Positive Mental Health of Individuals with a Cancer Diagnosis: Exploring the Role of Physical Activity

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Abstract

A cancer diagnosis is a significant life event that can lead to psychological distress and leaves individuals diagnosed with cancer at a higher risk of mental illness. Mental illness, such as depression and anxiety, is common in cancer patients and is associated with increased hospital stay time and treatment efficiency. Therefore, it is essential to prioritize the mental health of cancer patients. It is now recognized that mental health is not merely the absence or presence of mental illness; instead, it is a syndrome of symptoms of an individual's subjective well-being. This is where positive mental health has been introduced. Positive mental health is a concept recognized by the World Health Organization that views mental health as an evaluation of one's subjective well-being and how well they see themselves functioning in life, regardless of the absence or presence of mental illness. Therefore, our focus should turn to the promotion and protection of the positive mental health of cancer patients. Focusing on the promotion and protection of positive mental health will decrease the risk of these individuals developing mental illness over time which will, in turn, protect against increased hospital stay time and treatment efficiency. Highlighted here is the importance of exploring different avenues for promoting and protecting the positive mental health of individuals diagnosed with cancer. Previous studies have indicated that physical activity has psychological benefits as it can improve and prevent symptoms of anxiety and depression in cancer patients. Therefore, physical activity could play a role in promoting and protecting the positive mental health of cancer patients. This study examined how physical activity is associated with positive mental health among individuals, ages 20-80+, diagnosed with cancer. Compared to those without a diagnosis of cancer, those with a diagnosis had significantly lower scores on measures of positive mental health. However, among the individuals who reported a cancer diagnosis, the average number of hours of

moderate or vigorous activity in the past week was a significant predictor of positive mental health. The implications of these findings are discussed in this study.

Keywords: cancer, positive mental health, physical activity.

General Summary

Nearly half of Canadians can expect to receive a cancer diagnosis in their lifetime. A cancer diagnosis and treatment can lead to fear, sadness, anger, depression, and anxiety. Clearly, this can have an impact on the individual's mental health and well-being. Positive mental health is a term used to describe mental health as an individuals' perceptions and evaluations of their own lives related to their mood, emotions, psychological functioning, and social functioning. The promotion and protection of positive mental health are essential for decreasing the risk of mental illness. Individuals diagnosed with cancer could be expected to be at risk of developing lower levels of positive mental health and at greater risk of mental illness. Therefore, it is important to examine ways to promote and protect the positive mental health of cancer patients. Physical activity has been shown to have psychological benefits in cancer patients as it can improve and prevent symptoms of anxiety and depression. Therefore, physical activity could potentially promote and protect the positive mental health of cancer patients. This study aimed to explore physical activity as one possible avenue for promoting and protecting the positive mental health of individuals diagnosed with cancer.

The findings indicated that individuals with a cancer diagnosis had lower levels of positive mental health when compared to the general population. However, among the individuals who reported a cancer diagnosis, the average amount of physical activity in the past week influenced the levels of positive mental health. These findings highlight that high-quality cancer care should include some form of physical activity as physical activity can play a role in promoting and protecting the positive mental health of individuals with cancer.

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Chapter One: Introduction

Nearly one in two Canadians can expect to receive a cancer diagnosis in their lifetime (Canadian Cancer Statistics Advisory Committee, 2019). Cancer is the leading cause of death in Canada, as approximately one out of four Canadians are expected to die from the disease (Brenner et al., 2020). It is estimated that, in 2020, 225,800 new cases of cancer will be diagnosed in Canada, and 83, 000 Canadians are expected to die of cancer.

A cancer diagnosis and treatment are significant life events for an individual that can lead to psychological distress in the form of embarrassment, fear, sadness, anger, depression, and anxiety (Kim et al., 2011). Therefore, individuals who are diagnosed with cancer are at a higher risk of mental illness. Mental illness, such as depression and anxiety, is common in cancer patients and is associated with increased hospital stay time and reduced compliance and treatment efficiency (Kuhnt et al., 2016; Tsaras et al., 2018). Therefore, high-quality cancer care should focus on easing cancer patients' psychological distress by improving and protecting patients' mental health and quality of life.

Numerous studies have indicated that physical activity has several health benefits in cancer patients and can help reduce cancer symptoms and cancer treatment side effects (Feriolo et al., 2018; Juvet et al., 2017; Wiskemann et al., 2016). In particular, cancer research has shown physical activity to have a positive impact on cancer patient bone loss and disease, muscle loss and weight imbalance, cachexia, peripheral neuropathy, lymphedema, pain, and fatigue (Almstedt et al., 2016; Feriolo et al., 2018; Kraschnewski et al., 2017; Mustian et al., 2017; Winters-Stone et al., 2015; Winters-Stone et al., 2012; Winters-Stone et al., 2011; Wong et al., 2012; Wonders et al., 2013). Studies have also shown that physical activity has psychological benefits in cancer patients. Specifically, these studies have shown that physical activity can

prevent and improve cancer patient's symptoms of anxiety and depression (Brown et al., 2012; Chen et al., 2015; Craft et al., 2012).

It has been suggested that cancer patients participate in regular exercise, as exercise has been linked to having positive effects on the physical and psychological health of cancer patients (D'Ascenzi et al., 2019; Feriolo et al., 2018; Juvet et al., 2017; Kpame & Richard, 2020; Mikkelsen et al., 2017). Considering exercise is a safe, non-pharmacological, and cost-effective treatment that provides several health benefits for cancer patients, this study aims to add to the existing knowledge and literature on this topic by assessing the impact of exercise on cancer patients' mental health using the Canadian Community Health Survey (CCHS) database.

Chapter 2: Literature Review

2.1 Prevalence of Mental Disorders in Cancer Patients

Epidemiological studies suggest that between 32-60% of cancer patients experience psychological distress (Kendell et al., 2011; Meggiolaro et al., 2016). Psychological distress in patients with cancer is associated with increased pain, poor adherence to treatment, higher rates of mortality, and reduced quality of life (Kim et al., 2011; Meggiolaro et al., 2016; Mehnert et al., 2018). It is important to clarify that when discussing quality of life in relation to cancer, quality of life is referring to health aspects of quality of life. This is reflecting the impact of the disease and treatment on disability and daily functioning while also reflecting the impact of perceived health on one's ability to live a fulfilling life (Haralstad et al., 2019).

Studies have shown that 39%- 41% of cancer patients experience mental illness, with the most commonly reported mental illnesses being adjustment disorder, major depressive disorder, anxiety, and sleep disturbances (Dornelas, 2018; Gopalan et al.,2016; Kim et al., 2011; Kuhnt et

al., 2016). Research suggests that approximately 12-17% of patients with cancer have clinically significant symptoms of depression (Krebber et al., 2014; Linden et al., 2012). The prevalence of depression in cancer patients is higher than that of the general population (Caruso et al., 2017; Dornelas, 2018; Krebber et al., 2014). The rates of depressive symptoms vary among oncology subgroups, with lung cancer patients showing the highest prevalence of clinically significant depressive symptoms (Caruso et al., 2017; Dornelas, 2018; Pitman et al., 2018). There are multiple risk factors for developing depression following a cancer diagnosis, such as a prior history of depression, female gender, younger age, lack of social support, and greater awareness of illness (Caruso et al., 2017; Dornelas, 2018). It has been estimated that the prevalence of depression is highest in the acute phase of the disease, which could be related to the patient's psychological reactions to diagnosis and need for treatment (Krebber et al., 2014). Detecting depression in cancer patients can be difficult as cancer and depression have similar symptoms, such as fatigue, loss of appetite, and sleep disturbances (Caruso et al., 2017; Krebber et al., 2014). However, if the depression does go undetected and is not appropriately treated, it can lead to disease progression and increased mortality rates (Dornelas, 2018). Depression and low mood influence health behaviours, such as compliance with cancer treatments, which can extend hospitalization and reduce quality of life (Dornelas, 2018; Krebber et al., 2014). Additionally, depression can leave individuals socially isolated and negatively impact social relationships. Social support has been shown to have positive effects on the lives of cancer patients. Therefore, when these social supports are put at risk, it can further impact cancer progression and mortality (Dornelas, 2018; Thompson et al., 2017). Also, physiological symptoms associated with depression correlate with cancer progression, such as inflammation, suppressed immune system response, and heightened sympathetic reactivity (Dornelas, 2018). With these findings,

preventing and protecting patients from developing depression should be considered critical in cancer care.

