EXERCISE IN THE MANAGEMENT OF DEPRESSION

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Abstract

Major depressive disorder (MDD) is often treated with psychological and/or pharmacological therapies. Unfortunately, not all participants respond to these therapies, and no single treatment plan is effective for every participant. There is an urgent need for additional and alternative therapies, such as exercise. The goal of this project was to systematically review the literature on the efficacy of exercise in the treatment of MDD and the necessary components of an effective exercise intervention. In addition, the literature review guided the development of a pilot program proposal for exercise in depression. The literature supports exercise as an effective primary therapy for mild to moderate MDD and as an effective adjuvant therapy for moderate to severe MDD. Specifically, exercise therapy is most effective when it is supervised and lead by an exercise-professional in a group setting; with 3-5 exercise sessions per week; a duration of 60 minutes per a session; a program length of at least 9 weeks; and containing a variety of exercises performed at a moderate to vigorous intensity. Unfortunately, there are no supervised exercise programs available or designed specifically for participants with MDD in British Columbia. This is a serious gap in the treatment of MDD, and prompted the development of a pilot program proposal for exercise in depression. If implemented, health care practitioners will be able to refer their participants with mild to moderate MDD to this pilot program, thus increasing the percentage of participants receiving effective care for MDD.

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Introduction

By the year 2030, depression will be the leading cause of disability worldwide; it is currently the third leading cause of disease burden (World Health Organization, 2011). Major depressive disorder (MDD) is one of the most common mental disorders, with a lifetime prevalence of 11.3% in Canada (Patten et al., 2015; Kessler et al., 2003). This disorder can negatively impact people's quality of life, as well as cause significant economic impact due to associated medical service and occupational costs. There are also emotional, psychological and financial costs for families and communities when a person dies by suicide (Lam et al., 2016).

The use of pharmacological and psychological treatment for depression is common practice (Lopresti, 2019; Krogh et al., 2012). Unfortunately, only 30 to 50% of participants respond to a primary trial of antidepressant medication, with remission occurring in an even smaller amount (15% to 40%) of participants (Gerber et al., 2019; Trivedi et al., 2006). Psychotherapeutic treatments have been shown to be equally effective as exercise in treating depression, but such treatments can carry a stigma that may limit their acceptance by some participants (Cooney et al., 2013; Gartlehner et al., 2017; Hess et al., 2019). Given that no single treatment plan is effective for every person, there has been increased interest in developing and evaluating adjuvant therapies (Blumenthal et al., 2007; Danielsson et al., 2014). For example, there is increasing recognition of the efficacy of adjuvant therapies, such as exercise, music, social connections, and religious and spiritual practices in the treatment of depression (Lopresti, 2019).

When analyzing research on depression treatment options, it is important to note that there is no universally accepted definition of remission (Israel, 2006). This is largely due to the lack of biological tests or markers that confirm response to treatment. Instead, symptom severity

and thus remission is monitored using psychiatric rating scales, such as the Beck Depression Inventory (BDI), the Hamilton Depression Rating Scale (HAM-D), the Participant Health Questionnaire-9 (PHQ-9) and the Montgomery-Asberg Depression Rating Scale (MADRS). Although most definitions describe remission as the participant's experience of minimal to no symptoms and a return to normal functioning, remission scores vary among clinical trials and importantly, these numerical cut offs do not require participants be asymptomatic (Israel, 2006).

In an effort to gain a better understanding of effective treatments for depression, I formulated the following researchable (PIO) question: *In adults suffering from major depressive disorder, is exercise beneficial in treating depressive symptoms?* A secondary question is: *For adults suffering from mild to moderate major depressive disorder, what components of an exercises regime increase its effectiveness in treating depressive symptoms?*

In this paper I will describe the process and results of my literature review as well as the implications of these findings for clinical practice and future research. The literature review findings also guided my development of a pilot program proposal for "exercise for depression", as described in Appendix C of this paper.

Methods

Research Question Terms and Definitions

In my research question, "adult" included those aged 19 – 64 years. I specifically included studies that used a Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM 5) diagnosis of major depressive disorder which, features five (or more) of the following symptoms present for two or more weeks: an overwhelming feeling of depression (despair, sadness, hopelessness, emptiness and/or isolation), with diminished interest or pleasure in most activities, appetite changes (weight gain or loss), sleep issues (insomnia or hypersomnia),

psychomotor retardation or agitation, fatigue or loss of energy, feelings of worthlessness or guilt, diminished concentration and/or cognition and recurrent thoughts about death (APA, 2013; Lam et al., 2016). "Exercise" is a structured physical activity, which may be supervised, and performed with the aim of improving or maintaining health and physical fitness (Ravindran et al., 2016).

