciences. They were also more confident to perform all five PA promotion actions. This is in line with the educational focus of kinesiology and physiotherapy programs on PA for prevention and treatment of chronic illnesses, which likely contributes to increased motivation and confidence. There are a growing number of PA counselling classes offered to Kinesiology students with focused instruction on the five PA promotion actions. Kinesiology and physiotherapy students would also know the scope of practice of certified exercise professionals, possibly making them more motivated and confident to refer. Given the limited time physicians have with each patient, referral to an exercise specialist is an efficient,

effective option that should be employed more frequently, though financial constraints on patients should be considered.[29]

Differences in confidence according to university may be attributed to the amount of PA training offered. It is possible that institutions that include more PA information within the curriculum will have more confident students, though future research measuring the amount of time dedicated to PA at each university is recommended. Nevertheless, the faculties of medicine at Canadian universities are encouraged to connect with one another to share best practices with respect to PA education. Despite these differences, confidence rates were low at all institutions, with mean confidence scores indicating less than 'quite' confident for all PA actions. The overall low confidence scores suggest that further PA training is required to increase medical student confidence and the likelihood of recommending PA in future medical practice. This is in line with recent efforts calling for inclusion of PA in Canadian medical education.[30] Training could involve the delivery of workshops teaching students MI and behaviour change techniques to use on patients to promote long term PA participation. Workshops should be both educational and interactive, whereby students are able to practice techniques on their peers using mock scenarios.

Finally, there were differences in confidence according to specialty. Students pursuing family medicine were more confident to assess and prescribe PA compared to those pursuing paediatrics. Similarly, previous research found that family physicians provided PA counselling more frequently than obstetrician-gynecologists.[16] Preventive medicine is a major component of family medicine. Family physicians in Ontario, Canada receive a premium bonus for providing preventive care to their patients, and research shows that this incentive has improved the delivery of preventive care.[31] Concerning differences in specialities, family physicians take on more adult patients than paediatricians. Growing evidence shows that PA is an effective prevention and

treatment strategy for a variety of chronic illnesses,[1] several of which become increasingly prevalent with age. As such, students pursuing family medicine may see PA as an important strategy to utilize, leading them to educate themselves in preparation for future practice.

While family physicians may have a greater focus on preventive medicine, it is still important for medical students pursuing other specialties to be educated on how to promote PA, as PA is beneficial for people of all ages and conditions. Given that the PA guidelines differ according to age, and that limitations for certain medical conditions need to be considered, tailored interventions and training are recommended to help students promote PA to specific populations. Condition-specific PA resources are available and should be included in such training.[32] Moreover, specialties that are less confident could be offered additional support, such as the interactive educational workshop described above, including mock scenarios tailored to the proposed specialty. For example, students pursuing OB/GYN could practice promoting PA to a peer acting as a patient who would like to know the benefits/risks of exercising during pregnancy. Workshops could also incorporate videos of specialists recommending PA to patients for students to imitate, as modelling has been shown to increase behaviour and build self-efficacy.[12]

Strengths, Limitations, Future Directions

This research has many strengths. For instance, this is the first study to investigate multiple demographic differences in medical students with respect to motivation and confidence to perform five PA promotion actions. It is important to identify which students are lacking motivation and confidence to increase PA promotion in future medical practice. This information

is useful for researchers and medical education influencers, to inform future intervention and educational efforts.

There were also some study limitations. For instance, self-selection bias and self-report measures could have resulted in over reporting. The three universities that were included in this study may have also contributed to higher scores of motivation and confidence to promote PA, as these universities likely represent the most progressive medical programs for PA content compared to other Canadian universities, though there is still room for improvement. Additionally, the low response rate should be taken into consideration as a source of potential bias. Another limitation is that measuring motivation and confidence to promote PA in medical students may not necessarily predict future clinical behaviour as physicians. Finally, the cross-sectional design does not measure changes over time. Future research should use a longitudinal design, measuring motivation and confidence to recommend PA throughout medical school, and assess the frequency of performing these actions during residency as measured by patient reporting. Patient reporting is recommended as an accurate method for assessing the frequency of counselling in medicine.[33]

Conclusion

This study highlights demographic differences in Canadian medical students' motivation and confidence to recommend PA. Female participants were more motivated to counsel and refer compared to males. Second year students were more motivated to assess compared to third and fourth year students. Students pursuing family medicine were more confident to assess and counsel compared to students pursuing paediatrics, and students with a degree in kinesiology and/or physiotherapy were more confident to perform all five PA promotion actions compared to those who completed a degree in general, health and/or social sciences. These results may help

inform the design and implementation of targeted PA promotion interventions and educational efforts to incorporate PA training into the medical curriculum.

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Table 1. Demographic information of Canadian medical student participants (*N* = 221; 2017 – 2018).

	Total Sample (N= 221)
Gender, n (%)	
Male	70 (31)
Female	135 (61)
Other	1 (1)
Non-response	15 (7)
Ethnicity, n (%)	
White	133 (60)
Hispanic	1 (1)
Aboriginal Canadian	2 (1)
Black or African	5 (2)
Asian	41 (19)
Other	16 (7)
Non-response	23 (10)
Year, n (%)	
First	91 (41)
Second	54 (24)
Third	31 (14)
Fourth	37 (17)
Non-response	8 (4)
University, n (%)	
McGill University	89 (40)
University of Ottawa (English)	58 (26)
University of Ottawa (French)	26 (12)
Queen's University	48 (22)
Proposed Specialty	
Family Medicine	59 (27)
Internal Medicine	42 (19)
Surgery	34 (15)
Pediatrics	26 (12)
Other	45 (20)
Non-response	15 (7)
Academic Background, n	
General/Health/Social Sciences	194
Kinesiology/ Physiotherapy	35

Note. Participants were able to select more than one option for academic background. For data analyses, academic background was arranged into two categories: 1) students who indicated having a degree in General, Health and/or Social Sciences (who do not have a degree in Kinesiology or Physiotherapy) and 2) students who indicated having a degree in Kinesiology and/or Physiotherapy (even if they also have a degree in General, Health and/or Social Sciences).

Note. The Association of Faculties of Medicine of Canada national dataset in 2016/2017 showed that first year Canadian medical students are between the ages of 20-25.5 and 58% are female. National data on ethnicity, proposed specialty and academic background of medical students is not available for comparison to this sample.

Table 2. Demographic differences in Canadian medical students' motivation to perform five actions (assess, advise, counsel, prescribe, refer) related to promoting physical activity in future practice (*N* = 221; 2017 – 2018).

Demographic	**Motivation, Mean (SD)**				
	Asses	Advise	Counsel	Prescribe	Refer
Gender					
Female	2.91 (.91)	3.20 (.77)	3.21 (.72) *	3.06 (.96)	3.20 (.85)
Male	2.88 (.97)	3.06 (.84)	2.85 (.97) *	2.85 (1.01)	2.87 (1.04)
Ethnicity					
White	3.00 (.89)	3.24 (.73)	3.17 (.81)	3.06 (.95)	3.17 (.87)
Black or African	3.40 (.89)	3.60 (.89)	3.40 (.89)	3.40 (.89)	3.40 (.89)
Asian	2.59 (.89)	2.76 (.77)	2.80 (.75)	2.68 (.99)	2.73 (.95)
Year					
1	2.97 (.97)	3.15 (.87)	3.11 (.90)	3.02 (1.04)	3.20 (.93) *
2	3.19 (.78) *	3.37 (.71)	3.27 (.72)	3.17 (.81)	3.35 (.79) *
3	2.61 (.95) *	3.13 (.76)	2.97 (.87)	2.94 (1.0)	3.00 (.89)
4	2.61 (.84) *	2.89 (.71)	2.86 (.76)	2.72 (.97)	2.56 (.91) *
University					
McGill University	2.91 (1.02)	3.06 (.88)	3.02 (.92)	3.00 (1.02)	3.21 (.91)
University Ottawa (English)	2.91 (.82)	3.18 (.67)	3.11 (.71)	2.94 (.93)	2.98 (.89)
University of Ottawa (French)	3.12 (.88)	3.44 (.65)	3.32 (.80)	3.40 (.76)	3.44 (.58)
Queen's University	2.78 (.89)	3.15 (.84)	3.04 (.84)	2.83 (1.02)	2.83 (1.06)
Proposed Specialty					
Family Medicine	3.17 (.82)	3.36 (.67)	3.31 (.68)	3.16 (.85)	3.26 (.91)
Internal Medicine	2.67 (.93)	3.07 (.68)	3.00 (.73)	2.92 (.89)	2.95 (.82)
Surgery	2.67 (1.02)	2.91 (.98)	2.88 (.96)	2.55 (1.12)	2.67 (1.13)
Pediatrics	2.92 (.93)	3.12 (.91)	3.08 (.93)	3.23 (.86)	3.38 (.75)
Academic Background					
Kinesiology/Physiotherapy	3.37 (.17) *	3.43 (.14)	3.37 (.15)	3.37 (.18) *	3.47 (.17) *
General/Health/Social Sciences	2.76 (.07) *	3.05 (.07)	2.99 (.07)	2.86 (.08) *	2.95 (.08) *
Total Sample	2.91 (.92)	3.16 (.80)	3.08 (.83)	3.00 (1.67)	3.10 (.92)

Note. 0 = *not at all*, 1 = *a little*, 2 = *somewhat*, 3 = *quite*, 4 = *very*
Note. * Significant using Bonferroni adjustment.
Note. Ethnicity analyses did not include those who identified as Hispanic and Aboriginal Canadian, due to inadequate sample size.

Table 3. Demographics differences in Canadian medical students' confidence to perform five actions (assess, advise, counsel, prescribe, refer) related to promoting physical activity in future practice (*N* = 221; 2017 – 2018).

Demographic	**Confidence, Mean (SD)**				
	Assess	Advise	Counsel	Prescribe	Refer
Gender					
Female	2.01 (1.01)	2.39 (.89)	2.22 (1.03)	1.74 (1.22)	1.99 (1.30)
Male	2.13 (1.03)	2.23 (1.07)	2.00 (1.06)	1.57 (1.25)	1.89 (1.29)
Ethnicity					
White	2.14 (1.02)	2.44 (.98)	2.27 (1.09)	1.80 (1.27)	2.05 (1.34)
Black or African	1.60 (.55)	1.80 (.45)	1.40 (.89)	.80 (.84)	.80 (.84)
Asian	1.66 (.94)	1.90 (.74)	1.80 (.90)	1.44 (.95)	1.71 (1.17)
Year					
1	1.91 (1.23)	2.24 (1.09)	2.00 (1.16)	1.58 (1.36)	1.90 (1.45)
2	2.09 (.87)	2.26 (.96)	2.17 (.95)	1.65 (1.15)	2.00 (1.41)
3	2.06 (.96)	2.42 (.99)	2.06 (1.09)	1.77 (1.09)	1.97 (.95)
4	2.25 (.69)	2.47 (.61)	2.39 (.80)	1.86 (1.15)	1.89 (1.09)
University					
McGill University	1.98 (1.15)	2.19 (1.08) *	1.94 (1.08)	1.58 (1.24)	1.87 (1.40) *
University of Ottawa (English)	2.02 (.85)	2.18 (.92) *	2.07 (1.00)	1.58 (1.18)	1.89 (1.24) *
University of Ottawa (French)	2.27 (1.15)	2.81 (.75) *	2.50 (.99)	2.27 (1.28)	2.81 (1.10) *
Queen's University	2.04 (.93)	2.40 (.85)	2.28 (1.04)	1.62 (1.19)	1.62 (1.19) *
Proposed Specialty					
Family Medicine	2.37 (1.03) *	2.59 (.79)	2.36 (.92) *	1.92 (1.19)	2.24 (1.34)
Internal Medicine	1.71 (.94) *	2.10 (.98)	1.86 (1.09)	1.36 (1.08)	1.55 (1.11)
Surgery	2.03 (1.03)	2.26 (1.11)	2.24 (.99)	1.76 (1.28)	1.85 (1.26)
Pediatrics	1.69 (1.09) *	2.19 (1.13)	1.61 (1.10) *	1.15 (1.19)	1.77 (1.50)
Academic Background					
Kinesiology/Physiotherapy	2.97 (.17) *	2.97 (.16) *	2.90 (.18) *	2.81 (.20) *	2.97 (.22) *
General/Health/Social Sciences	1.82 (.08) *	2.16 (.07) *	1.93 (.08) *	1.41 (.09) *	1.76 (2.97) *
Total Sample	2.04 (1.03)	2.31 (.97)	2.12 (1.05)	1.67 (1.23)	1.93 (1.32)

Note. 0 = *not at all*, 1 = *a little*, 2 = *somewhat*, 3 = *quite*, 4 = *very;*
Note. * Significant using Bonferroni adjustment.
Note. Ethnicity analyses did not include those who identified as Hispanic and Aboriginal Canadian, due to inadequate sample size.

CHAPTER SIX: ARTICLE FOUR, STUDY TWO

Investigating the impact of a peer support walking intervention on mental health and physical activity in medical students: a multiple baseline single subject design

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Abstract

Medical students are at a high risk of experiencing psychological distress and mental illness. One positive predictor of mental health is physical activity; however, many medical students are not meeting the recommended physical activity guidelines. The purpose of this study was to implement and evaluate the impact of a two-month peer support walking intervention to improve the mental health and physical activity levels of medical students. This involved a multiple baseline single-subject design whereby participants (N = 10) acted as their own control with measurements taken at baseline, intervention and follow-up. Results showed relatively few significant differences in outcome variables over time. This was a positive finding given that the study was conducted during the COVID-19 pandemic, when significant decreases in mental health where shown among the general population and medical professionals. This suggests that peer support is a preventive approach to maintaining medical student mental health during stressful situations.