A cancer diagnosis is a major stressful event for individuals and is associated with high prevalence rates of anxiety (Bronner et al., 2018; Dornelas, 2018; Khalil et al., 2016; Linden et al., 2012). Studies suggest that approximately 37-46% of patients with cancer have clinically significant levels of anxiety (Bronner et al., 2018; Nikbakhsh, 2014). Risk factors for developing anxiety after a cancer diagnosis include female gender, younger age, the severity of illness, history of anxiety, and poor physician-patient relationship (Dornelas, 2018; Spencer et al., 2010). Cancer patients may experience anxiety as an adjustment reaction to their diagnosis, but their anxiety can be exacerbated when patients begin to experience symptoms associated with cancer (Dornelas, 2018). It is also common for anxiety to develop or intensify when cancer patients receive chemotherapy (Garcia, 2014). However, anxiety can also be experienced as a side effect of certain drugs used during cancer treatment (Mrakotsky et al., 2011). Overall, cancer patients' prevention and management of anxiety is crucial as anxiety can lead to poor psychosocial outcomes, dissatisfaction with care, and decreased adherence to treatment (Dornelas, 2018; Garcia, 2014).

2.2 Treatment Approaches

There are clear indications of the importance of addressing the mental health needs of individuals with cancer to improve their quality of life and chances of survival. Therefore, it is essential to investigate the most effective ways to address the mental health needs of these individuals. Findings have indicated that pharmacotherapy and psychosocial interventions effectively treat anxiety and depression in cancer patients (Osborn et al., 2006; Smith, 2015).

Pharmacotherapy

Two classes of medication are typically used for treating depression in cancer patients (Smith, 2015). These include selective serotonin reuptake inhibitors (SSRIs) and tricyclic antidepressants (TCAs) (Ng et al., 2011; Smith, 2015). SSRIs increase serotonin levels in the brain by blocking serotonin's reabsorption into neurons (Hirsch & Birnbaum, 2020). This type of medication can ease the symptoms of depression and other conditions such as anxiety (Bandelow et al., 2017; Hieronymus et al., 2016). Tricyclic antidepressants block the neurotransmitters' reabsorption of serotonin and norepinephrine, increasing these neurotransmitters' levels in the brain (Hirsch & Birnbaum, 2020b). This type of medication can help regulate mood and relieve symptoms of anxiety and depression (Bandelow et al., 2017; Von Wolff et al., 2013). Although both drugs have been shown to help with anxiety and depression, they are associated with side effects such as nausea, restlessness, headaches, fatigue, and increased or decreased appetite. Therefore, extra caution must be taken when prescribing these drugs to cancer patients with depression or anxiety as the side effects of their cancer treatments, such as chemotherapy, can be worsened by the side effects of SSRIs and TCAs (Smith, 2015).

Psychosocial Interventions

Psychosocial interventions such as cognitive behavioural therapy (CBT), problem-solving therapy (PST), and acceptance and commitment therapy (ACT) have been shown to improve depression, anxiety, and quality of life in cancer patients (Osborn et al., 2006; Smith 2015). CBT with cancer patients typically involves specific psychological or psychosocial interventions that are goal-oriented, designed to manage maladaptive thoughts, and focus on learning behavioural change (Osborn et al., 2006). CBT teaches patients skills that can help them overcome maladaptive thoughts and further encourage emotional growth (Smith, 2015). PST for

cancer patients is designed to provide patients with problem-solving skills to cope with problems affecting them, such as relationship and financial difficulties (Nezu et al., 2003; Smith, 2015). This process helps individuals change the attitudes and beliefs that may be interfering with attempts to engage in problem-solving tasks. Finally, ACT is an intervention that helps patients learn to have difficult thoughts and feelings without being dominated by them (Feros et al., 2013; Smith, 2015). This intervention aims to allow individuals to live effectively with their distressing symptoms through acceptance strategies, mindfulness techniques, and behavioural approaches (Feros et al., 2013).

Although these treatment approaches have been shown to help decrease symptoms of depression and anxiety, these types of treatments have not been shown to reduce the prevalence, burden, or early age of onset of mental disorders (Keyes, 2013). These treatments are often short-term fixes and can result in relapse and remissions into medical institutions for further treatment and care, causing high levels of social and economic burden to society. Governments worldwide are now faced with the challenge of finding a way to reduce the number of mental illness cases without solely relying on providing treatment to more and more people. An alternative to treating mental illness is making a shift towards mental health promotion. Mental health promotion looks to promote positive mental health and protect against its loss. This involves targeting all members of society, those with both good and impaired mental health, rather than only targeting those with the presence of mental illness, as seen in the treatment approach.

2.3 What is Positive Mental Health?

Mental health is often viewed as the absence of a mental disorder or mental illness (Keyes & Simones, 2012). This means that one may assume that because an individual has not been diagnosed with a mental disorder (i.e., depression), they live with good mental health.

However, research has confirmed this assumption to be false, and that mental health is not merely the absence or presence of mental illness, but instead, it is a syndrome of symptoms of an individual's subjective well-being (Keyes 2013; 2002). With these findings, positive mental health has been introduced.

Positive mental health is a relatively new concept within the field of psychology. It views mental health as an evaluation of one's subjective well-being and how well one sees themselves functioning in life (Keyes & Simones, 2012). Subjective well-being includes individuals' perceptions and evaluations of their own lives related to their mood, emotions, psychological functioning, and social functioning. The World Health Organization support this relationship between mental health and well-being as they conceptualize mental health as "a state of well-being in which the individual realizes his or her own abilities, can cope with normal stresses of life, can work productively and fruitfully and is able to make a contribution to his or her community" (World Health Organization, 2013, p.8). With well-being being a key concept in the definition of mental health, research on mental health has now developed from two distinct ancient philosophical viewpoints on well-being: the hedonic view and the eudemonic view (Keyes, 2013; Westerhof & Keyes, 2009).

Hedonic well-being reflects the Epicurean view of happiness, focusing on feeling positive emotions (Keyes, 2013). This can also be understood as emotional well-being as it is believed that there is an inherent human concern for maximizing positive, pleasant feelings while minimizing negative, unpleasant feelings. In addition to the presence of positive affect and the absence of negative affect, emotional well-being includes focusing on an individual's perceptions of happiness and life satisfaction. (Keyes, 2013; Westerhof & Keyes, 2009). Keyes (2013) explains that "happiness is based upon spontaneous reflections of pleasant and unpleasant

effects on one's immediate experience" and "life satisfaction represents a long-term assessment of one's life" (p.15).

Although hedonic well-being plays an essential role in subjective well-being, there is more to mental health than the presence or absence of emotional states (Keyes, 2013; Keyes, 2002). Subjective well-being also includes the presence or absence of positive functioning in life. This is covered in the eudaimonic view of well-being. The eudaimonic tradition reflects the Socratic view of happiness, in which happiness is about striving towards excellence and positive functioning as an individual and as a member of society (Keyes, 2013). This can be understood as psychological well-being. Psychological well-being requires individuals to self-critique their quality of functioning in life apart from their feelings or emotions about life. Psychological well-being comprises six elements: self-acceptance, purpose in life, autonomy, positive relations with others, environmental mastery, and personal growth (Ryff & Keyes, 1995).

Keyes (2013) states that "self-acceptance is the criterion toward which individuals must strive in order to feel good about themselves" (p.8). This is characterized by a positive and accepting attitude towards oneself in past and present lives (Westerhof & Keyes, 2009). Purpose in life includes an individual's life goals and objectives for living that uphold one's sense of direction and meaning in life (Keyes, 2013; Westerhof & Keyes, 2009). Autonomy reflects working towards achieving self-determination, independence, and regulation of behaviour from within (Ryff, 1989). Autonomy allows individuals to resist social pressures to think or act in specific ways and enables the individual to behave in ways that align with their standards and values (Keyes, 2013). Positive relations with others include the ability to develop and foster warm, trusting interpersonal relationships (Keyes, 2013; Ryff, 1989). Compassion, cooperation, and compromise are essential aspects of this dimension of psychological well-being. Keyes

(2013) describes environmental mastery as "the ability to manage everyday affairs to control a complex array of external activities, to make effective use of surrounding opportunities, and to choose or create contexts suitable to personal needs" (p.8). This type of mastery involves recognizing their personal needs and wants while feeling that they can take advantage of or manipulate their environment to get what they need (Keyes, 2013; Ryff, 1989). Finally, personal growth involves an individual continuously developing their potential by persistently pursuing and expanding on skills, talents, and opportunities for personal development. Continuous personal growth allows for insight into one's potential and is an essential dimension of psychological well-being (Ryff, 1989; Westerhof & Keyes, 2009).