Search Strategy and Selection Criteria

Prior to starting the literature search, I consulted an experienced librarian at the University of British Columbia for assistance to develop the search strategy and ensure its thoroughness.

Databases Selected

Utilizing the Medline Ovid and Embase databases, I performed a systematic search of the literature. Initially my goal was to include several databases in my search, but due to the sheer volume of results and limited amount of time for this culminating project, I have limited this review to two databases. Medline Ovid was chosen because it is the premier biomedical database as per the UBC librarian's guidance. The Embase (Ovid) database was selected to aid in the review of grey literature because it is an international biomedical database also recommended by the UBC librarian. In addition to the articles found using the databases, I found another clinical guideline (NICE, 2009) by reviewing the article by Ekkeckakis & Murri (2017), as well as the exercise and depression tool kit (Glowacki & Faulkner, 2019) from reading the Canadian Network for Mood and Anxiety Treatments (CANMAT) guidelines (Ravindran et al., 2016). Finally, I discovered in my reading that a Cochrane systematic review existed for exercise in depression (Cooney et al., 2013), which I manually searched for and included it in this review.

Search Terms Utilized

To ensure I was using effective search terms, I found the relevant MeSH terms in Medline Ovid and the relevant subject headings in Embase (Ovid) for my keywords, as outlined in Appendix A. In addition to my key words "exercise" and "depression," I also included "major depressive disorder" to help narrow the search given that my research question excludes other forms of depression such as post-partum depression, dysthymia and seasonal affective disorder. As I began my search and reviewed the key words of articles, I found that "physical activity" was often used interchangeably with "exercise". To ensure I would not omit any articles, I added "physical activity" to my keywords. To narrow my search further, I selected additional search terms for specific exercises relevant to the pilot program I planned to develop. The exercises needed to be ones which can be performed within a facility and led/supervised by a trained exercise professional.

The limiters I used in both my Medline Ovid and Embase (Ovid) searches included temporal limits (1990 – 2021), age-based limits (19 – 64 years), linguistic limits (written or available in English and subject limits (human). I chose not to limit my review by geographic region given the international nature of this body of work. I chose the date range to start in 1990 because, although this is over 3 decades ago, this is when much of the research started on the use of exercise in the treatment of depression and I did not want to miss any important seminal works. I set the age range to include adults (19-64) and exclude pediatrics (0-18 years) and geriatrics (65 and older) given the nature of my research questions. Also, because I am fluent in English and no other language, I included only English studies. Finally, I only included studies on human subjects to exclude intervention studies in animals. To obtain only grey literature results in my Embase (Ovid) search, I applied the following limiters in that database search:

conference abstract or conference paper or “conference review” or editorial or erratum or letter or note.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria with the corresponding number of articles excluded per criterion are presented in Appendix B. Utilizing my inclusion and exclusion criteria, I assessed the title and the abstract of articles for eligibility for full review. I obtained the full-text articles for the studies that met the criteria, or that I could not rule out based on abstract and title alone. A total of 55 articles were included for review and analysis, 38 from the Medline Ovid database, 14 from the Embase database, one Cochrane review and two clinical guidelines. Of the 55 studies included in this literature review, 23 are randomized control trials (Abdelbasset et al., 2019; Babyak et al., 2000; Hoffman et al., 2011; Blumenthal et al., 2007; Danielsson et al., 2014; De Groot et al., 2019; Doose et al., 2015; Dunn et al., 2005; Gerber et al., 2019; Heinzel et al., 2018; Knubben et al., 2007; Legrand & Neff, 2016; Meyer et al., 2016; Minghetti et al., 2018; Mota-Pereira et al., 2011; Olson et al., 2017; Salehi et al., 2016; Schuch et al., 2011; Schuch et al., 2015; Sherwood et al., 2016; Siqueira et al., 2016; Toups et al., 2017; Trivedi et al., 2011), one is a qualitative study (Danielsson et al., 2016), one is a non-RCT experimental study (De la Cerda et al., 2011), five are pilot studies (Dimeo et al., 2001; Jaworska et al., 2019; Kerling et al., 2015; Nasstasia et al., 2017; Trivedi et al., 2006), three are study design/protocol papers (Dunn et al., 2002; Gerber et al., 2019; Trivedi et al., 2006), one is a meta-analysis (Schuch et al., 2016), one is a systematic review (Cooney et al., 2013), one is a case study (Dunlop & Self, 2008), three are clinical practice guidelines (NICE, 2009; Qaseem et al., 2016; Ravindran et al., 2016), four are letter to the editor articles (Hallgren et al., 2016; Mota-Pereira et al., 2011; Rasky & Groth, 2016; Stanton et al., 2013), six are conference abstracts (Alosaimi & Baker, 2011;