Keywords: COVID-19; medical students; mental health; pandemic; peer support; physical activity

Introduction

Training to become a physician presents medical students with significant stress and responsibility, which contribute to the high rates of psychological distress and mental illness in this population. A systematic review and meta-analysis including 183 studies from 43 countries reported an overall depressive symptom prevalence of 27% among medical students and an overall suicidal ideation prevalence of 11% (Rotenstein et al., 2016). Relative to the general population, the rates of psychological distress and mental disorders reported in medical students is higher than age-, gender-, and education-matched peers (Ediz et al., 2017; Maser & Houlton, 2017; McBride et al., 2016). One positive predictor of mental health and well-being (i.e., psychological, emotional, social) is physical activity (Mammen & Faulkner, 2013; Ravindran et al., 2016); however, many medical students are not meeting the recommended physical activity guidelines [i.e., at least 150 minutes of moderate to vigorous physical activity/week (MVPA); Ross et al., 2020]. Additionally, medical students' physical activity levels have been shown to significantly decrease after beginning medical school (Kanikowska et al., 2017).

Medical student mental health is of growing concern and further compounding this issue is the lack of help-seeking reported in this population, specifically for mental health issues (Thistlethwaite et al., 2010). Among medical students who do seek help for mental health issues, most report a preference for seeking support from family or friends rather than from a professional (e.g., Dyrbye et al., 2015; Gold et al., 2015; Thistlethwaite et al., 2010). Therefore, it is not surprising that peer support, which is defined as, "a supportive relationship between people who have a lived experience in common" (Sunderland & Mishkin, 2013, pp. 7), has emerged as a promising approach. Peer support is recommended as an effective strategy to improve mental health, as it promotes a social environment that reduces isolation and encourages

people to share their thoughts, feelings, concerns, and coping strategies (Castelein et al., 2015; Lloyd-Evans et al., 2014). Indeed, evidence shows a positive association between social support and well-being (Park et al., 2015; Tough et al., 2017). While several local and national peer support programs offered to medical professionals have recently developed (e.g., Abrams et al., 2020; Canadian Medical Association, 2020), there is limited research on the impact of such programs (Horgan et al., 2016). The few available articles reporting on the effectiveness of peer support focus specifically on physicians not on medical students, yet medical school is when psychological distress begins to develop (e.g., Brewster et al., 2008; Shapiro & Galowitz, 2016; West et al., 2014). Only one study has evaluated a peer support intervention among medical students (Moir et al., 2016); however, this study did not show statistically significant findings, which may have been attributed to the limited time participants spent with their peer supporter throughout the intervention (approximately 1-2 hours in total throughout a six-month intervention). Moreover, this peer support intervention did not incorporate strategies to become more physically active. There is overwhelming evidence supporting the mental health benefits of physical activity, including mild activity, such as walking (Schuch et al., 2016; Wegner et al., 2014). The integration of walking into a peer support intervention could amplify mental health benefits. While medical student mental health merits attention in and of itself, there are also important implications related to the quality of care provided to patients (de Oliveira et al., 2013), which make medical student health not only an individual problem, but also a broader public health concern.

This leads to the overall purpose of this study, which was to implement and evaluate the impact of a two-month informal[1] peer support walking (PSW) intervention to improve the mental health (total and subscales: psychological, emotional, social well-being) and physical activity participation (total and intensities: mild, moderate, strenuous) of first and second year medical students. Given that the primary focus of this intervention was to support mental health through peer support, the main outcome variable is mental health and the secondary outcome is physical activity. To provide a comprehensive evaluation of the PSW intervention, the RE-AIM (reach, effectiveness, adoption, implementation, maintenance; Glasgow, Vogt, & Boles, 1999) framework was used. Reach was not evaluated because this study followed a single-subject design and adoption was not used because only two Canadian medical schools out of a possible 17 were involved. The specific research questions are:

1. With respect to effectiveness and maintenance of the RE-AIM framework:
    a) What is the effect of a two-month PSW intervention on mental health (total and subscales: psychological, emotional, social well-being) of medical students? It was hypothesized that mental health would improve from baseline to intervention (Shapiro & Galowitz, 2016; West et al., 2014). The improvement in mental health was anticipated to be maintained at the 1-, 2- and 3-month follow-ups.
    b) If there are improvements in mental health, what were the primary contributors to these improvements? This was an exploratory research question, without a hypothesis.
    c) What is the effect of a two-month PSW intervention on physical activity levels (total and intensities: mild, moderate, strenuous) of medical students? It was hypothesized that

[1] Informal peer support: supportive conversations between peers who share similar experience, but who have not been formally trained. Formal peer support: individuals are trained to provide support within a formal role (Well Doc Alberta, 2020)

physical activity levels would improve from baseline to intervention (Cooley et al., 2020; Revell & McLeod, 2015). The improvement in physical activity was anticipated to be maintained at the 1-, 2- and 3-month follow-ups.

2. With respect to implementation of the RE-AIM framework:
    a) Was the PSW intervention delivered as intended? It was hypothesized that students would engage in weekly sessions for 8 weeks, would discuss relevant topics during their sessions, that their basic psychological needs (i.e., competence, autonomy, relatedness) would be met by their peer supporter, and that students would receive high levels of social support from their peer supporter.

Method

Research Design

This study involved a multiple baseline single-subject design whereby participants (N = 10) acted as their own control with measurements taken over three study phases (baseline, intervention, follow-up). For each study phase, measures were taken a minimum of three times, as recommended to establish measure stability (Kazdin, 2019; Byiers et al., 2012). Single subject designs have many strengths such as the ability to: a) detect small changes in individuals over time b) determine directions of causality and c) detect significant effects in small samples (Barker et al., 2011; Gorcynski, 2013). For these reasons, single-subject designs have been recommended as the gold standard for providing evidence of effective interventions and treatments (Naughton & Johnston, 2014). Finally, single subject designs are good to use for hard to recruit participants, such as medical students, who have busy schedules and limited free time to dedicate to participating in research (Cook et al., 2009).

Participants

First and second year medical students attending University of Ottawa and Queen's University were recruited to participate in this study. While twenty-three medical students signed up and were eligible to participate in the program, a total of $N = 10$ followed through with an initial meeting and began the intervention (University of Ottawa $n = 4$; Queen's University $n = 6$) (Table 1).[2] Students were eligible to participate in the study if they were: a) enrolled in medical school at University of Ottawa or Queen's University; b) in first or second year of medical school; c) English speaking.

Procedure

Several recruitment strategies were used, including: emails sent directly to medical students from presidents of University of Ottawa and Queen's University medical student societies; posts made in medical student Facebook groups; emails sent directly to medical students who had participated previously in a related study and had indicated wanting to be contacted in the future; posters on billboards across University campus; handouts distributed in libraries and medical school buildings; and announcements made in mandatory classes.

Baseline. Participants who were interested in the study completed an online sign-up sheet, indicating their contact information, whether they had a peer to participate with, and their weekly availability to schedule an initial meeting with a member of the research team. Students who did not have a peer to participate with were matched with another student who signed-up individually (only one student pair was matched in this study: Participants 3 & 4). Once an initial meeting date was set between the researcher and the student-pair, students were asked to fill out

[2] Recruitment took place before the COVID-19 outbreak (January – March 2020), and the intervention began at the start of the pandemic (mid-March 2020). This may have contributed to the loss of study participants from recruitment to intervention. However, this study followed a single-subject design, so ten participants was an adequate sample size.

the baseline survey prior to the meeting, during the meeting, and following the meeting (before the first session) for a total of three baseline timepoints.

Peer Support Walking Intervention. Students scheduled their first peer support walking session within a week of the initial meeting. Weekly sessions involved 30- to 60-minute sessions of walking and talking every week for two months (eight sessions).[3] Participants were provided with a mental health topic checklist and were asked at the end of each peer support walking session to indicate which topics they discussed, by completing a fillable PDF and sending it to the researcher (see Supplementary Material). The list included common challenges that medical students experience that impact their mental health, as reported in the literature. There was also an 'other' option for students to describe conversations that may have occurred that were not related to a topic on the list. Given that physical activity was the secondary outcome, at the end of every session peers were also asked to make a physical activity goal (including details on: activity, target day(s), target time(s), duration, and how it will be made enjoyable) to incorporate into their schedule at least once before meeting the following week. Finally, they were asked each week to record their walking routes using the Strava app and send a screenshot of their route to the researcher. Quantitative subjective measures were taken at multiple time-points throughout the intervention: after two sessions, four sessions, six sessions and eight sessions. At endpoint (eight sessions), participants were asked additional questions related to implementation, including the extent to which their basic needs were satisfied by their peer and the perceived level of social support provided by their peer. They were also asked to what extent (%/100) they attribute any improvements in mental health to a) increases in physical activity b) topics discussed during sessions c) the social interaction and, if applicable, d) other.

[3] Due to the COVID-19 pandemic, students walked separately while talking on the phone with one another, to respect social distancing guidelines. This was required by the research ethics boards of both universities.

Follow-up. Measures of mental health and physical activity were taken 1-, 2- and 3-months following the eighth peer support session, to provide an indication of maintenance.[4]

Outcome Measures

Mental Health. The Mental Health Continuum- Short Form (MHC-SF; Keyes, 2002) is a 14-item scale used to measure mental health. The scale can also be scored to assess three facets of well-being: Emotional (E = 3 items), Social (S = 5 items), Psychological (P = 6 items). Participants were asked "During the past month, how often did you feel [14 -items; e.g., interested in life (E), that people are basically good (S), that you liked most parts of your personality (P)]?" Response options ranged on a scale from 0 = "never" to 5 = "everyday". A total mental health score was calculated by summing responses to all 14 items. Continuous scoring was also used to calculate scores for emotional, social and psychological well-being, by summing responses to items corresponding to each facet. This scale has been deemed valid and reliable (Keyes, 2009). In this sample, the internal validity was good for total mental health (Cronbach's = 0.97) and subscales (Cronbach's = 0.92 to 0.95).

Physical Activity. The Godin-Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985) was used to subjectively measure physical activity. Participants were asked to indicate the number of times per week (on average) that they engage in strenuous (e.g., running, hockey), moderate (e.g., fast walking, baseball) and mild physical activity (e.g., bowling, golf). In addition, for each intensity they were asked to indicate the average number of minutes/session. The times/week of strenuous, moderate and mild physical activity were multiplied by their respective minutes/session for individual intensity scores in minutes/week. Individual intensity scores were combined for total physical activity (minutes/week). This highly utilized scale has

[4] In line with the RE-AIM framework, the term "maintenance" is used in this article; however, measuring maintenance may require follow-ups of 12 months or more (Samdal et al., 2017).

been deemed valid and reliable and is used frequently with student populations (Joseph et al., 2014; McFadden et al., 2016). It has also been used to measure physical activity levels of medical professionals nationally (e.g., Canadian Medical Association, 2018).

Implementation Measures (assessed at endpoint)

Mental Health Topic Checklist. A topic checklist, including common challenges that medical students experience that impact their mental health, was developed by the researchers of this study. The list included 16 topics based on stressors medical students commonly face, as reported in the literature (e.g., heavy workload, parental pressure, competition with classmates; Heinen et al., 2018; Hill et al., 2018; Weber et al., 2019). There was also an 'other' option for students to describe conversations they had that were not related to a topic on the list. Participants were asked to complete the fillable checklist at the end of each peer support walking session and to send to the researcher before their next session.

Basic Needs Satisfaction. The Basic Needs Satisfaction Scale (BNSS; La Guardia et al., 2000) was used to measure basic needs satisfaction at endpoint. This 9-item scale starts with the stem "when I am with the peer supporter" and asks participants to rate on a 9-point Likert scale the extent to which their need for competence (e.g., "I feel very capable and effective"), autonomy (e.g., "I have a say in what happens, and I can voice my opinion"), and relatedness (e.g., "I feel loved and cared about") were satisfied. Scores for each subscale (3 items per subscale) were generated by averaging item responses, after reverse coding negative items. Maximum possible scores for each subscale were 7.

Social Support. The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988) was adapted to measure the degree of perceived social support provided by the peer supporter at endpoint. This scale asks participants to indicate the extent to which they

agree with 9 items (e.g., “My peer supporter is around when I am in need; I can talk about my problems with my peer supporter; I can count on my peer supporter when things go wrong”). Response options are on a 7-point Likert scale ranging from 1 = “very strongly disagree” to 7 = “very strongly agree”. Total social support provided by the peer supporter was calculated by obtaining a mean score of all nine items, for a maximum possible score of 7. This scale has been deemed valid and reliable (Basol, 2008; Wongpakaran et al., 2011).

Data Analysis

Simulation Modeling Analysis (SMA; version 9.9.28 available at http://www.clinicalresearcher.org/software.htm) was used to examine changes in outcome variables between study phases, within each participant individually. The SMA program provides a free and reliable method of analyzing relatively short streams of auto-correlated time-series data (i.e., when each subsequent observation is dependent on prior observations because measures are taken from the same individual). More conventional time-series analyses (e.g., HLM) were not appropriate, as they require a minimum of 30 data points/phase which is quite burdensome and unrealistic for this study as medical students are already overloaded by many other demands in their lives. Moreover, these conventional approaches treat autocorrelation as error as opposed to SMA which treats it as interesting data in and of itself (Borckardt et al., 2008; Goodman et al., 2017). Indeed, the SMA approach is widely accepted and has been used previously in single-subject research (e.g., Goodman et al., 2017; McFadden et al., 2017).