Five Dimensions of Social Well-Being

It is recognized that striving towards excellence and positive functioning in society requires optimal social functioning (Keyes, 2013). This led researchers to investigate the work of sociologists and social psychologists such as Marx, Durkheim, and Seeman to gather a better understanding of what it takes to thrive socially (Westerhof & Keyes, 2009). Findings led to the conceptualization of five dimensions of social well-being that would be included in the category of eudaimonic well-being. These five dimensions included social coherence, social acceptance, social actualization, social contribution, and social integration (Keyes, 2013; Westerhof & Keyes, 2009).

Social coherence involves making meaning of and being interested in society by understanding that society is intelligible, logical, and predictable (Keyes 2013; Keyes & Shapiro, 2004; Westerhof & Keyes, 1989). Social acceptance involves having a positive attitude towards others, trusting others, acknowledging others' difficulties, and accepting others even when their behaviours can be complex and different from one's own actions. Individuals who are socially

accepting are comfortable with other people and believe that people are kind and capable of working hard. Social actualization involves caring and thinking about society and believing that society has the potential to grow positively. Social contribution includes the belief that individuals feel that they are an essential member of society in that their actions contribute to and are valued by society. Finally, social integration involves a personal feeling of belonging to society and is further supported by society. This includes the extent to which individuals feel that they belong to the part of a community and feel that they share commonalities with others in that community (Keyes 2013; Keyes & Shapiro, 2004; Westerhof & Keyes, 1989).

2.4 Mental Health Continuum

The mental health continuum outlines how the dimensions of subjective well-being are collectively involved in measuring complete or incomplete mental health. It is important to reiterate here that mental health is not just the absence of mental illness; it is also not only the presence of high levels of subjective well-being. Instead, mental health should be viewed as a complete state that involves the presence and absence of mental illness and mental health symptoms (Keyes, 2002). Keyes (2013; 2002) discusses the mental health continuum, which consists of three diagnostic categories of positive mental health: flourishing, moderate, and languishing mental health.

Individuals with positive mental health are considered to have flourishing mental health as these individuals experience high levels of well-being, including consistent positive emotions and positive functioning psychologically and socially (Keyes, 2013; 2002). On the other hand, individuals with languishing mental health live with the absence of mental health as they are consistently experiencing low levels of emotional, psychological, and social well-being. Languishing mental health is a state of being mentally unhealthy and leaves individuals feeling

stagnant and empty. Individuals with moderate mental health are those who are neither flourishing nor languishing.

These three diagnostic categories of mental health can be measured using the Mental Health Continuum – Short Form (MHC-SF) (Keyes, 2013). The MHC-SF consists of 14 items of subjective well-being from the three dimensions of emotional, psychological, and social well-being. To measure subjective well-being, the MHC-SF uses three items from the emotional well-being dimension (happy, interested in life, and satisfied), six items from the psychological well-being dimension (one item to represent each element of self-acceptance, purpose in life, autonomy, positive relations with others, environmental mastery, and personal growth), and five items from the social well-being dimension (one item to represent each element of social coherence, social acceptance, social actualization, social contribution, and social integration) (Keyes, 2013).

To be diagnosed with flourishing mental health, an individual must experience at least one of the three signs of emotional well-being every day or almost every day and at least six of the eleven signs of psychological and social well-being during the past month (Keyes, 2013). For an individual to be diagnosed with languishing mental health, they must report feeling at least one of the measures of emotional well-being and at least six of the psychological and social well-being measures never or maybe once or twice over the last month. Individuals then who do not score as flourishing or languishing are diagnosed as moderately mentally healthy.

From reviewing the literature on this topic, it can be concluded that positive mental health results from a combination of emotional, psychological, and social well-being. This understanding of positive mental health harmonizes well with the core components of the WHO's (2013) definition of mental health as emotional well-being aligns with the element of

well-being in their definition, and psychological and social well-being aligns with the components of optimal individual functioning and optimal functioning in society (Westerhof & Keyes, 2009).

2.5 Two continua hypothesis

The two continua model helps to make the connection between how positive mental health is related to mental illness (Keyes 2013; Westerhof & Keyes, 2009). This model views mental health and mental illness to be related but along two separate continuums. One continuum indicates the presence and absence of positive mental health, and the other shows the presence or absence of mental illness symptoms (Keyes, 2013). The dual continua model has been supported by many studies' findings and has elucidated three critical implications. First is the implication that the absence of mental illness does not imply the presence of mental health (Keyes, 2005; 2007; 2013; Keyes et al., 2008). Research findings have shown that of individuals who have demonstrated to be free of mental disorders (i.e., major depressive disorder (MDE), panic disorder (PD), and generalized anxiety disorder (GAD)), only a small percentage of these individuals were shown to have flourishing mental health and the majority of these individuals lived with moderate mental health (Keyes, 2005; 2007; 2013;Westerhof & Keyes, 2009).

The second implication from the dual continua model is that the presence of mental illness does not implicate the absence of mental health (Keyes, 2002; 2007; 2013). Keyes (2002; 2013) discusses that through their research, they discovered that some individuals living with mental illness also lived with some good levels (flourishing and moderate) of mental health. The third implication of the dual continua model is that individuals with anything less than flourishing mental health, regardless of having a mental illness or not, were associated with

impaired dysfunctions in terms of work reductions, physical health outcomes, healthcare utilization, and psychosocial functioning (Keyes, 2002; 2005; 2007; 2013).

2.6 The Promotion and Protection of Positive Mental Health

These implications from the dual continua model highlight the importance of mental health promotion and protection (MHPP). Mental health promotion is central to decreasing the risk of mental illness over time (Keyes, 2013). The premise of the protection of mental health is that if high levels of mental health decrease mental illness risk, efforts should be made to protect and prevent the loss of one's good mental health. With these ideas being proven to be true (Keyes, 2013), there is a need to shift the focus of national public mental health goals from treating mental illness to creating effective techniques and interventions for mental health promotion and protection. As stated by Keyes (2013), "if a nation wants better mental health, it must focus on positive mental health-promoting flourishing and protecting against its loss. Governments cannot promote mental health by solely reducing mental illness, and no amount of wishful thinking will make this fact disappear" (p.25).

2.7 Exercise and its Role in Promoting and Protecting Positive Mental Health

There is a growing body of literature that advocates for the positive effects of exercise on mental health (Biddle & Mutrie, 2007; Craft & Perna, 2004; Klaperski et al., 2019; Mikkelsen et al.,2017). This research has shown that regular physical activity can significantly improve mental health and well-being. Exercise has shown to be related to numerous physiological and psychological changes resulting in reduced blood pressure, enhanced cardiovascular fitness, weight loss, prevention of chronic disease, improvement in mood, increased self-esteem, and lower levels of stress and anxiety.

Several physiological hypotheses suggest why exercise improves mood and mental health, including the endorphin hypothesis, the thermogenic hypothesis, and the monoamine hypothesis.

The endorphin hypothesis is based on the observation that following exercise, there is an elevation of plasma levels of endorphins (Craft & Perna, 2004). This release of endorphins is associated with reported feelings of euphoria, sedation, and analgesia. This is often referred to as the “runner's high” as individuals feel an increase in mood following running or jogging for extended periods (Mikkelsen et al.,2017).

The thermogenic hypothesis proposes that exercise creates an increase in body temperature, which is responsible for increases in mood elevation and leads to a reduction in symptoms of anxiety and depression (Craft & Perna, 2004; Mikkelsen et al.,2017). Specifically, it is believed that the increase in temperature in brain regions such as the brain stem may be the main contributing factor leading to a decrease in muscle tension and feelings of overall relaxation.

Like the endorphin hypothesis, the monoamine hypothesis proposes that mood change after exercise results from exercises producing chemical changes in the body (Craft & Perna, 2004; Mikkelsen et al.,2017). With this hypothesis, it is believed that exercise leads to an increase in the availability of brain neurotransmitters such as serotonin, dopamine, and norepinephrine. Imbalances in these brain neurotransmitters are linked to people suffering from depression and anxiety. Some individuals have successfully managed these imbalances with selective serotonin reuptake inhibitors (SSRI), which prevent monoamines’ reuptake. This allows more availability of these neurotransmitters in the brain. The monoamine hypothesis believes that exercise can work in the same way as antidepressants (Mikkelsen et al., 2017).