Bruchle et al., 2019; Faulkner & Rosenbaum, 2019; Jasinska-Mikolajczyk et al., 2019; Narwal et al., 2020; Novitch et al., 2013) , one is an editorial (Ekkekakis & Murri, 2017), one is a supplemental (Davidson, 2010), one is an opinion article (Kohler-Forsberg et al., 2019), and one is a commentary (Schuch et al., 2017).

Data Extraction and Analysis

A matrix was used to organize and extract data from the selected studies, following the *Garrard Matrix Method* (Garrard, 2017). A second matrix was made to help summarize the specific components of the exercise intervention in each study. The column headings in this second table included: effectiveness of exercise program (statistically significant reduction in depression scores), exercise location, supervised or unsupervised program, intensity of exercise program, exercise done in group setting or individual setting, frequency of exercise sessions (number per week), length of exercise session, length of exercise program (number of weeks), type of exercise (aerobic, combination resistance and aerobic, brisk walking, high intensity interval training on treadmill, sprint interval training), inpatient or outpatient, severity of depression, and whether participants were prescribed antidepressants.

In addition to utilizing matrices to summarize and review the articles, I also read each article and synthesized overarching themes such as barriers to exercise programs, facilitators to exercise programs, hypotheses on why exercise improves symptoms of depression and a need for exercise programs to be developed as a treatment option for participants with major depressive disorder.

Findings

Key Strengths and Weaknesses

Many of the experimental design studies were randomized control trials (RCT) (N=23 out of 55 studies reviewed). This is a strength in this body of research as RCTs generally have more rigorous designs and are the gold standard for studies exploring the impact of an intervention on an outcome (Polit & Beck, 2017). This is because RCT's aim to control for confounding variables using randomization of the study participants, which helps to increase validity of the study and reduce the risk of selection bias (Polit & Beck, 2017).

Some limitations of the studies include factors such as small sample sizes, non-blinding of assessors, non-blinding of participants to the exercise intervention and more women than men in the sample (Blumenthal et al., 2007; Carneiro et al., 2015). It is important to note though that, statistically, depression is much more commonly diagnosed in women than men, with female to male ratios of 2:1 (Lam et al., 2016; Carneiro et al., 2015), and thus study samples having more female than male participants may reflect the actual distribution of depression. It is also important to note that due to the nature of the intervention (exercise), it is impossible to fully blind participants to it, although some studies tried to create a placebo exercise group, which utilized stretching activities, to help "blind" participants to the exercise intervention (Knubben et al., 2007; Krogh et al., 2012; Legrand & Neff, 2016; Olson et al., 2017). Through this review, only one qualitative study was found on exercise in depression (Dannielson et al., 2016). This represents a gap in the literature as qualitative research helps to inform perceptions of the situation or problem, conceptualize solutions and understand people's experiences and concerns with a phenomena (Polit & Beck, 2017).

Within this review, formal literature review critical appraisal tools and checklists were not used to evaluate the chosen articles due to several factors including time, the difference in the

scope of a culminating project versus a team-based literature review project, and, additionally, the entire review was conducted by a single reviewer versus a team.

Discussion

In this section, I will discuss the main findings and themes of the literature review including: the efficacy and safety of exercise in the treatment of MDD including in participants receiving antidepressant therapy, why exercise is effective in the treatment of MDD, exercise in the participant with comorbid chronic illness, the benefits and risks of exercise in treating MDD and the efficacy of exercise in MDD in the inpatient and outpatient context. I will then discuss the effective components of an exercise intervention including whether it should be supervised or unsupervised, its' intensity, whether it should be in a group or individual setting, the frequency, length of sessions, and duration of entire exercise program, as well as the type of exercise to include, and barriers and facilitators to utilizing exercise in the treatment of depression.