Several different statistical tests can be performed in SMA. For this study, autocorrelation and level change were the most relevant to include. Autocorrelation, which is the dependency of sequential observations, was computed and controlled for to reduce the risk of Type I error (Smith, 2012; Borckardt et al., 2008). Level-change, which represents the difference in mean

scores from one study phase to another, was also calculated including the effect size (r) and *p*-value (p). Differences in means from baseline to intervention were deemed significant using a significance level of $p < .05$. If changes were significant from baseline to intervention, the analyses were run with data from intervention to follow-up to see if changes were maintained. Changes were maintained if the *p*-value from intervention to follow-up was greater than 0.05 (i.e., means were not significantly different from intervention to follow-up).

Results

Effectiveness and Maintenance (RE-AIM)

Results of the SMA analyses showed no significant changes in mental health (total and three well-being subscales) nor physical activity levels (total and three intensities) for 60% of participants (i.e., P1, P2, P6, P7, P8 and P10) from baseline to intervention (Table 3). P3 revealed a decrease in social well-being from baseline to intervention ($r = - 0.83$, $p = 0.05$) which was maintained from intervention to follow-up ($p = 0.20$). P4 showed significant increases in total physical activity ($r = 0.88$, $p = 0.05$) and approached significance for increases in mild physical activity ($r = 0.85$, $p = 0.08$) from baseline to intervention. These positive changes in total and mild physical activity were maintained from intervention to follow-up ($p = 0.10$; $p = 0.31$ respectively). P5 revealed a significant increase in social well-being from baseline to intervention ($r = 0.88$; $p = 0.05$) which was maintained from intervention to follow-up ($p = 0.17$). P7 approached significance for positive improvements in total mental health from baseline to intervention ($r = 0.86$; $p = 0.06$), as did P8 for increases in social well-being from baseline to intervention ($r = 0.80$; $p = 0.10$). These improvements were maintained from intervention to follow-up in P7 and P8 ($p = 0.52$; $p = 0.79$ respectively). Finally, P9 showed a decrease in social

well-being (r = - 0.89; p = 0.01), psychological well-being (r = - 0.94; p = 0.01), and total mental health (r = - 0.93; p = 0.01) from baseline to intervention.

When positive changes were shown in total mental health and/or any of the well-being subscales (P5, P7 & P8), responses to the endpoint question asking "to what extent (%/100) do you attribute any improvements in mental health to" were further examined. P5 indicated the following: 30% topics discussed; 60% social interaction with peer; 1% increases in physical activity; 9% other ("going through a tough breakup and recognizing that my peer supporter/friend is there for me"). P7 answered: 13% topics discussed; 19% social interaction with peer; 22% increases in physical activity; 24% other ("finishing school so more free time"); 22% other ("having structure"). P8 responded: 33% topics discussed; 67% social interaction with peer; 0% increases in physical activity; 0% other. Curiously, these three participants did not have significant increases in physical activity, despite psychological improvements.

Implementation *(RE-AIM):*

To address the second research question related to implementation of the intervention, descriptive statistics were generated for the total number of peer support walking sessions engaged in throughout the intervention period and topics discussed during sessions. Regarding number of sessions, eight of the ten participants engaged in all eight peer support sessions, as per the study protocol. P9 and P10 reported taking part in six peer support sessions; however, the supporting documents (i.e., topic checklist, physical activity goals and walking route) for only three sessions across all six were actually sent to the researcher.

With respect to the topic checklists, participants sent checklists to the researchers 31 times out of a possible 40 (5 pairs * 8 sessions = 40 checklists). The top three topics of discussion were: friendships (e.g., social interactions with friends outside of medical school),

peers (e.g., competition with classmates, social environment) and academic workload (e.g., courses, exams, performance pressure, study habits; Table 4). The least frequent topics were: 'other', patient care (e.g., exposure to human suffering and death), and personality traits (e.g., perfectionism, fear of failure, high self-expectations). The 'other' topics of discussion were: the impact of COVID-19 on mental health, the black lives matter movement and the weather. While students were asked to set a physical activity goal after each PSW session, only 55% of topic checklists indicated having a physical activity discussion.

Scores of basic needs and perceived social support from the peer supporter were also generated. Out of a maximum possible score of 7, average scores of autonomy, competency and relatedness were 6.56 (0.45), 6.60 (0.56) and 6.30 (0.58) respectively. Participants reported an average social support score of 6.38 (0.51), out of a maximum possible score of 7. These results suggest that participants perceived their peer supporter to satisfy the basic needs of autonomy, competency, and relatedness. Students also reported receiving high levels of social support from their peer supporter. Taken altogether, these results are in line with the study protocol, providing a good indication of appropriate delivery of the PSW intervention as intended.

Discussion

The purpose of this study was to implement and evaluate the impact of a 2-month informal PSW intervention aimed at improving the mental health and physical activity participation of first and second year medical students using the RE-AIM framework. With respect to effectiveness and maintenance (RE-AIM), results of the SMA analyses did not fully support the first research hypotheses. Seven out of ten participants (70%) did not reveal significant differences in mental health (total and well-being subscales) from baseline to intervention (Table 3). Among the other three participants, P5 showed significant improvements in social well-being, P3 revealed a

decrease in social well-being and P9 had decreases in social, psychological and total mental health from baseline to intervention. These findings (with the exception of P5) are contrary to previous research reporting mental health benefits among physicians receiving peer support (Shapiro & Galowitz, 2016; West et al., 2014). However, there are some possible explanations for these conflicting findings.

For instance, P3 was one of the two students who did not have a peer to sign-up with and was matched with P4 by the researcher. Perhaps P3 did not connect as well to the peer supporter assigned to them compared to those who self-selected a peer. However, the influence on mental health has not been considered. Future research should replicate the present study with a larger sample and compare differences in mental health outcomes between self-selected and randomly assigned peers. With respect to P9, this participant did not follow the study protocol, engaging in only 6/8 of the peer support walking sessions and did not respond to the follow-up surveys. Moreover, P9 was neither meeting the Canadian physical activity guidelines at baseline (M_{MVPA} = 92.5 minutes/week) nor during the intervention (M_{MVPA} = 113.3 minutes/week). Emerging research on the psychotherapy dose-response effect shows that a minimum of eight sessions are required to see reliable change (Chen & Keenan-Miller, 2020). As it relates to the physical activity dose-response effect, Stanton and Reaburn's review (2014) recommends mild to moderate aerobic physical activity in 30-40-minute bouts, three to four times a week, for a minimum of nine weeks to achieve psychological benefits. Taken together, the dose of this intervention may not have been sufficient for P9 to achieve mental health benefits. Finally, P9 had the lowest total mental health at baseline ($M_{Total\ MH\ =}$ 42; out of a maximum possible score of 70) and may have required more intensive care to achieve positive changes in mental health.

Regarding the secondary outcome variable, 9/10 participants did not show significant differences in physical activity levels (total and intensities) from baseline to intervention, contrary to the hypothesis. However, 8/10 participants were highly active at baseline, meeting physical activity guidelines. Interestingly, the only participant who showed a significant increase in total physical activity levels (P4) was the least active at baseline ($M_{\text{Total PA}}$ = 124 mins/week).

Although results of this study were not completely in line with the research hypotheses, when considering the broader context of when the study was conducted (i.e., January – August 2020, during the COVID-19 pandemic), seeing few significant changes in mental health and physical activity levels is actually a positive finding. Indeed, emerging literature suggests that the pandemic is having a negative impact on the mental health and well-being of the general public (Xiong et al., 2020) and healthcare providers specifically (Sartorao Filho et al., 2020; Sriharan et al., 2020; Medical Economics, 2020; Medscape, 2020). For example, a systematic review examining the psychological impact of COVID-19, including 19 studies, found high rates of anxiety, depression, post-traumatic stress disorder, psychological distress and stress among the general population (Xiong et al., 2020). Results from a recent Medscape survey including over 5,000 US physicians, revealed that nearly two thirds of the sample (64%) reported an increase in burnout since COVID-19 (Medscape, 2020). Findings from this survey also indicated changes in physician lifestyle behaviours with 31% indicating that they are engaging in less physical activity, 29% are eating more and 19% are drinking more as a result of the stay-at-home and social distancing regulations (Medscape, 2020). Finally, a cross-sectional study examining the impact of COVID-19 on medical students in Brazil (N = 347) found that 46% of students reported moderate to severe symptoms of anxiety and 64% reported moderate to severe depressive symptoms (Sartorao Filho et al., 2020). These rates were higher than studies

conducted among Brazil medical students prior to COVID-19 (e.g., Moutinho et al., 2017; Puthran et al., 2016), though statistical comparisons between studies were not performed. Considering these findings, it is encouraging that the medical student sample in the present study did not see similar decreases in mental health and physical activity levels while participating in the intervention, which was delivered during the COVID-19 pandemic.

Given that the sample included in this study reported high levels of mental health and most were physically active at baseline (Table 1), the insignificant results from baseline to intervention show that a PSW intervention may be effective at maintaining mental health and well-being, as well as physical activity levels during challenging and stressful situations, such as the COVID-19 pandemic. Medical students go through many stressful situations throughout their studies (e.g., exams, clerkship, residency matching), and so it is important for them to develop positive coping strategies early to continue to excel during these challenging times and throughout their practice as physicians. In sum, our results provide preliminary support for peer support while walking as a proactive, preventive approach to maintaining mental health and physical activity levels, particularly in the context of a pandemic.

Regarding the second research question, implementation findings were positive, supporting our hypotheses (RE-AIM). Indeed, 80% of participants engaged in a total of eight peer support walking sessions over two months, which supports acceptability of the intervention. They also discussed relevant topics during their sessions. When considering the total sample, every topic included on the checklist was discussed by at least one pair of students at some point during the intervention. There were only three instances when the “other” option was selected, out of 31 checklists. This shows that the checklist itself was comprehensive and indicates that relevant topics were discussed during sessions; students were not having conversations that were

unrelated to the overall goal of the sessions which was to share common challenges experienced during medical school. When reviewing checklists, the top three topics of discussion were: friendships, peers and academic workload (Table 4). This is in line with previous research highlighting these topics as major challenges that medical students face (Heinen et al., 2017; Hill et al., 2018; Weber et al., 2019). Finally, average scores of the basic needs subscales (i.e., autonomy, competency and relatedness) as well as perceived social support from the peer supporter were high. Taken altogether, implementation results show that the PSW intervention was implemented with high fidelity.

Strengths, Limitations and Future Directions

This study contributes to the growing body of literature examining the benefits of peer support delivered to medical students. The impact of a PSW intervention specifically has not been examined previously, in any population. While research has investigated peer support groups among medical professionals (e.g., Shapiro & Galowitz, 2016; West et al., 2014), little has involved medical students, and none has incorporated a physical activity component. Medical students are an important population to target as their levels of physical activity have been shown to decrease during medical school, they show a high prevalence of mental health issues, and as future physicians, they will have a significant influence on quality of care (de Oliveira et al., 2013) and physical activity engagement at the population level (Lobelo & de Quevedo, 2016). Another novel contribution of this study is that it took a proactive approach. Previous peer support interventions and programs typically provide support after adverse events when mental health issues are known to develop (e.g., after a medical error; Shapiro & Galowitz, 2016). This study intended to target medical students before mental health issues arise to strengthen their social support, build coping skills and help them navigate through medical school. Finally, this

study is unique in that it was conducted during a global pandemic which allowed for examining whether peer support could be an effective proactive intervention for maintaining mental health and physical activity during stressful situations.

While this study had many strengths, there were also limitations that should be considered when interpreting the results and when conducting future research in this area. First, the study population was already quite active ($M_{\text{Total PA}}$ = 451.5 minutes/week) with 80% meeting the Canadian physical activity guidelines of at least 150 minutes of MVPA per week at baseline. This might explain why there were few significant differences in physical activity levels over time. Similarly, the population had high levels of total mental health at baseline (M = 52.4, SD = 11.1). Inactive students with poorer mental health would likely benefit the most from a PSW intervention, however they are harder to recruit. Moreover, peer support is a non-clinical approach and more intensive psychological and/or psychiatric care would likely be required for students with mental health issues. The small sample size in this study may have also contributed to the insignificant findings and did not allow for testing mediation. Future research should follow a randomized controlled trial and test physical activity as a mediator between the PSW intervention (independent variable) and mental health (dependent variable). Another limitation could have been that the participants did not receive training on how to be an effective peer supporter (e.g., active listening, normalizing, reframing; Shapiro, 2020) prior to beginning the intervention. However, this study was designed as an informal peer support intervention to reflect reality, thus having better ecological validity. Future research should also explore the impact that changes in medical students' mental health and physical activity levels have on their intentions to recommend physical activity to patients in future practice. Finally, future studies

should incorporate all components of the RE-AIM framework, including reach and adoption, which are important to include when considering future scalability of PSW interventions.