Apart from these physiological hypotheses, there are also psychological hypotheses of how exercise impacts mood. Two of the main psychological mechanisms of exercise on mood states are distraction and self-efficacy (Craft & Perna,2004; Kpame & Richard, 2020; Mikkelsen et al., 2017).

The distraction hypothesis proposes that physical activity creates a distraction and makes it difficult to think about negative and worrying thoughts (Kpame & Richard, 2020; Mikkelsen et al., 2017). Distraction has been used as a general means of coping with depression in forms such as relaxation and social contact. However, exercise has been shown to be more effective than other modes of distraction in alleviating depressive mood (Craft & Perna, 2004).

The self-efficacy/mastery hypothesis proposes that completing an important and effortful task, such as exercise, creates a feeling of mastery, which elevates mood (Mikkelsen et al., 2017). Following this hypothesis, it is also believed that when individuals are depressed, they lack a healthy sense of self-efficacy (Craft & Perna, 2004). Self-efficacy refers to an individual's belief in their capability to accomplish specific goals. When individuals engage in physical activity, their feelings of self-efficacy increase, and individuals feel more capable of accomplishing exercise-related goals. With this increase in self-efficacy, individuals will have a greater chance of maintaining adherence to their exercise-related goals. Sustaining a commitment to exercise-related goals by participating in physical activity and a healthy lifestyle is linked to positive self-esteem and lower depressive behaviour levels (Mikkelsen et al., 2017). Overall, mastery and self-efficacy are two psychological aspects that contribute to the mood-elevating effects of exercise.

Anti-Inflammatory Effects of Exercise

There is also literature that supports the possibility that the positive effects of exercise on mental health are related to the ability of exercise to reduce inflammation (Euteneuer et al., 2017; Mikkelsen et al., 2017). Chronic inflammation has been linked to depression and poor mental health, and regular exercise has been shown to alleviate depressive symptoms in patients with inflammatory-related diseases. The anti-inflammatory effects of exercise have been primarily attributed to cytokine changes such as interleukin (IL)-6 and IL-10 (Mikkelsen et al., 2017).

Exercise has been shown to stimulate an increase in many different cytokines, but specifically, exercise has been shown to produce more significant amounts of interleukin (IL)-6 than any other cytokine (Mikkelsen et al., 2017; Pedersern & Fischer, 2007). IL-6 is released into circulation during exercise as it is produced by contracting muscle, and the increase in production is related to exercise intensity, duration, muscle mass, and the individual's capacity for endurance. IL-6 is often classified as a pro-inflammatory cytokine, but it also holds anti-inflammatory properties as it stimulates the production of anti-inflammatory cytokines. IL-6 also inhibits the production of pro-inflammatory cytokines such as IL-1 and TNF- alpha, which have been linked to depression.

It has also been suggested that reduced levels of the anti-inflammatory cytokine IL-10 increase the risk of depression and that exercise can increase levels of IL-10. (Euteneuer et al., 2017). Euteneuer et al. (2017) randomly assigned ninety-eight patients with major depression (MD) to either a cognitive-behavioural therapy with an emphasis on exercise (CBT-E), a cognitive behavioural therapy with pleasurable low energy activities as an active control condition (CBT-C), and a passive waitlist control group (WL). The CBT-E and CBT-C interventions were delivered by clinical psychologists who completed clinical training in CBT

and followed typical CBT protocols during 50 minutes of individual manualized psychotherapy weekly for 16 weeks. The CBT-E intervention was modified to increase physical activity to align with the recommendations of the World Health Organization. This intervention included psychoeducation that focused on MD, recommendations for being physically active, and problem-solving strategies to reduce any barriers to physical activity. The patient and therapist prepared an individualized schedule during treatment sessions that included at least four 40-minute exercise sessions per week. The study also included thirty none-depressed age and sex-matched controls to compare immunological alterations in patients with MD at baseline. The researchers found that patients with MD exhibited lower baseline levels of anti-inflammatory IL-10 than the controls prior to the treatment phase. However, the results indicated that after week eight and week sixteen, the patients in the CBT-E group had higher levels of IL-10 than patients in the CBT-C and WL conditions. In relation to depressive symptoms of the patients in this study, the CBT-E condition was associated with significantly lower depressive symptoms at weeks eight and sixteen when compared to the WL condition. The CBT-C condition was associated with lower depressive symptoms than the WL condition and there was no significant difference in depressive symptoms between the CBT-E and CBT-C conditions. An additional finding from this study that highlights the potential benefits of exercise being included in CBT for MD is its impact on one's cardiovascular health. Before the treatment stage of this study, forty-two patients with MD had elevated C- reactive protein (CRP) levels and were potentially at risk of cardiovascular disease (CVD). However, after the sixteen weeks of treatment, the patients in the CBT-E condition showed significantly lower CRP levels than patients in the CBT-C and WL conditions. This study indicates that, given the links between depression, inflammation, and CVD, there are significant implications for how exercise being included in behavioural

treatments of depression can be beneficial in reducing depressive symptoms, decreasing inflammation, and promoting cardiovascular health (Euteneuer et al., 2017).

Research has shown no significant differences between gender and the effectiveness of exercise on mental health (Helgadottir et al., 2016). However, it has been indicated that there are differences in the preferred type of exercise and perceived barriers to exercise across gender (Busch et al., 2016; Rosselli et al., 2020). For example, in a study by Busch et al. (2016), men preferred weightlifting more than double the rate of women, and women preferred yoga significantly more than men. The most preferred form of exercise among both genders was walking. Additionally, women have substantially higher levels of perceived barriers to exercise than men (Rosselli et al., 2020). These barriers include lack of time, social influence, lack of energy, lack of willpower, lack of skill, and lack of resources. With these findings, it is important to consider providing patients with multiple forms of exercise to choose from when developing an exercise treatment program while also developing and implementing strategies to contrast any barriers to physical activity that the patient may be experiencing.

Overall, exercise has shown to have a positive impact on mental health from multiple avenues. This suggests that exercise could be helpful in promoting and protecting positive mental health. Further, this would be beneficial for the development of individuals and society as it has been shown that mentally healthy individuals function better than others in terms of fewest workdays missed, fewest cutbacks of work, lowest levels of health limitations of activities of daily living, fewest chronic physical diseases and conditions, lowest health care utilization, and higher levels of psychosocial functioning (Keyes, 2007).

2.8 Exercise and Cancer

Cancer patients experience multiple symptoms from the disease, along with the adverse effects of treatments (Feriolo et al., 2018). These include physical aspects such as bone loss and bone disease, weight and muscle imbalance, peripheral neuropathy, pain, and fatigue. However, exercise is capable of reducing these cancer symptoms and cancer treatment side effects.

Bone loss and bone diseases, for example, are linked to cancer metastasis and treatments such as hormonal therapy (Feriolo et al., 2018). This can cause severe pain, pathological fractures, compression syndromes of the nerve root or the spinal cord, metabolic disturbances, and can lead to osteopenia or osteoporosis. However, studies have shown that exercise in cancer patients positively impacts bone health (Almstedt et al., 2016; Bolam et al., 2012; Winters-Stone et al., 2013; Winters-Stone et al., 2011). The training programs in these studies included a combination of impact (e.g., walking, jogging, running, and jumping) and resistance (e.g., bodyweight exercise, dumbbells, and resistance bands) training or aerobic (e.g., walking or use of elliptical machines) and resistance training.

Cancer patients are also prone to muscular and weight changes such as loss of muscular mass, increased fat mass, and weight gain (Feriolo et al., 2018). These can be due to cancer itself and cancer treatment. Either way, loss of muscle mass is associated with poor survival and the development of other cancer syndromes such as cachexia, while increased fat mass and weight gain leave the patient at risk for cardiovascular disease, poor survival, and cancer recurrence. Exercise has been shown to be one of the most effective treatments for acting on muscle strength, fat mass, and weight gain (Cormie et al., 2015; Fiuza-Lucas et al., 2017; Kim et al., 2015; Kolden et al., 2002; Ohira et al., 2006). Fiuza-Lucas et al. (2017) completed a randomized controlled trial to determine the effects of an in-hospital exercise intervention that combined

aerobic and strength training among cancer patients. They found that three sessions per week of approximately 30 minutes of aerobic exercise (cycle-ergometer pedalling, treadmill running, or arm cranking) followed by approximately 30 minutes of strength training (resistance training, mobility work, and dumbbell exercises) resulted in significant increases in cancer patients upper and lower body muscle strength. Another study by Kim et al. (2015) examined the effects of a 12- week walking exercise program on the body weight and fat mass of breast cancer patients undergoing chemotherapy. The program in this study involved walking five times per week for 12 weeks. Each session included a 5-10-minute warm-up and cool down with a walking period of 30-40 minutes. Each participant's body composition was measured before and after the 12-week exercise program, and the results showed significant reductions in weight, body mass index, and percent of body fat. These studies' findings provide clinically meaningful evidence for a positive effect of exercise training on muscle strength, fat mass, and weight gain in cancer patients.