The Efficacy of Exercise in the Treatment of MDD

The majority of articles included in this review support the claim that exercise is effective in the treatment of MDD, as indicated by a reduction in depression scores using the BDI, the HAM-D and/or the MADRS (Abdelbasset & Alqahtani, 2019; Alosaimi & Baker, 2011; Babyak et al., 2000; Hoffman et al., 2011; Blumenthal et al., 2007; Bruchle et al., 2019; Cooney et al., 2013; Danielsson et al., 2016; Danielsson et al., 2014; Davidson, 2010; De Groot et al., 2019; De la Cerda et al., 2011; Dimeo et al., 2001; Doose et al., 2015; Dunlop et al., 2008; Dunn et al., 2002; Dunn et al., 2005; Ekkekakis., 2017; Faulkner & Rosenbaum, 2019; Hallgren et al., 2016; Jasinska-Mikolajczy et al., 2019; Jaworska et al., 2019; Kerling et al., 2015; Knubben et al., 2007; Kohler-Forseberg et al., 2019; Legrand & Neff, 2016; Meyer et al., 2016; Minghetti et al., 2018; Narwal & Hervey, 2020; Nasstasia et al., 2017; Novitch et al., 2010; Olson et al., 2017;

Qaseem et al., 2016; Rasky & Groth, 2016; Rethorst et al., 2017; Rethorst et al., 2016; Salehi et al., 2016; Schuch et al., 2011; Schuch et al., 2015; Schuch et al., 2016; Schuch et al., 2017; Sherwood et al., 2016; Siqueira et al., 2016; Stanton et al., 2013; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2006; Trivedi et al., 2011). Only one study did not find a statistically significant difference in depression scores between the exercise and control groups (control group was receiving pharmacotherapy, no exercise intervention) (Mota-Pereira et al., 2011). In fact, several studies have found that exercise is as effective a treatment for mild to moderate MDD as psychotherapy or antidepressant medication (Babyak et al., 2000; Blumenthal et al., 2007; Cooney et al., 2013; Rethorst et al., 2009; Silveira et al., 2013; Dimeo et al., 2001; Cipriani et al., 2011; Schuch et al., 2016). In Cooney et al.'s (2013) Cochrane review on exercise in depression, exercise had a moderate effect on depression scores, and had neither superior nor inferior effect sizes compared to antidepressant therapy or cognitive behavioural therapy. A more recent meta-analysis by Schuch et al., (2016) found large effect sizes for moderate intensity, aerobic exercise, supervised by professionals. Schuch et al., (2016) state that previous meta-analyses may have underestimated the effect size of exercise due to researcher bias such as variable application of inclusion/exclusion criteria, the inappropriate choice of statistical tests used and the exclusion of newer studies without providing sound rationale as to why this decision was made. Because the literature is clear that exercise is effective in the treatment of major depressive disorder, many national health care guidelines have incorporated exercise into their management recommendations of adults with MDD (Ekkekakis & Murri, 2017), including the CANMAT clinical guidelines (Ravindran et al., 2016), and the NICE guidelines (NICE, 2009).

Of the studies in this review that utilized an experimental research design, 12 studies included participants with mild to moderate depression (Abdelbasset et al., 2019; Blumenthal et al., 2007; Danielsson et al., 2016; Danielsson et al.,2014; De Groot et al., 2019; Dunn et al., 2005; Dunn et al., 2002; Heinzel et al., 2018; Jaworska et al., 2019; Meyer et al., 2016; Mota-Pereira et al., 2011; Olson et al., 2017), 11 included participants with moderate to severe MDD (Dimeo et al., 2001; Gerber et al., 2019; Kerling et al., 2015; Knubben et al., 2007; Minghetti et al., 2018; Nasstasia et al., 2017; Salehi et al., 2016; Siqueira et al., 2016; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2011), two studies included participants with mild to severe MDD (Babyak et al., 2000; Doose et al., 2015), one study included only moderately depressed participants (De la Cerda et al., 2011), two studies included participants with severe depression (Legrand & Neff, 2016; Schuch et al., 2011) and two studies did not state the severity of the participants' depression (Hoffman et al., 2011; Sherwood et al., 2016). Across all severities of MDD (mild, moderate and severe), exercise was effective at reducing depression scores. This review aligns well with the CANMAT guidelines for major depressive disorder, which recommends "exercise as first-line monotherapy for mild to moderate MDD and as second-line treatment for moderate to severe MDD" (Ravindran et al., 2016, p. 579).