Conclusion

Results of this study showed that there were relatively few significant changes in mental health and physical activity levels among medical students during a 2-month PSW intervention. Although contrary to our hypotheses, the insignificant results are, in fact, a positive finding. Indeed, the present study was conducted in 2020 during the COVID-19 pandemic, when significant decreases in mental health where shown among the general population and medical professionals specifically, including medical students. Our results suggest that peer support is a proactive, preventive approach to maintaining mental health during stressful situations, though future research addressing the study limitations should be conducted. Medical students will undoubtedly go through several challenges throughout their studies. Thus, it is important for them to develop positive coping strategies early in order to thrive as practicing physicians and provide high quality patient care in the future.

Disclosures and Declarations

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Table 1. Participant characteristics at baseline.

ID (*N* = 10)	Age	Gender	Ethnicity	University	Year	Emotional WB	Social WB	Psycho-logical WB	Total Mental Health	Mild PA	Mode-rate PA	Stren-uous PA	Total PA
1	24	Female	White	uOttawa	2	12.5 (1.7)	19.8 (2.8)	25.8 (3.5)	55.8 (7.9)	125.0 (19.1)	210.0 (106.8)	318.8 (106.3)	653.8 (175.0)
2	23	Female	White	uOttawa	2	13.5 (0.6)	22.0 (1.8)	28.8 (0.9)	64.2 (2.2)	175.0 (70.0)	125.0 (10)	165.0 (17.3)	465.0 (60.3)
3	22	Female	White	uOttawa	1	11.8 (0.5)	14.0 (1.8)	19.8 (3.0)	45.5 (4.1)	192.5 (35.0)	138.8 (53.9)	285.0 (90.0)	616.3 (156.1)
4	23	Male	Pakistani	uOttawa	1	15.0 (0.0)	24.5 (0.6)	30.0 (0.0)	69.5 (0.6)	112.5 (70.9)	11.25 (6.3)	0.0 (0.0)	123.8 (67.5)
5	27	Male	White	Queen's	2	14.7 (0.6)	23.0 (1)	26.0 (3.0)	63.7 (3.8)	186.7 (102.6)	160.0 (17.3)	180.0 (60.0)	526.7 (119.3)
6	26	Male	White	Queen's	2	11.0 (0.0)	17.7 (0.6)	21.0 (1.7)	49.7 (0.6)	138.3 (93.1)	85.0 (56.8)	600.0 (52.0)	823.3 (92.5)
7	21	Female	Asian	Queen's	2	9.7 (1.1)	12.0 (2.6)	20.3 (3.1)	42.0 (4.6)	92.5 (23.8)	87.5 (10.8)	87.5 (10.8)	267.5 (20.7)
8	23	Male	White	Queen's	2	11.0 (0.0)	16.0 (0.0)	18.3 (1.1)	45.3 (1.2)	90.0 (0.0)	360.0 (0.0)	180.0 (0.0)	630.0 (0.0)
9	23	Female	Asian	Queen's	1	10.0 (0.8)	13.0 (1.8)	19.0 (1.6)	42.0 (3.6)	150.0 (54.8)	47.5 (9.6)	45.0 (23.8)	242.5 (59.1)
10	23	Female	Asian	Queen's	1	10.3 (2.1)	13.0 (4.2)	18.8 (2.4)	42.0 (7.7)	80.0 (51.5)	83.8 (22.1)	112.5 (51.2)	276.25 (101.4)

Note. WB = well-being (average at baseline); PA = physical activity (average minutes/week at baseline)
Note. Maximum possible score of emotional well-being = 15; social well-being = 25; psychological well-being = 30; total mental health = 70

Table 2. Summary of data collection for the peer support walking intervention.

Measures	**Baseline** Before initial meeting During initial meeting After initial meeting	**Intervention** 2 sessions 4 sessions 6 sessions	**Endpoint** 8 sessions	**Follow-up** 1-month 2-months 3-months
Mental health	X	X	X	X
Physical activity	X	X	X	X
Mental health topic checklist		X	X	
Basic needs satisfaction			X	
Social support			X	
Attribution of improvements			X	

Table 3. Autocorrelation and level change for measures of mental health (total and well-being subscales) and physical activity participation (total and intensities) from baseline to intervention.

Participant #	Measure	Autocorrelation lag -1	*p*	Level change (*r*)	*p*
1	Emotional WB	-0.43	.05	-0.23	0.44
	Social WB	-0.33	0.22	-0.07	0.83
	Psychological WB	-0.01	0.69	-0.46	0.25
	Total MH	-0.20	.39	-0.29	0.42
	Mild PA	-0.67	.01	0.37	0.13
	Moderate PA	-0.09	.63	-0.60	0.10
	Strenuous PA	0.45	.02	-0.40	0.51
	Total PA	0.05	.22	-0.51	0.22
2	Emotional WB	0.17	0.15	0.15	0.76
	Social WB	0.02	0.29	0.23	0.59
	Psychological WB	-0.76	0.01	┼	┼
	Total MH	0.02	.30	0.19	0.65
	Mild PA	-0.20	0.37	-0.35	0.31
	Moderate PA	-0.19	0.34	0.11	0.76
	Strenuous PA	-0.24	0.23	-0.58	0.08
	Total PA	0.22	0.10	-0.52	0.28
3	Emotional WB	0.08	0.18	-0.42	0.33
	Social WB	0.51	<.01	-0.83	0.05*
	Psychological WB	-0.80	<.01	-0.09	0.72
	Total MH	-0.08	.59	-0.52	0.16
	Mild PA	-0.07	0.55	0.46	0.23
	Moderate PA	-0.10	0.57	0.11	0.79
	Strenuous PA	0.51	0.02	-0.11	0.87
	Total PA	0.45	0.02	0.25	0.70
4	Emotional WB	┼	┼	┼	┼
	Social WB	0.52	.01	0.58	0.33
	Psychological WB	┼	┼	┼	┼
	Total MH	0.52	.01	0.58	0.32
	Mild PA	0.77	<.01	0.85	0.08
	Moderate PA	-0.15	.48	0.04	0.92
	Strenuous PA	┼	┼	┼	┼
	Total PA	0.78	<.01	0.88	0.05*
5	Emotional WB	-0.22	0.14	0.35	0.38
	Social WB	0.64	<.01	0.88	0.05*
	Psychological WB	0.34	0.05	0.68	0.18
	Total MH	0.54	.01	0.79	0.12
	Mild PA	-0.05	0.64	-0.52	0.21
	Moderate PA	-0.04	0.56	-0.55	0.20
	Strenuous PA	0.02	0.23	-0.08	0.87
	Total PA	0.03	0.20	-0.56	0.20

6	Emotional WB	-0.51	0.10	0.24	0.54
	Social WB	-0.64	0.04	-0.45	0.18
	Psychological WB	-0.59	0.04	-0.12	0.76
	Total MH	0.50	.001	-0.71	0.25
	Mild PA	-0.05	0.65	-0.52	0.22
	Moderate PA	-0.04	0.57	-0.55	0.20
	Strenuous PA	0.02	0.23	-0.08	0.87
	Total PA	0.03	0.23	-0.56	0.20
7	Emotional WB	0.62	<0.01	0.71	0.23
	Social WB	0.54	0.01	0.74	0.17
	Psychological WB	0.26	0.10	0.74	0.10
	Total MH	0.60	.007	0.86	0.06
	Mild PA	-0.02	0.68	0.51	0.24
	Moderate PA	-0.37	0.24	0.09	0.80
	Strenuous PA	0.48	0.02	-0.70	0.19
	Total PA	0.33	0.05	0.13	0.83
8	Emotional WB	-0.04	0.45	0.45	0.36
	Social WB	0.34	0.05	0.80	0.10
	Psychological WB	-0.36	0.31	0.47	0.24
	Total MH	0.22	0.13	0.57	0.31
	Mild PA	┼	┼	┼	┼
	Moderate PA	┼	┼	┼	┼
	Strenuous PA	┼	┼	┼	┼
	Total PA	┼	┼	┼	┼
9	Emotional WB	0.56	<.01	-0.80	0.12
	Social WB	0.13	0.18	-0.89	0.01**
	Psychological WB	0.45	0.03	-0.94	0.01**
	Total MH	0.44	0.04	-0.93	0.01**
	Mild PA	-0.29	0.33	-0.33	0.37
	Moderate PA	-0.12	0.56	-0.19	0.64
	Strenuous PA	-0.06	0.61	0.58	0.15
	Total PA	-0.34	0.27	-0.13	0.71
10	Emotional WB	-0.15	0.47	-0.64	0.09
	Social WB	-0.06	0.61	-0.32	0.46
	Psychological WB	0.38	0.04	-0.70	0.17
	Total MH	0.38	0.05	-0.67	0.22
	Mild PA	-0.05	0.65	0.39	0.37
	Moderate PA	0.15	0.16	0.45	0.36
	Strenuous PA	-065	0.02	-0.19	0.55
	Total PA	0.10	0.23	0.39	0.42

Note. * Significantly different $p \leq 0.05$.
Note. ┼ indicates that there were no changes, scores were the exact same between phases.
Note. WB = Well-Being; PA = Physical Activity.
Note. Autocorrelation was accounted for in level change analyses.

Table 4. List of topics discussed during peer support walking sessions.

Topic	**Count (%)** ***N* = 31**
Friendships (e.g., social interactions with friends outside of medical school)	24 (77)
Peers (e.g., competition with classmates, social environment)	23 (74)
Academic Workload (e.g., courses, exams, performance pressure, study habits)	22 (71)
Work-Life Balance (e.g., difficulty managing personal and professional responsibilities)	19 (61)
Physical Activity (e.g., barriers, goals)	17 (55)
Other Lifestyle Behaviours (e.g., sleep, diet, alcohol use, extra-curriculars)	16 (52)
Family (e.g., parental pressure/demands)	13 (42)
Time Management (e.g., time constraints, competing events/commitments)	12 (39)
Significant Other (e.g., conflicts with romantic relationship)	11 (35)
Career Planning (e.g., resident matching, concerns about future in medicine)	11 (35)
Coping Strategies (e.g., resilience training, mindfulness, accessing services)	10 (32)
Faculty (e.g., teaching quality, poor supervisory behavior, mistreatment of learners)	9 (29)
Finances (e.g., lack of money, debt/loans)	8 (26)
Medical Culture (e.g. competition, unrealistic expectations)	6 (19)
Personality Traits (e.g., perfectionism, fear of failure, high self-expectations)	4 (13)
Patient Care (e.g., exposure to human suffering and death)	3 (10)
Other	3 (10)

Supplementary Material:

Mental Health Topic Checklist and Physical Activity Goal Setting

Names:_____ **Date:**_____

Please check 'Yes' or 'No' to indicate whether you discussed the following topics during your peer support walking session. If you discussed a topic that is not on this list, check 'Other' and provide a brief description.

Topic	Check Yes/No
Family **(e.g., parental pressure/demands)**	Yes No
Significant Other **(e.g., conflicts with romantic relationship)**	Yes No
Friendships **(e.g., social interactions with friends outside of medical school)**	Yes No
Peers **(e.g., competition with classmates, social environment)**	Yes No
Faculty **(e.g., teaching quality, poor supervisory behavior, mistreatment of learners)**	Yes No
Academic Workload **(e.g., courses, exams, performance pressure, study habits)**	Yes No
Work-Life Balance **(e.g., difficulty managing personal and professional responsibilities)**	Yes No
Time Management **(e.g., time constraints, competing events/commitments)**	Yes No
Medical Culture **(e.g. competition, unrealistic expectations, reluctance admitting to vulnerability)**	Yes No
Patient Care **(e.g., exposure to human suffering and death)**	Yes No
Finances **(e.g., lack of money, debt/loans)**	Yes No
Career Planning **(e.g., resident matching, concerns about future in medicine)**	Yes No
Personality Traits **(e.g., perfectionism, fear of failure, high self-expectations)**	Yes No
Physical Activity **(e.g., barriers, goals)**	Yes No
Other Lifestyle Behaviours **(e.g., sleep, diet, alcohol use, extra-curriculars)**	Yes No
Coping Strategies **(e.g., resilience training, mindfulness, deep breathing, accessing services)**	Yes No
Other *(please describe):*	☐ **N/A**

Date and time of next session:_____

Physical activity goal (1 per person) to incorporate into your schedule prior to the next session:

Activity	**Target day(s)**	**Target time(s)**	**How long**	**How will I make it enjoyable**
1.				
2.				

CHAPTER SEVEN: ARTICLE FIVE, STUDY TWO

Evidence-based strategies for conducting mental health research in medical professionals to optimize recruitment, engagement and retention

Taylor McFadden & Michelle Fortier

Submitted to: *Medical Science Educator*

Abstract

Physicians, residents and medical students, are a difficult population to recruit, engage and retain in research. Medical professionals report higher rates of mental illness and burnout compared to the general population, which could explain their lack of energy to participate in research. Other barriers may include lack of time, concerns about confidentiality and mental health related stigma. Many studies have offered recommendations on how to recruit hard-to-reach populations; however, few have considered medical professionals and those that do focus on 1-2 strategies. None have provided a comprehensive list of recommendations on how to recruit, engage and retain physicians and trainees. The high rates of mental illness and burnout in medical professionals and the impact of their mental health on patient care, makes physicians and trainees a population that is crucial to support through mental health research. Therefore, the purpose of this monograph is to offer evidence-based strategies for conducting mental health research in medical professionals to optimize recruitment, engagement and retention. Ten strategies are provided. This knowledge may be used to inform the planning of future research aiming to support the mental health of medical professionals. Ultimately, this will benefit individual physicians, patients, and the health system at large.