The neurotoxic effects of chemotherapy also put cancer patients at an increased risk for damage to peripheral nerves, causing a condition called peripheral neuropathy (Fiuza-Lucas et al., 2017). Peripheral neuropathy is associated with sensory symptoms such as tingling, hyperalgesia, and allodynia but can also cause motor or autonomic symptoms such as hypotension, muscle atrophy, constipation, and erectile dysfunction. This can negatively impact the course of the disease and treatment as it often results in the need for dose reductions, treatment delays, and sometimes it is necessary to stop treatment altogether (Brewer et al., 2016). Overall, peripheral neuropathy has a negative impact on cancer patients' quality of life as it slows the treatment process. The symptoms also limit the patient's mobility and ability to perform daily activities (Fiuza-Lucas et al., 2017). Studies have shown that exercise that focuses on strength

and balance can positively impact patients' lives with peripheral neuropathy (Allet et al., 2010; Streckmann et al., 2014). These strengths and balance exercise programs helped increase patients' walking speed, improve balance and stability, and reduce the fear of falling in patients with peripheral neuropathy by focusing on a multitude of balance exercises and strengthening the leg and core muscles.

Cancer pain is another symptom that negatively impacts cancer patients' quality of life (Fiuza-Lucas et al., 2017; Schug & Chandrasena, 2015). Epidemiologic data have indicated that about 35% of cancer patients are experiencing pain at the time of their cancer diagnosis, with 46% of cancer patients experiencing moderate to severe pain throughout the course of the disease. This data reported that 76% of patients experience pain during the advanced stages of the disease (Russo & Sundaramurthi., 2019). Pain can be directly related to cancer itself but can be induced by cancer treatments or aggravated by the patient's comorbidities. Studies on exercise and cancer pain have indicated that aerobic exercise interventions significantly decrease pain levels in cancer patients (Galiano-Castillo et al., 2016; Griffith et al., 2009; Wong et al., 2012).

All types of cancer can cause cancer-related fatigue, which is characterized by “a distressing, persistent, subjective sense of physical, emotional, and cognitive exhaustion related to cancer or cancer treatment that is not proportional to recent activity and interferes with usual functioning” (Berger et al., 2015, p. 1021). Approximately 80% of individuals who receive chemotherapy experience cancer-related fatigue (Fiuza-Lucas et al., 2017). This type of fatigue is described as being more severe and intense than normal fatigue and cannot be reduced by sleep or rest. Cancer patients have described fatigue as more distressing than pain and the most distressing symptom associated with cancer (Berger et al., 2015). Studies have shown that physical activity is a non-pharmacological intervention that effectively treats cancer-related

fatigue (Fiuza-Lucas et al., 2017; Mustian et al., 2017). In a study by Patel and Bhise (2017), patients screened for cancer-related fatigue were assigned to an intervention group that received an aerobic exercise program. This intervention was a 6-week exercise program that consisted of moderate-intensity (50-70% of maximum heart rate) treadmill walking for 20-40 minutes a day, five days a week. This study showed a significant reduction in cancer-related fatigue after the 6-week exercise intervention compared to the control group. Another study by Stan et al. (2016) found that yoga and strength exercises resulted in significant improvements in cancer-related fatigue and cancer patients' quality of life. These findings indicate that different types of physical activity and exercise are feasible, safe, and effective for managing cancer-related fatigue.

Along with the physical aspects described above, cancer patients also experience psychological aspects such as depression and anxiety (Feriolo et al., 2018). As previously mentioned, depression and anxiety are two common symptoms of cancer and can occur for many reasons, such as from the individual's response to a cancer diagnosis, from the symptoms associated with cancer, from the side effects of cancer treatment, and the fear of cancer recurrence or progression (Kim et al., 2011; Meggiolaro et al., 2016; Mehnert et al., 2018). Depression and anxiety in cancer patients negatively impact the individual's quality of life and are associated with increased hospital stays, physical distress, and lower treatment adherence. Studies have shown that exercise has a positive impact on depression and anxiety symptoms in cancer patients (Chen et al., 2015; Kang et al., 2017; Lee et al., 2015). In a study by Chen et al. (2015), cancer patients took part in a 12-week, moderate-intensity walking exercise program consisting of three forty-minute sessions per week. The results from this study indicated that regular exercise is associated with significant improvements in cancer patient's anxiety and depression levels over time.

Chapter 3: Current Study

This literature indicates that mental illness is prevalent in patients with cancer and is associated with increased pain, poor adherence to treatment, reduced quality of life, and even higher mortality (Kim et al., 2011; Meggiolaro et al., 2016; Mehnert et al., 2018). Pharmacological and psychosocial interventions have been discussed and have shown to decrease anxiety and depression symptoms in cancer patients (Osborn et al., 2006; Smith, 2015). However, these treatment methods have not been shown to reduce the prevalence, burden, or early age of onset of mental illness (Keyes, 2013). A growing body of literature advocates for promoting and protecting positive mental health, allowing individuals to recognize their abilities, cope with the everyday stresses of life, work productively, and contribute to society (Keyes, 2013; World Health Organization, 2013). This literature review further indicates that exercise and physical activity positively impacts mental health and well-being (Biddle & Mutrie, 2007; Craft & Perna, 2004; Klaperski et al., 2019; Mikkelsen et al.,2017). Additionally, it has been recognized in this literature review that exercise benefits cancer patient's physical and mental health (Chen et al., 2015; Ferioli, 2018; Patel & Bhise, 2017). Therefore, exercise and physical activity could play a role in promoting and protecting all individuals' positive mental health in society but specifically for individuals diagnosed with cancer. This study looks to investigate the relationship between exercise and the positive mental health of cancer patients using the Canadian Community Health Survey (CCHS) database.

Chapter 4: Methods

4.1 Participants

Data for the current study were obtained through the Statistics Canada Canadian Community Health Survey of Mental Health, a cross-sectional approach to understand the influences, factors, and processes contributing to mental health across the Nation (CCHS-MH; Statistics Canada, 2013). The CCHS-MH focuses on health, social, and economic determinants to allow for a multidisciplinary approach to individual information across Canada (Statistics Canada, 2013). The CCHS-MH encompasses ten provinces and collected data from individuals between the ages of 15- and 80-years old living in private dwellings throughout 115 different health regions in Canada. The combined household and person response rate was 68.9%, with 29,088 households agreeing to participate (79.8%) and 25,113 individuals (one per household) agreeing to participate (86.3%), with the final sample including 25,113 Canadians (Statistics Canada, 2013).

Excluded from the sample were individuals living in territories, living on reserves or other Aboriginal settlements, or full-time members of the Canadian Forces and those who are institutionalized. However, as estimated by Statistics Canada, the total number of individuals in these exclusion criteria is less than 3% of the total Canadian population (Statistics Canada, 2013). Therefore, the sample used in the CCHS-HM is still considered to be nationally representative.

To select the sample of respondents for the CCHS-MH, a three-stage design was used. First, geographical areas referred to as “clusters” were selected. Second, households were

selected within each of these chosen clusters. Last, of the selected households, one individual was randomly selected as the respondent.

Age is recorded categorically in the database in five-year increments from age 15 to age 80+. Inclusion in this study is based on age and response to variables of interest. Those under the age of 20 years old were not included in the current study as the focus of the study was on adults with cancer. The way in which age is categorized in the CCHS database did not allow for the inclusion of 19- and 18- year-olds without including those ages 15-17 years old as well. Therefore, we could not include any respondents under the age of 20. An examination of the dataset indicated that only two individuals (one male and one female) reported having cancer in the 15-19 age group.

The final sample of participants who reported having cancer consisted of 562 individuals. The prevalence rate of cancer in the sample was 2.4%.