Efficacy of Exercise in Outpatient and Inpatient Populations

In reviewing the literature, exercise was used within the outpatient and inpatient context. Within this review, seven studies were based in inpatient settings (Gerber et al., 2019; Kerling et al., 2015; Knubben et al., 2015; Legrand & Neff, 2016; Minghetti et al., 2018; Shuch et al., 2011; Schuch et al., 2015), 23 studies were in the outpatient setting (Abdelbasset et al., 2019; Babyak et al., 2000; Hoffman et al., 2011; Blumenthal et al., 2007; Danielsson et al., 2016; Danielsson et al., 2014; De Groot et al., 2019; De la Cerda et al., 2011; Doose et al., 2015; Dunn

et al., 2005; Dunn et al., 2002; Heinzel et al., 2018; Jaworska et al., 2019; Meyer et al., 2016; Mota-Pereira et al., 2011; Nasstasia et al., 2017; Olson et al., 2017; Sherwood et al., 2016; Siqueira et al., 2016; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2011; Trivedi et al., 2006) and one study included both inpatients and outpatients (Dimeo et al., 2001). In both settings, the studies listed found exercise effective in the treatment of MDD.

Proposed Mechanisms of efficacy in MDD Treatment

Although the precise mechanisms behind the antidepressant effects of exercise remain unknown (Olson et al., 2017), several theories as to how or why exercise is an effective treatment in major depressive disorder focus on psychological and biological factors. Psychological factors include the positive impact of people developing a sense of mastery, competency and purpose, increasing self-efficacy, self-esteem, positive thoughts, and distractions from negative thoughts and rumination (Careiro et al., 2015; Danielsson et al., 2016; Schuch et al., 2011). Other psychological factors that may influence the efficacy of exercise on decreasing MDD include providing a feeling of control over one's body, releasing feelings of hostility and anger, and providing human contact (socialization) in the context of group exercise and increasing psychosocial functioning (Knubben et al., 2007; Mota-Pereira et al., 2011). The single qualitative study included in this review (Danielsson et al., 2016) provided rich descriptions of how participants felt exercise improved their depression. Danielsson et al. (2016) report that exercise sparked a sense of capability, in contrast to the depressed state participants often felt entrapped in. In addition, exercise provided a way of restoring the depressed person's self-image and identity. Exercise also provided a concrete way to participate in life with other people. Participants also reported a feeling of accomplishment and pride from challenging their

bodies in strenuous movements, and a feeling of alertness, mobility, softness and energy in contrast to their usual feelings of psychological numbness (Danielsson et al., 2016).

The proposed biological factors involved in the efficacy of exercise in improving MDD include altering the hypothalamic-pituitary-adrenocortical axis, which controls the release of the stress hormone cortisol, and facilitating neurogenesis, particularly in the hippocampal region of the brain (Ernst et al., 2006; Blumenthal et al.,2007). Aerobic exercise increases tryptophan hydroxylase, an enzyme necessary in serotonin synthesis, and it increases brain-derived neurotrophic factor (BDNF), a key mediator of brain neuroplasticity (Gourgouvelis et al., 2017).

Overall, it is likely that many mechanisms, both psychological and biological, work together to mediate the effect of exercise on depression, with each individual having a unique combination of factors (Yun et al., 2020).

Exercise is Effective as a Monotherapy and/or Adjuvant Treatment in MDD

Exercise is efficacious in the treatment of MDD as a monotherapy in mild to moderate depression (Dunn et al., 2005; Jaworska et al., 2019; Ravindran et al., 2016) and as an adjuvant to antidepressant medication and/or psychological therapy in mild to moderate depression (Babyak et al., 2000; Carneiro et al., 2015; Danielsson et al., 2014; De Groot et al., 2019). Studies have even shown exercise is effective as an adjuvant in moderate to severe depression (Dimeo et al., 2001; Gerber et al., 2019; Kerling et al., 2015; Ravindran et al., 2016; Siqueira et al., 2016; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2011).

Exercise in the Participant With MDD and Chronic Illness

Based on my inclusion/exclusion criteria, I included articles (N=3) in which the participants had comorbid chronic illnesses (Abdelbasset et al., 2019; De Groot et al., 2019; Sherwood et al., 2016). This was important given the remitting and relapsing course of MDD is