Keywords: engagement, medical learners, mental health research, physicians, recruitment, retention

Introduction

Medical professionals[1], including physicians, residents and medical students, are often a difficult population to recruit, engage and retain in research (Cook et al., 2009; Noel and Huang, 2018). To illustrate, a systematic review found that physician response rates of less than 20% are not uncommon when considering internet-based surveys (Dykema et al., 2013). Low response rates have also been found in trainees[2] (e.g., 7.7%, Hughes et al., 2017; 12%, McFadden et al., 2019). Issues with recruiting medical professionals in research may be attributed to their busy schedules (Klabunde et al., 2013). Indeed, Canadian physicians and residents report working an average of 48 hours per week plus an additional 111 on-call hours a month (CMA, 2017), while the average Canadian works 33 hours per week including overtime (Statistics Canada, 2007). Considering this, it is not surprising that medical professionals report a lack of work-life integration (Karakash et al., 2019), with limited free time to dedicate to anything outside of work, let alone to research. Physicians and trainees report higher rates of mental illness and burnout compared to the general population (CMA, 2017; Maser and Houlton, 2017; Rotenstein et al., 2016), which could also explain their lack of energy to participate in research. With respect to participating in mental health research specifically, some other potential barriers medical professionals may have include concerns about confidentiality, stigma associated with seeking help for mental health related issues, and the belief that they can take care of themselves (Pospos et al., 2017).

Promoting the mental health status of medical professionals through research has individual benefits to physicians and trainees, and may also positively impact society at large, such that mentally healthy physicians provide higher quality patient care (Makary and Daniel,

[1] Medical professionals: term used throughout this article to describe physicians, residents and medical students.
[2] Trainees: term used throughout this article to describe residents and medical students.

2016). The high rates of mental illness and burnout in medical professionals as well as the impact of their mental health on patient care, makes physicians and trainees a population that is crucial to examine and support through mental health research.

Many studies have offered recommendations on how to recruit hard-to-reach populations (e.g., migrants, homeless; Shaghaghi et al., 2011); however, few have considered medical professionals. This is a gap because determining appropriate strategies to optimize recruitment, engagement and retention depend largely on our knowledge of the sub-group of interest (Shaghaghi et al., 2011); strategies that work for certain hard-to-reach populations may not necessarily be effective with medical professionals. Therefore, it is important to consider the unique characteristics of medical professionals when conducting research. The few articles that have discussed recruitment of medical professionals in research mostly focus on 1-2 strategies (e.g., reminders; Cook et al., 2016); none have provided a comprehensive list of recommendations on how to not only recruit, but also engage and retain physicians and trainees. Finally, previous literature has not defined strategies to conduct mental health research in medical professionals, which is a growing area.

This leads to the purpose of this monograph, which is to offer evidence-based strategies for conducting mental health research in medical professionals to optimize recruitment[3], engagement[4] and retention[5].

[3] Recruitment: The process by which individuals are recruited as potential subjects in a research study (Encyclopedia of Behavioral Medicine, 2013).
[4] Engagement: Active participation of subjects throughout the course of a research study.
[5] Retention: Complete participation of subjects in a research study (Encyclopedia of Behavioral Medicine, 2013).

Strategies to optimize recruitment, engagement and retention

Once a research problem has been identified, specific research questions have been defined and a research design has been selected, there are many strategies that may be considered when conducting research to enhance recruitment, engagement and retention of medical professionals. When deciding whether to incorporate these strategies, always consider your research questions and design to ensure the integrity of your study is maintained. The following section offers ten potential strategies to consider when conducting your research.

1. Limit participant burden

- Limit the number of questions/items included in your data collection tool (e.g., questionnaires, interview/focus group guides, checklists, etc.) to promote engagement and retention.
    - When administering questionnaires, consider using abbreviated versions of scales, that have been deemed valid and reliable, instead of full versions. Abandon rates[6] increase for questionnaires that take more than 7-8 minutes to complete (SurveyMonkey, 2020) and this abandon rate likely occurs more quickly for physicians and learners who have minimal time to commit to research.
- Consider the usability of your data collection tool. For example, ensure that questionnaires are easy to fill out, phone applications are simple to download/use, interview questions are clear and concise, etc.
- Minimize the number of measurement time points as much as possible, while still adhering to your research design.

[6]Abandon rates: The number of subjects who abandon research prior to completion.

- Shorten the follow-up period (if possible) to improve retention over time (National Research Council, 2010; Little et al., 2012).

2. Consider question sequence during data collection

- When collecting data quantitatively, include less burdensome questions at the beginning of your tool to increase engagement and limit abandon rates (Dyrbye et al., 2018). The most important questions (e.g., measures that address your primary research questions) should be placed close to the beginning in case participants fail to complete the entire tool (Dyrbye et al., 2018). However, be cognisant of the potential impact of item-order-effects in psychological research (i.e., when the order of questions affects participant responses; Weinberg et al., 2016).
- For qualitative research, be sure to include less intrusive "easy" questions at the beginning of your interview guide in order to make your participants feel comfortable, prior to asking more sensitive questions related to mental health/illness (McGrath, 2018). This will also increase engagement throughout the interview.

3. Conduct studies that maximize participant choice and allow for flexibility

- Emphasize individual preferences, promote enjoyment and increase well-being by providing participants with a menu of options, such as different levels of intervention intensity, frequency, duration, type, etc. (Fortier, McFadden & Faulkner, 2020; Teixeira et al., 2012). This will promote engagement and retention.
- To accommodate the demanding schedules of medical professionals, and to optimize recruitment, be flexible by suggesting a range of dates/times to participate and offer choices of study sites/locations to meet, including in-person and virtually.

4. ***Consider broadening your inclusion criteria to increase the pool of participants you can recruit***

- Previous research has shown that there are very few significant differences in mental health, burnout, depression and suicidal ideation among medical professionals according to demographics (CMA, 2017). This suggests that medical professionals in general can benefit from mental health interventions (i.e., not just female physicians, or surgeons). Considering this, it might be appropriate to broaden the inclusion criteria to include a range of participant ages, genders, ethnicities, years of training/practice, area of practice, etc. However, this will depend largely on your research questions.

5. ***Carefully consider the timing of recruitment and data collection***

- Be aware of the typical schedule of your study population and plan data collection accordingly. For instance, if you are conducting research with medical students, avoid exam periods when rates of psychological distress and/or mental illness might be heightened (causing biased results). Avoid conducting research during breaks in the academic calendar as well, because students might be away on vacation and/or taking a break and be less responsive to emails. Both time periods would result in poor recruitment, engagement and retention of subjects.

6. ***Employ multiple sampling techniques to optimize recruitment***

- Time-location (space) sampling: identify different locations where medical professionals are known to gather and make a group announcement and/or approach select individuals about the study. For example, announcements made in mandatory medical student classes, handouts at medical conferences and hospitals, etc. In-person recruitment has been

recommended as an effective strategy for engaging physicians in research (McKinn et al., 2014).

- Snowball (chain, chain-referral, referral) sampling: ask individuals who have already agreed to participate in your study to recommend and/or introduce you to other potential participants in their social networks who they think might be interested in participating. Having someone known to the invitee champion the study has been recommended previously in physician populations (Cook et al., 2016).

7. Offer financial and non-financial incentives

- Apply for funding and obtain ethical approval to offer financial incentives, as a strategy to recruit, engage and retain participants (Abshire et al., 2017). Previous research has shown that incentives increase physician response rates to surveys (Noel and Huang, 2018; Signorelli et al., 2017; VanGeest et al., 2007; VanGeest et al., 2015), particularly prepaid incentives compared to incentives promised post-survey completion (Pit et al., 2013). Incentives are shown to increase physician response rate because they show appreciation and instill a sense of trust and value in the research (VanGeest et al, 2015). Financial incentives are likely even more effective for recruiting and retaining medical students who have reported finances as a major source of stress (Hill et al., 2018).
- Apply to have your research certified by the College of Family Physicians of Canada for Mainpro+ credits and/or accredited by the Royal College of Physicians and Surgeons of Canada for Maintenance of Certification credits, as a non-financial incentive to offer participants.

8. Emphasize study benefits

- Clearly defining the benefits of participating in research is a commonly used recruitment and retention strategy (Abshire et al., 2017), and this might be especially effective among medical professionals. Indeed, one of the main reasons why physicians pursue a career in medicine is because they want to make a positive impact on other people's lives (Gillies et al., 2009). This is why it is important when conducting mental health research on medical professionals to highlight both the personal benefits (e.g., improvements in their own mental health) and altruistic benefits (e.g., strengthening the physician-patient relationship, improving the quality of care provided to patients; Makary and Daniel, 2016). Indeed, previous research has indicated that perceiving a study to be valuable and relevant is important for physicians, when deciding whether to participate (Signorelli et al., 2017; Kaner et al., 1998).

9. Emphasize confidentiality of data

- Ensuring confidentiality is particularly important when conducting mental health research with medical professionals. The cultural and societal stigma around mental illness in medicine, and fears concerning confidentiality, remain significant barriers to admitting to vulnerability and seeking help (CMA, 2017; Mehta and Edwards, 2018). Thus, in order to recruit participants, and to collect data that accurately reflects medical professionals' mental heath, researchers must maintain confidentiality and protect all personal information.

10. Create and maintain positive relationships with study participants

- Always communicate politely with potential participants during recruitment and throughout the duration of your study.
- When conducting longitudinal research:

- Establish positive relationships and maintain regular contact/communication with your participants (Kearney et al., 2017) to enhance engagement and retention. Aim for one member of the research team to be in contact with participants (as opposed to multiple members), for consistency and to build familiarity.
- Stay organized by using spreadsheets to monitor participants throughout the study so that you can detect missing data when it occurs, and promptly follow-up with individuals (Abshire et al., 2017).
- Send personalized reminders to participants using first names and warm greetings; personal touches are important for retention (Abshire et al., 2017).

In sum, there are many strategies that may be considered when determining research methods, that may help enhance the participation of medical professionals. Keep in mind that these are options to consider; it is unlikely that all of these recommendations will apply to your research.

Conclusion

To conclude, the purpose of this monograph was to offer evidence-based strategies for conducting mental health research to optimize recruitment, engagement and retention of medical professionals. This paper generates knowledge that may be used to inform the planning of future research aiming to support the mental health of medical professionals. Ultimately, this will benefit individual physicians, patients, and the health system at large.

Disclosures and Declarations

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CHAPTER EIGHT: GENERAL DISCUSSION

This general discussion provides an overview of my program of research, a summary of findings from Study One and Study Two according to each article, the knowledge, methodological, and practical contributions, as well as the study limitations and opportunities for future research.

Program of Research

This dissertation contributes to the growing body of literature examining medical student mental health and physical activity participation. Medical students are at an increased risk of experiencing psychological distress and mental illness, compared to the general population (Maser & Houlton, 2017; Rotenstein et al., 2016). Decreases in physical activity levels have also been shown throughout medical school (Morris et al., 2012), despite the significant mental health benefits associated with being active (Ravindran et al., 2016; Schuch et al., 2016; Wegner et al., 2014). This is concerning not only at an individual level for the medical students, but it also has an impact on the quality of care provided to patients in future medical practice such that mentally healthy physicians provide higher quality patient care (de Oliveira et al., 2013). Moreover, physically active physicians are more likely to address physical activity with their patients (Frank et al., 2008; Lobelo & de Quevedo, 2016) which is an important preventive approach and treatment option for several chronic physical and mental health illnesses (Hoffman et al., 2016). While the positive association between physical activity and mental health is well-known, what remains less clear is the relationship between the different physical activity intensities and mental health. Moreover, while we know that active medical professionals are more likely to prescribe physical activity, the underlying mechanisms (e.g., confidence, motivation) need to be further researched. This led to Study One which investigated the relationships between physical activity participation (total, mild,

moderate, strenuous) and mental health of medical students, as well as their confidence, motivation and frequency in recommending physical activity in future medical practice. Published Articles One, Two and Three report on findings from Study One.

After gaining a better understanding of the abovementioned relationships, showing that medical students who engage in more mild physical activity had higher levels of mental health in Article One (though not significantly), that physically active medical students are more confident, and thus more likely, to prescribe physical activity to patients in future practice (Article Two), and that first and second year students are more motivated to recommend physical activity to patients in future medical practice (Article Three), a logical next step was to design, implement and evaluate the impact of an intervention aimed at improving mental health and physical activity levels of medical students in first and second year. When designing Study Two, it was important to consider the type of mental health intervention that would be most appropriate for medical students. Indeed, medical students report a reluctance to seek help from formal health professionals (Dyrbye et al., 2015; Thistlethwaite et al., 2010), indicating that their preferred help-seeking source is a family member or peer (Hope, Dring, & Dring, 2005). Considering this, peer support was chosen as an approach that could benefit medical students and that might be accepted by this population. While some research has reported on the benefits of peer support offered to physicians (Shapiro & Galowitz, 2016; West et al., 2014), there is very limited research on the impact of peer support delivered to medical students specifically. Moreover, no previous research has incorporated physical activity into a peer support intervention/program, which could further amplify the mental health benefits. As such, Study Two evaluated the impact of a peer support walking intervention aimed at improving the mental health and physical activity participation of medical students. Article Four reports on findings from the intervention and Article Five provides evidence-based

recommendations for how to recruit, retain and engage medical professionals in mental health research, based on the knowledge acquired and lessons learned from Studies One & Two.