4.2 Data Collection Method

Data collection for the CCHS-MH took place from January 2012 to December 2012. The data was obtained from individuals aged 15-80 living in private dwellings throughout the ten Canadian provinces. During this sample period, 25,113 valid interviews were conducted. A detailed explanation of sampling techniques and data collection is available from Statistics Canada (2013); however, they are summarized below.

The CCHS-MH used the area frame design for the Canadian Labour Force Survey (LFS) as a sampling frame, which is a multistage stratified cluster design. Firstly, homogeneous strata are formed, from which independent samples of clusters are drawn from each stratum. Secondly, dwelling lists are prepared for each cluster and households (i.e., dwellings) are selected from

these lists. Lastly, a random individual is chosen, with the assistance of selection probabilities based on household composition and age, within each chosen dwelling. Before data collection, the 43,030 selected households were sent introductory letters and brochures explaining the purpose of the study, the importance of survey participation, and examples describing the planned utilization of the CCHS-MH data. It was presented to participants that their contribution to the survey would be impactful and meaningful; however, their participation was entirely voluntary.

Use of CAPI by trained interviewers. The data were directly collected from survey respondents by trained individuals from Statistics Canada's collections planning and management division. A small portion of interviews were conducted via telephone (13%); however, the majority were in person (87%). All interviews were completed using a form of computer-assisted interview known as the computer-assisted personal interviewing method (CAPI). This system allows for the customization of interviews for each respondent based on their individual characteristics and results throughout the survey. This ensures a concise and clean interview and data collection as the interviewers will not ask questions that do not apply to the respondent.

Minimizing non-responding. The CAPI interviewers were instructed to make personal contact with the randomly selected survey respondent from each dwelling initially, and every reasonable effort was made to obtain interviews. Initially, respondents were contacted by phone to arrange a time to conduct the in-person interview, or they were offered the opportunity to complete the interview over the phone is available immediately. Interviews by proxy were not permitted for the CCHS-MH.

In a further attempt to minimize non-responding, a letter further describing the importance of the dwelling's participation in the CCHS-MH was sent to respondents who refused to complete the survey initially. Following this letter was a second contact with a statistics Canada representative, either in person or by phone, to further emphasize the importance of survey participation.

Weighting. Each respondent of the CCHS-MH was assigned a survey weight value. This value corresponds with the number of people in the entire population that the respondent is intended to represent. Weighting is conducted so that the estimates made based on the sample data can be representative of the entire population rather than just the sample itself.

4.3 Instrument Description

Statistics Canada designed the CCHS-MH in consultation with the Mental Health Commission of Canada, academic experts in mental health, and representatives from various government agencies. Health, healthcare services, lifestyle and social conditions, mental health and well-being, and preventions and detections of disease are all subjects that are covered in the survey. The survey is composed of 30 modules, including an in-depth module assessing for symptoms of a given psychiatric disorder. The decision to include this module was guided by recommendations from the CCHS-MH expert committee. Modules to be incorporated into the CCHM-MH were selected based upon numerous factors, such as relevance to current programs/policy, currently available estimates of prevalence, comparability with previous CCHS-MH cycles, and perceived impact on health care costs (CCHS-MH; Statistics Canada, 2013).

4.4 Measures

Socio-demographic variable. The socio-demographic variables included in the analysis included age, marital status, level of education, and personal income. The variables are all categorical in nature.

Age. Age was recorded in the database categorically in five-year increments; 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-79, and 80 and older.

Education. Level of education was categorized as: 'less than secondary school graduation,' 'secondary school graduation,' 'some post-secondary, 'post-secondary graduation.'

Martial Status. Marital status was recorded as: 'married,' 'common-law,' 'widowed,' 'divorced or separated,' or 'single.'

Income. Respondents' personal income from all sources was recorded as 'less than $10,000", "$10,000-$19,999", "20,000-$29,999", "30,000-$39,000", "$40,000-$49,000", and "$50,000 or more".

Sex. Participant's sex was recorded as either male or female. No other options for reporting gender were provided in the CCHS database.

Self Report of Cancer. A series of long-term health conditions were listed, including cancer, and respondents were asked to answer "yes" or "no" to any long-term health conditions they had been diagnosed with. Researchers explained to respondents that they were interested in conditions diagnosed by a health professional, and which are expected to last or have already lasted six months or more. The question utilized to determine whether respondents had been diagnosed with cancer were directly asked, "do you have cancer?".

Positive Mental Health (PMH). Positive mental health is assessed using the Mental Health Continuum- Short Form (MHC-SF) instrument (Keyes, 2009). The MHC-SF contains 14 items that classify the respondent as having flourishing, languishing, or moderate mental health. In addition, the MHC-SF provides a total score (ranging from 0-70), with higher scores indicating higher levels of positive mental health.

Physical Activity (PHS). The CCHS-MH assessed respondent's levels of physical activity by providing two questions that asked how often the respondent participates in moderate or vigorous physical activity in the past seven days and the average duration of these activities. For an introduction to this section, the interviewer states, "The next questions are about physical activity done for leisure, work, housework, or for transportation." The first question then asks, "In the past seven days, how many times did you participate in moderate or vigorous physical activity?". To clarify the criteria for moderate or vigorous physical activity, the interviewer explained that "Moderate physical activity causes an increase in breathing and heart rate" and "physical activity related to transportation includes brisk walking, cycling, etc.". The second question asks, "About how much time did you spend on each occasion?". The interview then reads the following categories to the respondent; 0 to 15 minutes, 16 to 30 minutes, 31 to 60 minutes, 61 minutes to 2 hours, and more than 2 hours.

4.5 Data Analysis

Descriptive statistics were calculated to characterize the sample in terms of demographic variables (i.e., province of residence, age, sex, personal income, marital status, and education level).

Following this, a series of t-tests were conducted to compare mean scores on the physical activity and positive mental health variables between (1) the overall sample of individuals with cancer to the population mean; (2) the males with cancer to the males without cancer; (3) the females with cancer to the females without cancer; and (4) the males with cancer to the females with cancer.

Lastly, a hierarchical regression was used to analyze factors that predict positive mental health in the sample of individuals with cancer. The variables included as predictor variables in the hierarchical regression were income, education, age, sex, and physical activity. All analyses described were completed using IMB SPSS Statistics Software.

Chapter 5: Results

In the current study, there were 23,089 adult respondents to the survey ranging in age from 20 to 80+. Of this total sample, 562 (2.4%) respondents reported having been diagnosed with cancer by a medical professional. Of the 562 respondents who reported having been diagnosed with cancer by a medical professional, 270 (48%) identified as male and 292 (52%) identified as female.

Table 1 shows the means and standard deviations of the physical activity and positive mental health variables for the male and female participants in the total sample. Results from independent sample t-tests showed that males reported a significantly higher number of hours of moderate or vigorous physical activity in the past week than females, $t\ (23{,}029) = 22.467$, $p<.001$, while females had significantly higher scores on the positive mental health measures, $t\ (20{,}749) = -1.973$, $p = .049$.

Table 1. Means and Standard Deviations of the Physical Activity and Positive Mental Health Scores for Male and Female Participants in Total Sample

	N	Mean	Standard Deviation
Average number of hours of moderate or vigorous physical activity in the past week			
Male	10,347	4.094	4.462
Female	12,684	2.897	3.623
Positive mental health: continuous score			
Male	9,434	53.71	11.353
Female	11,317	54.02	11.076

A series of one-sample t-tests were carried out to compare the means of the cancer sub-groups to the overall population. The mean physical activity score for individuals reporting a cancer diagnosis was 2.7 ± 3.8, which was lower than the mean physical activity score of the overall population, with a mean score of 3.43. The difference of .75 (95% CI [0.43 – 1.06]) was statistically significant ($t(558) = -4.656$, $p < .001$). In the sub-group of males reporting a cancer diagnosis, the mean physical activity score was 2.96 ± 4.17 compared to the mean for the overall sample of males of 4.09. This difference of 1.13 (95% CI [0.63 – 1.63]) was also statistically significant ($t(266) = -4.435$, $p < .001$). In the sub-group of females reporting a cancer diagnosis, the mean physical activity score was 2.43 ± 3.41, which was lower than the mean for the overall sample of females, with a mean score of 2.89. The difference of .46 (95% CI [0.07 to 0.85]) was statistically significant ($t(291) = -2.307$, $p = .022$).