Summary of Findings

Study One

This study involved a cross-sectional research design, using an online survey composed of validated scales, distributed to 1st to 4th year medical students at three large Canadian universities (N = 221). Three articles, published in peer-reviewed medical journals, report on findings from this study. Article One used latent profile analysis to identify three distinct mental health profiles among participants, showing *low*, *moderate* and *high* self-reported ratings of mental health. Individuals in the *high* mental health profile reported engaging in more mild physical activity and less MVPA compared to students in the *moderate* and *low* profiles, suggesting that mild physical activity might be the most effective intensity in supporting the mental health of medical students. However, this finding was not statistically significant, likely due to low statistical power, so future research was recommended.

Article Two focused on the underlying mechanism(s) contributing to frequency in recommending physical activity to patients, to provide insight into how we can increase physical activity recommendations among medical students in future practice as physicians. Results showed that students were more motivated, than they were confident, to assess, advise, counsel, prescribe and refer patients regarding physical activity. Indeed, only 52% of students were able to accurately recall the Canadian physician activity guidelines. Significant, positive correlations were shown between medical students' total physical activity participation (summation of mild, moderate and strenuous) and their frequency of assessing, advising, and prescribing physical activity to patients.

Strenuous physical activity was more strongly correlated to frequency of recommending physical activity compared to total, mild and moderate.

Article Three considered demographic differences in Canadian medical students' motivation and confidence to promote physical activity. Results showed that female participants were more motivated to counsel patients on physical activity and refer patients to an exercise specialist, compared to males. Considering year of study, second year students were more motivated to assess a patients' level of physical activity compared to third and fourth year students, and first and second year students were more motivated to refer compared to fourth year students. Students pursuing family medicine were more confident to assess and counsel compared to students pursuing pediatrics. These results may be used to inform future efforts to increase physical activity promotion in medical practice, an important preventive and therapeutic approach.

Study Two

This study involved the delivery of a two-month informal peer support walking intervention aimed at improving the mental health and physical activity participation of first and second year medical students.[1] This study was conducted during the COVID-19 pandemic from March – August 2020. Article Four reports on the implementation and evaluation of the intervention. Overall, results showed that while levels of mental health and physical activity did not increase, they did remain relatively stable and high from baseline to intervention and follow-up. Considering the broader context, this was a positive finding in terms of prevention. Indeed, recent literature shows that mental health and physical activity levels in the general population and in medical professionals

[1] A walking intervention was chosen based on findings from Article 1, suggesting that mild physical activity might be the most effective intensity in supporting the mental health of medical students. The mental health benefits of walking are widely supported in the literature (e.g., Fortier, McFadden, & Faulkner, 2020; Mammen & Faulkner, 2013; Robertson, Robertson, & Jepson, 2012; White et al., 2017).

specifically has suffered as a result of the pandemic (Medscape, 2020; Sartorao Filho et al., 2020; Xiong et al., 2020). Implementation findings were also positive, showing that participants adhered to the study protocol (i.e., participated in weekly sessions, discussed relevant topics, supported each others' basic psychological needs and offered high levels of social support to one another).

Finally, Article Five outlines ten evidence-based strategies for conducting mental health research in medical professionals to optimize recruitment, engagement and retention (e.g., conduct studies that maximize participant choice and allow for flexibility; carefully consider the timing of recruitment and data collection). These strategies are science-informed and were derived from lessons learned in Studies One and Two. This information may be used to inform the planning of future research aiming to support the mental health of medical professionals.

Collectively, the five articles presented in this thesis offer several noteworthy strengths, including knowledge, methodological and practical contributions that may inform future research supporting the mental health and physical activity participation of medical students.

Knowledge Contributions

Previous research investigating the mental health of medical students has focused predominantly on the presence of mental illness. Accordingly, recommendations to focus on promoting mental health among medical students, have been put forth (Dyrbye & Shanafelt, 2015). Studies One and Two are in line with this proactive approach. Moreover, Study One fills several important gaps, such as investigating the relationship between physical activity intensities (mild, moderate, strenuous) and mental health in medical students (Article One). Additionally, while previous research has shown that active medical professionals are more likely to prescribe physical activity, the underlying mechanisms have not been considered, which was another gap that Study

One addressed (Article Two). Finally, previous research has not considered the association between multiple demographics (i.e., gender, ethnicity, year of study, university, proposed specialty, academic background) and medical students' motivation and confidence to recommend physical activity, another knowledge contribution of Study One (Article Three).

Regarding Study Two (Article Four), the effectiveness of a peer support walking intervention had not been examined previously, in any population. While research has investigated peer support groups among medical professionals, few have been done with medical students and none have incorporated a physical activity component. Medical students are an important population to target, as their levels of physical activity decrease during medical school, they show a high prevalence of mental health issues, and as future physicians, they will have a significant influence on quality of care and physical activity engagement at the population level. Finally, while a few articles have examined how to recruit medical professionals as research subjects, they have only included 1-2 strategies. None have provided a comprehensive list of recommendations on how to recruit, engage and retain physicians and trainees, a gap that Article Five addresses.

Methodological Contributions

There are a few notable methodological contributions of this dissertation that are important to acknowledge. As discussed in Article Five, medical students are a difficult population to recruit, engage and retain in research given their heavy workloads, busy schedules, competing priorities, etc. Knowing this, a single-subject design was used for Study Two, which has been recommended as the gold standard for providing evidence of effective interventions when you anticipate a small sample size (Naughton & Johnston, 2014). Although this design has been used previously in other bodies of literature (e.g., Baragash, Al-Samarraie, Alzahrani, & Alfarraj, 2020; Goodman et al., 2017; McFadden et al., 2017; Mesa & Restrepo, 2019), it has not been applied with a medical

student sample, who are a difficult population to recruit, especially for intervention research that requires more time commitment than surveys. Indeed, despite using multiple recruitment strategies, only ten students agreed to participate in Study Two, which was enough for a single-subject design, but would not have been adequate to achieve power for a randomized controlled trial, for example.

Another methodological strength of this dissertation is the use of several advanced statistical analyses performed in a variety of statistical software programs. To illustrate, Article One used latent profile analysis, a mixture model using continuous latent profile indicators, performed in Mplus. Article Two ran hierarchal multiple regression analysis and path analysis in SPSS. Also performed in SPSS, a multivariate analysis of variance was run for Article Three. Finally, Article Four tested autocorrelation and level change using the Simulation Modeling Analysis program. This demonstrates breadth and depth of knowledge in statistical analysis.

Finally, another notable methodological contribution is the delivery of peer support in a virtual context (i.e., walking while talking over the phone). While initially Study Two was meant to be in-person, the research ethics boards of participating universities put all face-to-face research on hold in March 2020 to respect the COVID-19 physical distancing recommendations. While this was a necessary precaution, we felt it was more important than ever for medical students to continue connecting with their peers. As such, an ethics modification was made for the peer support walking sessions to be done individually, while talking on the phone with one another. This format may have contributed to the positive implementation findings in Article Four which showed that 80% of our sample engaged in a total of eight sessions, as per the study protocol. Indeed, this allowed for participant choice and flexibility in where they walked and at what pace, which was one of the evidence-based strategies reported in Article Five. Moreover, this format could be practical for third

and fourth year medical students who are traveling for their clerkship rotations which makes it difficult for in-person sessions.

Practical Contributions

This thesis also had several practical contributions. For instance, Study One (Article Three) identified demographic differences in medical students' motivation and confidence to recommend physical which may help inform the design of physical activity promotion interventions and educational efforts to incorporate physical activity training into the medical curriculum. For instance, medical schools should offer interactive physical activity training to first and second year medical students when motivation to recommend physical activity is high (compared to clerkship years). Results from this study are also useful for patients who are seeking a new physician, to know who may be more likely to focus on prevention, as opposed to pharmacologic, surgery, and other modes of treatment.

Furthermore, this dissertation aimed to improve medical student mental health at an individual level, which may extend beyond that to also have an impact on their patients in future medical practice. For example, burnout among medical professionals is linked to an increased risk of medical errors, which are highly prevalent and costly (Makary & Daniel, 2016). Medical students will become physicians, it is important to be proactive and improve their mental health, in order to prepare them to provide quality patient care in future medical practice. Another consequence of physician burnout is reduced work hours and increased odds of leaving the profession (Dyrbye et al., 2017), further demonstrating the economic costs associated with poor physician health.

Although results of Study One (Article One) did not reach statistical significance, they do suggest that mild physical activity might be the most effective intensity in supporting the mental health of medical students. Considering this, medical schools are encouraged to implement

compulsory physical activity blocks (two to three times per week) where students are encouraged to engage in mild physical activity of their choice (e.g., walking, stretching, yoga). Building from this, findings from Study Two (Article Four) showed that a peer support walking intervention may be a proactive, preventive approach to maintaining medical student mental health and physical activity levels during stressful situations. Maintaining mental health during medical school, may make students less likely to make a medical error in future practice, and less likely to leave the profession early.

Additionally, active medical students are more confident and thus likely to focus on physical activity with their patients in future practice (as per results from Article Two, Study One). While evidence supports that physical activity significantly reduces the risk of chronic diseases, physical activity remains under prescribed in practice (Hoffmann et al., 2016; Pedersen & Saltin, 2015). Active physicians are more likely to focus on physical activity with their patients, thus maintaining high physical activity levels among medical students has the potential to result in a more active and healthy population. Therefore, peer support while walking should offered within medical student wellness programs as an important prevention strategy.

Limitations and Future Research

While there were many strengths associated with this dissertation, there were also study limitations and areas for future research. Study One limitations were thoroughly described in Articles One, Two and Three; however, Study Two limitations were only briefly mentioned in Article Four due to page restrictions. Therefore, this section expands primarily on the limitations of Study Two and highlights subsequent recommendations for future research.

Theoretical framework and peer support training

While certain aspects of the Self-Determination Theory (SDT) were included in Study Two (e.g., measuring psychological needs satisfaction at endpoint), formal peer support training was not provided to participants in advance. Although this was a consideration when designing the study, it was decided that informal peer support (i.e., supportive conversations between peers who share a similar experience, who have not been formally trained; Well Doc Alberta, 2020) would better reflect the real-world and improve ecological validity. Nevertheless, requiring training may have led to greater improvements in mental health and physical activity levels among medical students in Study Two. There are clear synergies between the underlying values of peer supporters and the SDT. Indeed, previous theory-driven research on peer support has been based on the SDT (e.g., Cherrington et al., 2015; Moran et al., 2014). As such, future research should deliver a peer support training workshop prior to starting the intervention. This training could involve didactic learning about the SDT (e.g., basic needs of competence, autonomy and relatedness) as well as experiential learning whereby students are able to practice how to be need supportive on their peers using mock scenarios. Training could also include information on how to recognize and support distressed colleagues (McFadden, 2020), especially if delivering peer support to medical students with mental health challenges. Finally, future research should consider developing and validating set training standards for peer supporters to promote consistency in formal peer support programs offered nationally. While this type of research would be valuable, it will require a great deal of resources, so investment and buy-in from medical associations, organizations, educators, granting agencies, etc. will be necessary.

Single-subject research design

Single-subject research designs have many strengths, including the ability to detect significant effects in small samples (Gorcynski, 2013) and requiring minimal resources (e.g., time, money, personnel) compared to large-sample designs (Lobo, Moeyaert, Cunha, & Babik, 2017); nevertheless, they are not without limitations. First and foremost, single-subject research typically has poor generalizability (Portney & Watkins, 2015). Interventions that are effective in one individual or a small group of participants may not be effective for the population at large. However, the multiple baseline single-subject design used in this study, which introduces the intervention to multiple participants at different times, does help overcome this limitation. Second, single-subject designs do not allow for more advanced statistical analyses, such as testing for mediation. For example, it would be interesting to see if physical activity participation (total and intensities: mild, moderate, strenuous) and/or social support (total and subscales: friends, family, significant other) mediated the relationship between the PSW intervention (independent variable) and mental health (dependent variable). Similarly, single-subject designs look at differences within-subjects and typically do not have enough power to consider differences between-groups, which could have provided insight into results from Study Two. For instance, comparing differences in outcomes according to self-selected vs. randomly matched peers as well as between same gender vs. mixed gender peers would have been interesting to explore. Future research should consider employing different research designs, such as randomized controlled trials with larger and diverse samples, to further investigate these relationships. However, medical students are a difficult population to recruit in research; so, the recommendations offered in Article Five should be considered when planning future research, to maximize sample size.

Quantitative research methods

Studies One and Two were completely quantitative in nature, using online surveys composed of validated self-report scales. Using quantitative methods are useful as they are relatively cost-efficient and require minimal time for participants to complete (Sue & Ritter, 2012), which is important when considering an already overburdened population of medical students. However, quantitative research does have limitations, such as being vulnerable to response bias and they typically focus on breadth of information versus depth, which may cause important information to be missed (Creswell, 2013; Fowler & Cosenza, 2009). To illustrate, the topic checklists used in Study Two were incorporated to ensure that students were participating in their weekly sessions and that relevant topics were being discussed (e.g., friendships, faculty, physical activity, etc.). However, this quantitative tool offered limited information with respect to the nature of these discussions. For example, were conversations about physical activity positive or negative? How much time was spent on each topic? Future peer support research should consider incorporating a qualitative component (e.g., follow-up interviews) to gain more insight into the nature and quality of the discussions themselves and also the impacts of the intervention. This could involve an explanatory sequential mixed methods research design which involves a two-phase process whereby quantitative data is collected and analyzed first, followed by qualitative data (Creswell, 2014).

Length of PSW intervention

The PSW intervention delivered in Study Two was two months in duration (eight sessions in total) with a three-month follow-up period. This length was chosen for feasibility reasons; that is, to complete this doctoral degree in a reasonable time, given that it was not the only study included in this dissertation. However, it is possible that participants required more peer support walking

sessions to achieve mental health benefits and increases in physical activity. Previous research exploring the psychotherapy dose-response has shown that a minimum of eight sessions are required to see reliable change (Chen & Keenan-Miller, 2020). With respect to physical activity and mental health, recommendations have been made to engage in physical activity three-four times per week for a minimum of nine weeks to achieve mental health benefits (Stanton & Reaburn, 2014). That results in a minimum of 27 physical activity sessions, which is significantly more than the eight peer support walking sessions in Study Two. Moreover, previous research has indicated that follow-ups of ≥12 months are required to evaluate long term maintenance (Samdal, Eide, Barth, Williams, & Meland, 2017). Taken together, future research should consider delivering a longer PSW intervention, incorporating more frequent physical activity sessions/week, with at least a year of follow-up to determine maintenance.

Delivery of PSW intervention during COVID-19 pandemic

Delivering the PSW intervention during the COVID-19 pandemic allowed for examining whether peer support could be an effective proactive intervention for maintaining mental health and physical activity levels of medical students during stressful situations. Indeed, results of Study Two showed that there were relatively few significant changes in the outcome variables among participants, at a time when significant decreases in mental health and physical activity levels where shown among the general population (Xiong et al., 2020) and medical professionals specifically (Sriharan et al., 2020; Medical Economics, 2020; Medscape et al., 2020), including medical students (Sartorao Filho et al., 2020). However, if Study Two had not been conducted during a global pandemic, it is possible that greater benefits would have been seen among participants. As such, future research should replicate this study under “normal” conditions to examine whether a PSW intervention can not only maintain, but also boost, mental health and physical activity levels of medical students.

Conclusion

Medical students are at a high risk of experiencing poor mental health and although physical activity offers numerous psychological benefits, activity levels have been shown to decrease throughout medical education. This is concerning because physician mental health has been shown to influence quality of patient care and a physicians' physical activity levels are related to the frequency in which they recommend physical activity to their patients. Taken together, proactively supporting medical students' physical activity levels and mental health may lead to better patient outcomes during doctorhood. This thesis contributes to the growing body of literature on medical student mental health, offering several knowledge, methodological and practical contributions.

This doctoral dissertation supports the positive relationship between medical student physical activity levels and their frequency in recommending physical activity to patients in future medical practice (Study One). Moreover, this research showed that medical students who engage in more mild physical activity have higher levels of mental health (Study One). Building from those findings, a peer support walking intervention was developed and implemented and found to be an effective proactive strategy for maintaining mental health and physical activity levels of medical students during stressful situations (Study Two). Although it is promising to see national leadership acknowledging student wellness as a priority (e.g., The Association of Faculties of Medicine of Canada, 2018; Canadian Medical Association, 2018), there is still work to be done to ensure that every medical school has a robust student wellness program. This research helps build the case for why peer support incorporating mild physical activity should be considered for inclusion within medical student wellness programs as an effective prevention strategy. This may help medical students thrive as physicians and lead to the provision of high quality patient care.

CONTRIBUTIONS OF AUTHORS

I, Taylor McFadden, was responsible for the conceptualization, data collection, data analyses, interpretation of results and writing of five articles for this doctoral dissertation. Dr. Michelle Fortier offered valuable input on the conceptualization and design of the two research studies and provided significant feedback on each of the five articles. Dr. Jennifer Tomasone assisted with obtaining ethics approval at Queen's University for Studies One and Two and offered feedback as a co-author on Articles One, Two, Three and Four. Dr. Shane Sweet assisted with obtaining ethics approval at McGill University for Study One and provided feedback as a co-author on Articles One, Two and Three. Medical residents, Dr. Ryan McGinn and Dr. Brendan Levac, assisted with coordinating data collection for Study One and provided feedback as co-authors on Articles Two and Three. Doctoral candidate, Tamara Morgan, assisted with coordinating data collection for Studies One and Two and offered feedback as a co-author on Article Four.

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APPENDICES

APPENDIX A: RESEARCH ETHICS BOARD APPROVAL NOTICES

Study One: University of Ottawa Ethics Clearance

File Number: H06-16-40 **Date (mm/dd/yyyy):** 03/09/2017

Université d'Ottawa University of Ottawa
Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

Certificate of Ethics Approval

Health Sciences and Science REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

First Name	Last Name	Affiliation	Role
Michelle	Fortier	Health Sciences / Human Kinetics	Supervisor
Shane	Sweet	Health Sciences / McGill University	Co-investigator
Brendan	Swift	Medicine / McGill University	Co-investigator
Jennifer	Tomasone	Health Sciences / Queens University	Co-investigator
Brendan	Levac	Health Sciences / Human Kinetics	Student Researcher
Taylor	McFadden	Health Sciences / Human Kinetics	Student Researcher
Ryan	McGinn	Health Sciences / Human Kinetics	Student Researcher

File Number: H06-16-40

Type of Project: Independent Student Project

Title: Health Behaviours and Prescribing Habits of First to Fourth Year Medical Students

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)
02/07/2017	02/06/2018

Special Conditions / Comments:
N/A

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Ottawa (Ontario) K1N 6N5 Canada Ottawa, Ontario K1N 6N5 Canada
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Study One: McGill University Ethics Clearance

McGill

Research Ethics Board Office
James Administration Bldg.
845 Sherbrooke Street West. Rm 325
Montreal, QC H3A 0G4

Tel: (514) 398-6831

Website: www.mcgill.ca/research/researchers/compliance/human/

Research Ethics Board II
Certificate of Ethical Acceptability of Research Involving Humans

REB File #: 177-0917

Project Title: Health Behaviours and Prescribing Habits of First to Fourth Year Medical Students

Lead Investigator: Prof. Shane Sweet

Department: Kinesiology & Physical Education

Co- Investigators: Jennifer Tomasone, Queen's University; Michelle Fortier, University of Ottawa; Taylor McFadden, University of Ottawa; Ryan McGinn, University of Ottawa; Brendan Levac, University of Ottawa; Brendan Swift, McGill University

Approval Period: October 24, 2017 to October 23, 2018

The REB-II reviewed and approved this project by full board review in accordance with the requirements of the McGill University Policy on the Ethical Conduct of Research Involving Human Participants and the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.

Deanna Collin
Ethics Review Administrator, REB I & II

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* Approval is granted only for the research and purposes described.
* Modifications to the approved research must be reviewed and approved by the REB before they can be implemented.
* A Request for Renewal form must be submitted before the above expiry date. Research cannot be conducted without a current ethics approval. Submit 2-3 weeks ahead of the expiry date.
* When a project has been completed or terminated, a Study Closure form must be submitted.
* Unanticipated issues that may increase the risk level to participants or that may have other ethical implications must be promptly reported to the REB. Serious adverse events experienced by a participant in conjunction with the research must be reported to the REB without delay.
* The REB must be promptly notified of any new information that may affect the welfare or consent of participants.
* The REB must be notified of any suspension or cancellation imposed by a funding agency or regulatory body that is related to this study.
* The REB must be notified of any findings that may have ethical implications or may affect the decision of the REB.

Study One: Queen's University Ethics Clearance

QUEEN'S UNIVERSITY HEALTH SCIENCES & AFFILIATED TEACHING HOSPITALS RESEARCH ETHICS BOARD (HSREB)

HSREB Initial Ethics Clearance

October 31, 2017

Dr. Jennifer Tomasone
School of Kinesiology and Health Studies
Queen's University

ROMEO/TRAQ: #6022151
Department Code: PHE-172-17
Study Title:PHE-172-17 Health Behaviours and Prescribing Habits of First to Fourth Year Medical Students
Co-Investigators: Dr. M. Fortier, Dr. S. Sweet, Ms. T. McFadden
Review Type: Delegated
Date Ethics Clearance Issued: October 31, 2017
Ethics Clearance Expiry Date: October 31, 2018

Dear Dr. Tomasone,

The Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (HSREB) has reviewed the application and granted ethics clearance for the documents listed below. Ethics clearance is granted until the expiration date noted above.

- Survey – Version 2
- Recruitment Text – Version 2
- Information/Consent Form – Version 2

Documents Acknowledged:

- University of Ottawa HSREB Approval Letter – February 7, 2017
- Queen's UGME Clearance – October 10, 2017

Amendments: No deviations from, or changes to the protocol should be initiated without prior written clearance of an appropriate amendment from the HSREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

Renewals: Prior to the expiration of your ethics clearance you will be reminded to submit your renewal report through ROMEO. Any lapses in ethical clearance will be documented on the renewal form.

Completion/Termination: The HSREB must be notified of the completion or termination of this study through the completion of a renewal report in ROMEO.

Reporting of Serious Adverse Events: Any unexpected serious adverse event occurring locally must be reported within 2 working days or earlier if required by the study sponsor. All other serious adverse events

Study Two: University of Ottawa Ethics Clearance

14/08/2019

Université d'Ottawa
Bureau d'éthique et d'intégrité de la recherche

University of Ottawa
Office of Research Ethics and Integrity

CERTIFICAT D'APPROBATION ÉTHIQUE | CERTIFICATE OF ETHICS APPROVAL

Numéro du dossier / Ethics File Number	H-06-19-4226
Titre du projet / Project Title	Implementing a Peer Support Walking Pair Intervention to Assess Well-Being and Physical Activity Levels in First to Fourth Year Medical Students
Type de projet / Project Type	Thèse de doctorat / Doctoral thesis
Statut du projet / Project Status	Approuvé / Approved
Date d'approbation (jj/mm/aaaa) / Approval Date (dd/mm/yyyy)	14/08/2019
Date d'expiration (jj/mm/aaaa) / Expiry Date (dd/mm/yyyy)	13/08/2020

Équipe de recherche / Research Team

Chercheur / Researcher	Affiliation	Role
Taylor MCFADDEN	École des sciences de l'activité physique / School of Human Kinetics	Chercheur Principal / Principal Investigator
Michelle FORTIER	École des sciences de l'activité physique / School of Human Kinetics	Superviseur / Supervisor
Jennifer TOMASONE	Queen's University	Co-chercheur / Co-investigator
Dania RIDA	École interdisciplinaire des sciences de la santé / Interdisciplinary School of Health Sciences	Assistant de recherche / Research Assistant

Conditions spéciales ou commentaires / Special conditions or comments

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Study Two: Queen's University Ethics Clearance

Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (HSREB)

HSREB Initial Ethics Clearance

August 28, 2019

Dr. Jennifer Tomasone
School of Kinesiology and Health Studies
Queen's University

TRAQ #: 6027267
Department Code: PHE-183-19
Study Title: "PHE-183-19 Implementing a Peer Support Walking Pair Intervention to Assess Well-Being and Physical Activity Levels in First to Fourth Year Medical Students"
Co-Investigators Dr. Michelle Fortier and Ms. Taylor McFadden
Review Type: Delegated
Date Ethics Clearance Issued: August 28, 2019
Ethics Clearance Expiry Date: August 28, 2020

Dear Dr. Tomasone:

The Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (HSREB) has reviewed the application and granted ethics clearance for the documents listed below. Ethics clearance is granted until the expiration date noted above.

- Consent: Appendix A v.2019AUG16
- Survey: Appendix C v.2019AUG16
- Recruitment Materials: Interview Guide v.2019JUN26
- Recruitment Materials: Recruitment Text: Appendix B v.2019AUG16

Documents Acknowledged:

- CV: Tomoasone
- Ethics Training Certification: McFadden, Tomoasone
- Supervisor's Letter: Email v.2019AUG02

Amendments: No deviation from, or changes to the protocol, informed consent form and conduct of study should be initiated without prior written clearance or an appropriate amendment from the HSREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the study.

APPENDIX B: QUESTIONNAIRES AND IMPLEMENTATION TOOL

Study One: University of Ottawa Online Survey

1. Have you heard of the Canadian Physical Activity Guidelines? (please check)
   - ☐ Yes
   - ☐ No

2. According to the Canadian Physical Activity Guidelines, how many minutes per week of moderate- to vigorous- intensity physical activity is recommended for adults aged 18-64?

_____

3. Are you aware of the College of Kinesiologists of Ontario? (please check)
   - ☐ Yes
   - ☐ No

4. How knowledgeable are you on the scope of practice of a Kinesiologist? (please check)

Not at all Knowledgeable	Little Knowledge	Somewhat Knowledgeable	Knowledgeable	Very Knowledgeable

5. Please select which of the following apply to the scope of practice of a Kinesiologist (please check all that apply):
   - ☐ Preventing and managing injury
   - ☐ Preventing and managing chronic disease
   - ☐ Reducing time lost to injuries and accidents
   - ☐ Helping with return to work
   - ☐ I do not know the scope of practice of a Kinesiologist

6. In your opinion, how important is prescribing physical activity as preventative medicine? (please check):

Unimportant	Little Importance	Somewhat Important	Important	Very Important

7. In your opinion, how important is prescribing physical activity as therapeutic medicine? (please check):

Unimportant	Little Importance	Somewhat Important	Important	Very Important

8. In assessing a patient's level of physical activity with respect to the Canadian Physical Activity Guidelines, how…

	Not at all	A little	Somewhat	Quite	Very
a) **Confident** are you in <u>your current ability</u> to make an assessment?					
b) **Motivated** are you to make an assessment (i.e. do you want to do it)?					