One-sample t-tests also compared the means of positive mental health scores of cancer subgroups to the overall population. The positive mental health scores from the MHC-SF for individuals reporting a cancer diagnosis was 52.13 ± 12.48, which was lower than the mean positive mental health scores of the overall population, with a mean score of 53.88. The

difference of 1.75 (95% CI [0.62 to 2.87]) was statistically significant (t (474) = -3.048, p = .002). In the sub-group of males reporting a cancer diagnosis, the mean positive mental health score was 51.85 ± 12.68 compared to the mean for the overall sample of males of 53.71. The difference of 1.86 (95% CI [0.20 to 3.52]) was statistically significant (t (225) = - 2.206, p = .028). In the sub-group of females reporting a cancer diagnosis, the mean positive mental health score was 52.39 ± 12.32, which was lower than the mean positive mental health score for the overall sample of females of 54.02. The difference of 1.63 (95% CI [0.09 to 3.16]) was also statistically significant (t (248) = - 2.084, p = .038).

Table 2 shows the mean and standard deviations of the physical activity and positive mental health variables for the male and female participants reporting a cancer diagnosis. Results from independent samples t-tests showed that there were no significant differences in the average number of moderate or vigorous physical activity hours in the past week that males and females with cancer reported, t (557) = 1.646, p = .10 or in their positive mental health scores, t (473) = -. 474, p = .64.

Table 2. Means and Standard Deviations of the Physical Activity and Positive Mental Health Scores for Male and Female Participants Reporting a Cancer Diagnosis

	N	Mean	Standard Deviation
Average number of hours of moderate or vigorous physical activity in the past week			
Male	267	2.958	4.171
Female	292	2.429	3.414
Positive mental health: continuous score			
Male	226	51.85	12.676
Female	249	52.39	12.315

A hierarchal regression analysis was conducted to determine the effect of physical activity on the positive mental health in individuals reporting a cancer diagnosis. The first step of the regression consisted of age, sex, the highest level of education attained, and total personal income. In the second step of the regression, the average number of moderate or vigorous physical activity hours in the past week was added. Results of the regression analysis are shown in Table 3. The overall regression model predicted approximately 5% of variance in positive mental health based on the scores from the MHC-SF scores ($R^2 = .05$, $F(5,433) = 4.58$, $p < .001$). On step one, age, sex, the highest level of education attained, and total personal income predicated approximately 1.2% of the variance in positive mental health. However, as indicated in Table 3, only total personal income was a significant predictor. In step two of the analysis, physical activity accounted for an additional 3.8% of the variance in positive mental health scores. The average number of hours of moderate or vigorous physical activity in the past week was a significant predictor of positive mental health scores.

Table 3. Summary of Stepwise Regression Analysis for Variables Predicting PMH Among 18-80+ Year-Olds Diagnosed with Cancer

		Unstandardized Coefficients		*Standardized Coefficients*				
Step	*Predictor*	*B*	*SE*	*B*	*p*	R^2	*F*	*p*
1						.012	1.329	.258
	Age	-.185	.234	-.040	.429			
	Sex	.824	1.212	.034	.497			
	Total personal income from all sources	.846	.416	.108	.043			
	Highest level of education attained by respondent: 4 levels	-.357	.500	-.038	.475			
2						.050	4.584	.000
	Age	-.026	.233	-.006	.911			
	Sex	1.353	1.196	.056	.259			
	Total personal income from all sources	.772	.409	.099	.060			
	Highest level of education attained by respondent: 4 levels	-.345	.490	-.037	.483			
	Average number of hours of moderate or vigorous physical activity in the past week	.636	.152	.199	.000			

Chapter 6: Discussion

Nearly one in two Canadians can expect to receive a cancer diagnosis in their lifetime (Canadian Cancer Statistics Advisory Committee, 2019). It is well established that individuals with cancer experience impairments that can negatively impact their well-being and quality of life (Burke et al.,2017; Kayl & Meyers, 2006). Therefore, this population is at a greater risk of experiencing low levels of positive mental health and possible mental illness. It is essential to

develop further what is currently understood about promoting and protecting the positive mental health of individuals with cancer. The current research emphasizes the importance of physical activity as one possible avenue for promoting and protecting positive mental health in individuals from this population.

6.1 Cancer and Positive Mental Health

As expected, in the current study, respondents reporting a cancer diagnosis scored significantly lower in positive mental health. These findings support previous research that suggests that individuals diagnosed with cancer are at a higher risk of experiencing psychological distress associated with increased pain, poor adherence to treatment, and reduced quality of life (Kendell et al., 2011; Kim et al., 2011; Meggiolaro et al., 2016; Mehnert et al., 2018). It is not surprising when previous studies have also reported that individuals diagnosed with cancer are at a higher risk of mental illness when compared to healthy populations (Ng et al., 2018; Wang et al., 2020). Studies have reported that 39%-41% of cancer patients experience mental illness, with the most commonly reported mental illnesses being adjustment disorder, major depressive disorder, anxiety, and sleep disturbances (Dornelas, 2018; Gopalan et al., 2016; Kim et al., 2011; Kuhnt et al., 2016). When cancer patients experience mental illness, such as anxiety or depression, these individuals are at risk of reduced treatment efficiency, reduced quality of life, increased hospital stay time, increased disease progression and increased mortality rates (Dornelas, 2018; Garcia, 2014; Krebber et al., 2014). Therefore, these findings highlight the importance of healthcare professionals understanding the association between cancer and mental health and the need for high-quality cancer care to focus on easing cancer patients' psychological distress by improving and protecting patients' positive mental health.

6.2 Cancer, Positive Mental Health, and Exercise

It has been suggested that regular physical activity has psychological benefits in cancer patients (Chen et al., 2015; Kang et al., 2017; Lee et al., 2015). The results of this current study suggest that regular moderate or vigorous physical activity may be beneficial for the positive mental health of individuals diagnosed with cancer. In the present study, the average number of moderate or vigorous physical activity hours in the past week was a significant predictor of positive mental health scores in individuals who reported a cancer diagnosis. These findings suggest that regular physical activity, if possible, should be included in high-quality cancer care to help promote positive mental health in cancer patients. Additionally, physical activity can reduce cancer symptoms and cancer treatment side effects such as bone loss, bone disease, weight and muscle imbalances, peripheral neuropathy, pain, and fatigue (Feriolo et al., 2018; Fiuza-Lucas et al.,2017). These findings further highlight the benefits of physical activity to be included in the care of cancer patients as it positively impacts the patients' physiological and psychological health.

Although the regression analysis did show a statistically significant effect of physical activity on positive mental health scores, the r-squared value for the model was relatively small. This indicates that the independent variables included in the model explained only a small proportion of the variance in positive mental health scores. These findings are not surprising as mental health is influenced by many factors which were not included in the model. The Public Health Agency of Canada identified 25 determinants of positive mental health as they developed a conceptual framework to collect positive mental health data to help inform mental health promotion programs and policies across Canada (Orpana et al., 2016). The 25 determinants of positive mental health were organized within four domains: individual, family, community, and

societal. Determinants included protective and risk factors such as resiliency, nurturing childhood experiences, health status, physical activity, household income, family relationship quality and connectedness, social support, workplace environment, inequality, discrimination, and more (Canada, 2020). As many factors influence positive mental health, it is not surprising that any one factor would account for only a small amount of variance in a regression. Previous studies have seen similar results when looking at significant predictors of positive mental health. A study by Bickerdike et al. (2019), for example, identified eight variables as predictors of positive mental health, and after a multivariate linear regression was carried out, the model had an adjusted R-squared value of 0.370, thus accounting for 37.0% of the variance. This means that it could be possible that each factor accounted for only a small amount of variance. Therefore, in the current study, although physical activity only accounted for a small amount of the variance of positive mental health, the effect was statistically significant. These findings suggest that although there are many determinants of positive mental health, it seems that physical activity is one of these determinants.

Despite the reported physiological and psychological benefits of physical activity in cancer patients, physical activity guidelines are not always included in the care of cancer patients (Nadler et al., 2017). Findings from the current study indicated that the mean physical activity score of individuals reporting a cancer diagnosis was significantly lower than the mean physical activity score of the overall population. These findings could support that physical activity is not always included as part of cancer care. This could result from the lack of knowledge of cancer care providers regarding exercise counselling (Nadler et al., 2017). Nadler et al. (2017) surveyed oncology care practitioners and found that 48% of respondents reported that they did not know Canada's Physical Activity guidelines and that 69% of respondents were not aware of any

exercise guidelines for people with cancer. Additionally, 80% of respondents reported insufficient knowledge of when, how, and which patients to refer to exercise programs and how to counsel based on exercise guidelines (Nadler et al., 2017). These findings indicate that cancer care providers could benefit from education and training regarding the existence, description, and utilization of physical activity in high-quality cancer care.

However, in the current study, the lower physical activity scores from the individuals who reported a cancer diagnosis could result from other barriers experienced by cancer patients. For example, previous studies have shown that being too unwell or fatigued to exercise was a barrier experienced by cancer patients (Blaney et al., 2013; Hardcastle et al., 2018). Additional barriers experienced by cancer patients could include fear, pain, time, lack of facilities, and motivation (Blaney et al., 2013; Hardcastle et al., 2018; Russel, 2017). This information is helpful for cancer care providers as it could be used to help cancer care providers create solutions to overcome these identified barriers.

6.3 Gender Differences

In the current study, the results indicated differences between males and females, in the overall sample, on both positive mental health scores and the average number of hours of moderate or vigorous physical activity in the past week. Males in the overall population reported lower positive mental health scores when compared to the females of the overall population. This aligns with previous research that has shown women to report higher levels of subjective well-being than men (Yue et al., 2017). These studies have indicated that women possess greater optimism and gratitude than men, which could enable them to obtain higher subjective well-being (Lai & Yue, 2014; Yue et al., 2017). Research has also indicated that women suffer more than men from internalizing mental health disorders such as depression and anxiety (Boyd et al.,

2015; Rosenfield & Mouzon, 2013; Van Droogenbroeck et al., 2018). However, suppose women possess more significant optimism and gratitude, this could lead to higher levels of subjective well-being, even while experiencing mental health symptoms. In that case, this could explain why women reported higher positive mental health scores as positive mental health is not the absence of a mental health disorder but instead, it is an evaluation of one's subjective well-being and how well they see themselves functioning in life (Keyes & Simones, 2012).

Looking at the physical activity variable, males in the overall population reported a higher average number of hours of moderate or vigorous physical activity in the past week when compared to women of the overall population. These findings have been highlighted in previous research in which females consistently reported getting less moderate-vigorous physical activity than their male counterparts (Arriaza Jones,1998; Edwards & Sackett, 2016; Troiano et al., 2008). This difference in physical activity levels could be related to factors such as self-efficacy, perceived competency, outcome expectancies, attitudes, perceived barriers and risks, subjective norms, social support, enjoyment, and body image (Edwards & Sackett, 2016).

The gender differences that were found in the overall population were non-existent within the cancer sample population. There was no statistically significant difference between males' and females' positive mental health scores who reported a cancer diagnosis. These findings align with the results of previous research that have shown no gender differences in severity of depressive symptoms in cancer patients (Aass et al., 1997; Ciaramella & Poli, 2001; Miaskowski, 2004; Walsh et al., 2000). Previous studies on cancer and quality of life have also indicated no significant relationship between gender and quality of life, a construct that reflects a person's evaluation of subjective well-being (Akhondi-Meybodi et al., 2016; Burke et al., 2017; Laghousi et al., 2019). As cancer is related to a decrease in patient's subjective well-being (Palgi

et al., 2014; So et al., 2010), it is not surprising that both males and females who reported a cancer diagnosis reported similar scores of positive mental health.

There were also no gender differences in physical activity scores within the cancer sample population. This could be the result of physical activity guidelines not being included in the care of cancer patients or other barriers to physical activity experienced by cancer patients such as fear, pain, time, lack of facilities, and motivation (Blaney et al., 2013; Hardcastle et al., 2018; Nadler et al., 2017; Russel, 2017).

6.4 Limitations

The current study's findings shed light on the positive relationship between physical activity and the positive mental health of individuals with cancer. Nonetheless, important limitations should be discussed. First, the data utilized in this current study are subject to biases introduced by both respondent self-reporting and misdiagnoses of cancer. During the survey, respondents were asked to indicate whether they had previously been diagnosed with cancer by a medical professional. Responses to this question might have been inaccurate if participants received an informal diagnosis or misdiagnosis of the disease.

Furthermore, the dependent variable (positive mental health) and the independent variable (average number of hours of moderate or vigorous physical activity in the past week) were each self-report measures. This creates the risk of responder bias, resulting in the possibility that associations between these variables have been inflated. Another limitation is that respondents who reported a cancer diagnosis were not asked to provide any information about the type of cancer or the stage of their cancer. Differences may exist between different types of cancer and different stages of cancer. For example, previous research has indicated that the

psychological distress of someone who has recently been diagnosed with cancer is significantly lower than the psychological distress of metastatic cancer patients and terminal phase cancer patients (Sahin et al., 2013; Zabora et al., 1997). Additionally, different types of cancer and cancer phase could also play a role in an individual's physical ability to partake in physical activity. Finally, it is essential to note that respondents were only asked to indicate if they had been diagnosed with cancer, and no questions were asked regarding the treatment of the disease. This information could be important because some participants may have availed of medications, therapy, or a combination of both. This could have had an impact on their positive mental health and physical activity scores.

Considering study limitations and results, recommended future research could investigate cancer patients with specific types of cancer and similar stage of cancer. Randomized controlled trials could be utilized to test the effectiveness of physical activity on positive mental health scores in comparison to other treatment options such as psychotherapy, pharmacotherapy, a combination of both, and waitlist control. Some form of moderate to vigorous physical activity may, according to the findings of the current study, enhance levels of positive mental health for cancer patients. Not only does this hypothesis draw on the results of this present study, but it is also informed by a growing body of literature supporting physical activity being linked to having positive effects on the physical and psychological health of cancer patients (D'Ascenzi et al., 2019; Feriolo et al., 2018; Juvet et al., 2017; Kpame & Richard, 2020; Mikkelsen et al., 2017).

Chapter 7: Conclusion

The current study's findings highlight the need for more public health discussion regarding the positive mental health of individuals living with a cancer diagnosis. The results indicated that individuals reporting a cancer diagnosis reported lower positive mental health

scores. Keyes (2013) suggested that lower levels of positive mental health put an individual at greater risk of mental illness over time. As previously discussed, mental illness, such as anxiety and depression, in cancer patients is associated with increased hospital stay time and reduced compliance and treatment efficiency (Kunt et al., 2016; Tsaras et al., 2018). Therefore, high-quality cancer care should include a focus on the promotion and protection of positive mental health.

Additionally, the current study's findings indicated that regular moderate to vigorous physical activity was associated with higher levels of positive mental health in individuals reporting a cancer diagnosis. These findings contribute to the growing body of literature that has shown that physical activity has a positive impact on mental health from multiple avenues (Biddle & Mutrie, 2007; Craft & Perna, 2004; Klaperski et al., 2019; Mikkelsen et al., 2017). This further suggests that physical activity could help promote and protect the positive mental health of individuals diagnosed with cancer.

This study also informs the research and practice in the field of counselling psychology. If health care professionals and counsellors, who are working with cancer patients, are aware of the positive impact that physical activity can have on the mental health of cancer patients, then these professionals can counsel individuals on physical activity's ability to manage and promote positive mental health. Additionally, this literature can support future research in this area. Future research could investigate physical activity's impact on the positive mental health of individuals living with other health conditions or even physical activity's impact on the positive mental health of healthy individuals. As research in physical activity and positive mental health accumulates and is recognized by organizations, such as the World Health Organization, this type of research can become more publicly published. This will create an opportunity to educate

professionals across multiple disciplines which will further promote physical activity and positive mental health across the world.

Overall, these findings highlight that high-quality cancer care should include some form of regular moderate to vigorous physical activity. Cancer care committees, which develop, implement, monitor, and evaluate comprehensive care plans for cancer patients, have an excellent opportunity to be aware of this type of research and to incorporate physical activity as a critical lifestyle recommendation within their comprehensive care plans. Cancer care providers are also in a great position to educate and support cancer patients by helping them develop realistic, individualized physical activity goals and plans to achieve these goals. For this to happen, cancer care providers need to receive proper education and training regarding the existence, description, and utilization of physical activity in high-quality cancer care. The current study makes an important contribution to understanding how physical activity may help promote and protect the positive mental health of individuals diagnosed with cancer. Therefore, promoting physical activity should be considered in cancer care, and future research should investigate comparing physical activity interventions to alternative interventions that promote positive mental health within this population.

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