9. In advising a patient to meet the Canadian Physical Activity Guidelines (e.g. recommending that the patient would benefit from becoming more active), how…

	Not at all	A little	Somewhat	Quite	Very
a) **Confident** are you in <u>your current ability</u> to advise a patient?					
b) **Motivated** are you to advise a patient (i.e. do you want to do it)?					

10. In counselling a patient about physical activity (e.g. helping the patient develop physical activity goals and a plan of action), how…

	Not at all	A little	Somewhat	Quite	Very
a) **Confident** are you in <u>your current ability</u> to counsel a patient?					
b) **Motivated** are you to counsel a patient (i.e. do you want to do it)?					

11. In providing a patient with a written physical activity prescription, how…

	Not at all	A little	Somewhat	Quite	Very
a) **Confident** are you in <u>your current ability</u> to provide a prescription?					
b) **Motivated** are you to provide a prescription (i.e. do you want to do it)?					

12. In providing a patient with a referral to an exercise specialist, how…

	Not at all	A little	Somewhat	Quite	Very
a) **Confident** are you in <u>your current ability</u> to provide a referral?					

b) **Motivated** are you to provide a referral (i.e. do you want to do it)?					

13. What year are you currently enrolled in? (please check)
- ☐ 1st
- ☐ 2nd
- ☐ 3rd
- ☐ 4th

LOGIC: Questions 14-18 apply to third and fourth year medical students only. These questions will only appear in the online survey if students indicate they are in fourth year.

14. How frequently do you assess a patient's level of physical activity with respect to the Canadian Physical Activity Guidelines? (please check)

Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently	Always

15. How frequently do you advise a patient to meet the Canadian Physical Activity Guidelines (e.g. recommending that the patient would benefit from becoming more active)? (please check)

Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently	Always

16. How frequently do you counsel a patient about physical activity (e.g. helping the patient develop physical activity goals and a plan of action)? (please check)

Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently	Always

17. How frequently do you provide written physical activity recommendations in collaboration with the attending physician? (please check)

Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently	Always

18. How frequently do you provide a patient with a referral to an exercise specialist? (please check)

Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently	Always

19. How much training has been dedicated to the topic of physical activity since you began medical school? (please check)

No Time	Little Time	Some Time	Enough Time	Extensive Time

20. You feel adequately prepared to prescribe physical activity (please check):

Strongly Disagree	Disagree	Somewhat	Agree	Strongly Agree

21. Compared to what you are receiving now, how much should the medical program at your university decrease or increase the curriculum on physical activity? (please check)

Decrease Greatly	Decrease Slightly	Stay the Same	Increase Slightly	Increase Greatly

22. In your opinion, how much training do physicians have in prescribing physical activity as preventative medicine? (please check)

None	Very Little	Some	Quite a Bit	Very Much

PHYSICAL ACTIVITY (LTEQ; Godin & Shephard, 1985):

Physical activity is any bodily movement produced by your muscles that use energy to occur. The following questions will ask you about the time you spent being physically active in a typical **7-Day period.** Please answer each question even if you do not consider yourself to be an active person. Please think about all activities you do at work, at school, as part of your house and yard work at home, to get from place to place and in your time for recreation, exercise or sport.

1. During a typical **7-Day period**, how many times on average do you engage in **strenuous** exercise (heart beats rapidly) (e.g. long distance bicycling, running, hockey, football, soccer, basketball)?
   _____ Times per week

   _____ Average minutes per session

2. During a typical **7-Day period**, how many times on average do you engage in **moderate** exercise (not exhausting) (e.g. fast walking, baseball, easy bicycling, volleyball, badminton, dancing)?
   _____ Times per week

   _____Average minutes per session

3. During a typical **7-Day period**, how many times on average do you engage in **mild** exercise (minimal effort) (e.g. yoga, golf, bowling, easy walking, fishing)?
   _____Times per week

   _____Average minutes per session

4. During a typical **7-Day period**, how many times on average do you spend **sitting** on a **weekday?** _____ **Hours** per day

DEMOGRAPHICS:

1. Gender (please check):
   - ☐ Male
   - ☐ Female
   - ☐ Other (please specify) _____

2. What is your age? _____ years

3. Which of the following describes your ethnicity? (please check)
   - ☐ White
   - ☐ Hispanic
   - ☐ Aboriginal Canadian
   - ☐ Black or African American
   - ☐ Asian
   - ☐ Other (please specify): _____

ACADEMICS:

1. Highest level of education to date (please check):
   - ☐ College Degree
   - ☐ University- Bachelor-level Degree (BA, BSc, etc.)
   - ☐ University- Master-level Degree (PhD, DPhil, EdD, etc.)
   - ☐ University- Professional Post-Graduate
   - ☐ Other (Please Specify): _____

2. Which university are you attending while completing your medical studies? (please check)
   - ☐ McGill University
   - ☐ University of Ottawa- Anglophone stream
   - ☐ University of Ottawa- Francophone stream
   - ☐ Queen's University

3. Throughout your academic studies, which programs have you completed? (check all that apply)
   - ☐ General Sciences (Biology, Chemistry, Physics, etc.)
   - ☐ Health Sciences
   - ☐ Social Sciences
   - ☐ Kinesiology/Exercise Science/Physical Education
   - ☐ Physiotherapy/Occupational Therapy
   - ☐ Other (please specify): _____

4. What area of medicine are you currently <u>most likely</u> to practice in the future?
   - ☐ Family Medicine
   - ☐ Internal Medicine
   - ☐ Surgery
   - ☐ Pediatrics
   - ☐ Other (please specify) _____

Study One: Queen's and McGill University Online Survey (additional question)

MENTAL HEALTH (MHC SF; Keyes, 2002):

How often in the past month did you feel…	Never	Once or twice	About once a week	About 2 or 3 times a week	Almost every day	Every day
Happy?						
Interested in life?						
Satisfied with your life?						
That you had something important to contribute to society?						
That you belonged to a community (like a social group, your neighbourhood, your city, your school)						
That our society is becoming a better place for people like you?						
That people are basically good?						
That the way our society works makes sense to you?						
That you liked most part of your personality?						
Good at managing the responsibilities of your daily life?						
That you had warm and trusting relationships with others?						
That you had experiences that challenged you to grow and become a better person?						
Confident to think or express your own ideas and opinions?						
That your life has a sense of direction or meaning to it?						

Study Two: University of Ottawa and Queen's University Online Survey

Note: This survey includes baseline, intervention and end-point measures

DEMOGRAPHICS

1. How do you self-identify in terms of gender (please check):

☐ Man
☐ Woman
☐ I do not identify within the gender binary
☐ I prefer not to disclose information concerning my gender

2. What is your age? _____ years

3. Which of the following describes your ethnicity? (please check)

☐ White
☐ Hispanic
☐ Aboriginal Canadian
☐ Black or African American
☐ Asian
☐ Other (please specify): _____

4. Which university are you attending while completing your medical studies? (please check)

☐ University of Ottawa
☐ Queen's University

5. What is your current year of enrollment in medical school? (please check)
☐ First year
☐ Second year

PHYSICAL ACTIVITY (LTEQ; Godin & Shephard, 1985):

Physical activity is any bodily movement produced by your muscles that use energy to occur. The following questions will ask you about the time you spent being physically active in a typical **7-Day period.** Please answer each question even if you do not consider yourself to be an active person. Please think about all activities you do at work, at school, as part of your house and yard work at home, to get from place to place and in your time for recreation, exercise or sport.

5. During a typical **7-Day period**, how many times on average do you engage in **strenuous** exercise (heart beats rapidly) (e.g. long distance bicycling, running, hockey, football, soccer, basketball)?
   _____ Times per week

   _____ Average minutes per session

6. During a typical **7-Day period**, how many times on average do you engage in **moderate** exercise (not exhausting) (e.g. fast walking, baseball, easy bicycling, volleyball, badminton, dancing)?
   _____ Times per week

   _____Average minutes per session

7. During a typical **7-Day period**, how many times on average do you engage in **mild** exercise (minimal effort) (e.g. yoga, golf, bowling, easy walking, fishing)?
   _____Times per week

   _____Average minutes per session

8. During a typical **7-Day period**, how many times on average do you spend **sitting** on a **weekday?**
   _____ **Hours** per day

MENTAL HEALTH (MHC SF; Keyes, 2002):

Please answer the following questions are about how you have been feeling during the past month. Place a check mark in the box that best represents how often you have experienced or felt the following:

How often in the past month did you feel …	Never	Once or twice	About once a week	About 2 or 3 times a week	Almost every day	Every day
Happy?						
Interested in life?						
Satisfied with life?						
That you had something important to contribute to society?						
That you belonged to a community (like a social group, or your neighborhood)?						
That our society is a good place, or is becoming a better place, for all people?						
That people are basically good?						
That the way our society works makes sense to you?						

That you liked most parts of your personality						
Good at managing the responsibilities of your daily life?						
That you had warm and trusting relationships with others?						
That you had experiences that challenged you to grow and become a better person?						
Confident to think or express your own ideas and opinions?						
That your life has a sense of direction or meaning to it?						

End-Point Questions:

BASIC PSYCHOLOGICAL NEEDS (BNSS; La Guardia, Ryan, Couchman, & Deci, 2000):

Please respond to each statement by indicating how true it is for you.

When I am with my peer supporter…	Not at all true			Somewhat true			Very true
I feel free to be who I am							
I feel like a competent person							
I feel cared about							
I often feel inadequate or incompetent							
I have a say in what happens							
I often feel a lot of distance in our relationship							
I feel very capable and effective							
I feel closeness							
I feel controlled and pressured to be certain ways							

SOCIAL SUPPORT (MSPSS; Zimet, Dahlem, Zimet, & Farley, 1988):

Please indicate the extent to which you agree with the following statements, regarding the peer supporter who you participated in this intervention with.

	Very strongly disagree	Strongly disagree	Mildly disagree	Neutral	Mildly agree	Strongly agree	Very strongly agree
My peer supporter is around when I am in need							
My peer supporter is someone I can share my joys and sorrows with							
My peer supporter really tries to help me							
I get the emotional help and support I need from my peer supporter							
My peer supporter is a real source of comfort to me							
I can count on my peer supporter when things so wrong							
I can talk about my problems with my peer supporter							
My peer supporter cares about my feelings							
My peer supporter is willing to help me make decisions							

ATTRIBUTION OF IMPROVEMENTS

Since participating in the peer support walking intervention, to what extent do you attribute any improvements in your mental health to… (%/100)

a) Increases in physical activity?
b) The topics discussed during your sessions?
c) The social interaction with your peer supporter?
d) Other factors (please indicate)

Study Two: Mental Health Topic Checklist

Names:_____ **Date:**_____

Please check 'Yes' or 'No' to indicate whether you discussed the following topics during your peer support walking session. If you discussed a topic that is not on this list, check 'Other' and provide a brief description.

Topic	Check Yes/No
Family **(e.g., parental pressure/demands)**	Yes No
Significant Other **(e.g., conflicts with romantic relationship)**	Yes No
Friendships **(e.g., social interactions with friends outside of medical school)**	Yes No
Peers **(e.g., competition with classmates, social environment)**	Yes No
Faculty **(e.g., teaching quality, poor supervisory behavior, mistreatment of learners)**	Yes No
Academic Workload **(e.g., courses, exams, performance pressure, study habits)**	Yes No
Work-Life Balance **(e.g., difficulty managing personal and professional responsibilities)**	Yes No
Time Management **(e.g., time constraints, competing events/commitments)**	Yes No
Medical Culture **(e.g. competition, unrealistic expectations, reluctance admitting to vulnerability)**	Yes No
Patient Care **(e.g., exposure to human suffering and death)**	Yes No
Finances **(e.g., lack of money, debt/loans)**	Yes No
Career Planning **(e.g., resident matching, concerns about future in medicine)**	Yes No
Personality Traits **(e.g., perfectionism, fear of failure, high self-expectations)**	Yes No
Physical Activity **(e.g., barriers, goals)**	Yes No
Other Lifestyle Behaviours **(e.g., sleep, diet, alcohol use, extra-curriculars)**	Yes No
Coping Strategies **(e.g., resilience training, mindfulness, deep breathing, accessing services)**	Yes No
Other ***(please describe):***	☐ **N/A**

Date and time of next session:_____

Physical activity goal (1 per person) to incorporate into your schedule prior to the next session:

Activity	Target day(s)	Target time(s)	How long	How will I make it enjoyable
3.				
4.				

Study Two: Strava Application Instructions

1. Click on your smartphone's 'App Store' and download the Strava application
2. Once the download is complete, you will be prompted to allow the app to access your location. Click "allow"
3. When you are ready to begin your walking route, click the "record" button at the bottom, in the middle of the screen
4. Click "start"
5. You will be prompted to accept the Strava Community Standards. Read the conditions and click "I accept"
6. Click "start" prior to beginning your session
7. When you have completed your session, click "finish"
8. Take a screenshot of your results
9. Click "save activity"
10. After each weekly walking session, email screenshot of route to Taylor McFadden