associated with decreased exercise and physical activity levels, which makes people with MDD twice as likely to develop metabolic syndrome, diabetes (type two) and cardiovascular disease (Doose et al., 2015; Gerber et al., 2019; Kerling et al., 2015; Lam et al., 2016). In fact, having MDD in an otherwise healthy person confers a 1.5 to 2 fold adjusted relative risk for the development of cardiovascular disease and a 2 to 4 fold increased risk for cardiac mortality and nonfatal heart attack (Sherwood et al., 2016). Participants with diabetes mellitus (type 2) are also twice as likely to experience MDD than their non-diabetic peers, with 11.4% meeting the criteria for MDD (De Groot et al., 2019). Therefore, utilizing exercise as a treatment modality in MDD is not only important in the reduction of depressive symptoms, but also to prevent cardiovascular events, lower blood lipid levels, decrease blood pressure, decrease the risk of developing type two diabetes mellitus, and certain types of cancers (breast and colon) (Doose et al., 2015; Dunlop & Self, 2008; Kerling et al., 2015). Importantly, exercise is as helpful for depression in this subset of participants with chronic diseases, as in the larger set of studies (Doose et al., 2015; Dunlop & Self, 2008; Kerling et al., 2015).

Benefits and Risks of Exercise in the Treatment of MDD

There are many benefits to utilizing exercise in the treatment of MDD. In addition to preventing chronic diseases (Doose et al., 2015; Gerber et al., 2019; Kerling et al., 2015; Lam et al., 2016; Olson et al., 2017; Trivedi et al., 2006), it also is inexpensive, relatively accessible, can be sustained indefinitely, improves sleep and energy, and it can be immediately effective in treating depressive symptoms while reaching therapeutic levels of antidepressants in the bloodstream, which requires 3 to 4 weeks (Dimeo et al., 2001; Mota-Pereira et al., 2011; Rethorst et al., 2013; Siqueira et al., 2016; Toups et al., 2017). In fact, even a single episode of exercise can improve depression scores (Dimeo et al., 2001). A study by Siqueira et al. (2016)

found that when exercise was used as an adjuvant treatment alongside antidepressant medication, there was a decreased need for higher doses of medication to achieve antidepressant efficacy.

Another benefit of exercise is that, when compared to pharmacological interventions, exercise has significantly fewer side effects and safety concerns (Gartlehner et al., 2017; Gerber et al., 2019; Hess et al., 2019). Studies have also found low compliance with antidepressant medication, with as many as 20 to 60% of primary care participants stopping their antidepressant medication in the first three weeks after initiation (Cassano & Fava, 2002). One potential reason for the low compliance rate with medication is that antidepressants can have negative side effects, such as significant weight gain and selective serotonin reuptake inhibitor (SSRI)-related sexual dysfunction (Gerber et al., 2019). Up to 63% of participants on second-generation antidepressant medication, such as selective serotonin reuptake inhibitors (SSRI's such as escitalopram, fluoxetine, citalopram, sertraline etc.) and selective serotonin norepinephrine reuptake inhibitors (SSNRI's such as venlafaxine, duloxetine, atomoxetine, etc.), experience persistent negative side effects (Gartlehner et al., 2017). In addition to side effects, participants may also avoid antidepressant medication due to skepticism about potential addiction (Gartlehner et al., 2017; Minghetti et al., 2018). Instead, participants may prefer non-pharmacological interventions such as exercise and herbal remedies (Gartlehner et al., 2017).

There are minimal risks in utilizing exercise in the treatment of MDD, as exercise is generally well tolerated with adverse events, such as injuries, rarely reported in the literature (Dunn et al., 2005; Mota-Pereira et al., 2011; Ravindran et al., 2016; Siqueira et al., 2016). Within this review, only one study, by Dunn et al. (2005), reported adverse events related to the exercise intervention, which included chest pain, joint pain and joint swelling. Ensuring a medical professional assesses each participant with a thorough medical history including

cardiopulmonary risk prior to beginning an exercise program can help mitigate such adverse events. Where risks are identified in a person's medical history, there may still be benefits to participating in exercise; however, such participants would require modified programs, close medical monitoring, and may not be appropriate for the group fitness interventions outlined in this current review. Another way to decrease the risk of adverse events is providing supervised (not self-guided), professional-led exercise groups, which help to ensure exercises are being performed properly and safely (Dunlop & Self, 2008).

Components of an Effective Exercise Intervention

In this section I will discuss the components of an effective exercise intervention including whether it should be supervised or unsupervised, exercise intensity, group or individual setting, frequency of exercise sessions, length of exercise sessions, length of entire exercise program, what type of exercise to include, congruency with public health recommendations on exercise, and barriers and facilitators to utilizing exercise in the treatment of depression.

Supervised or Unsupervised Exercise Programs

Within this review there was 27 articles where exercise professionals supervised the exercise intervention within a facility such as a community, university, or hospital gym, or a university lab (Abdelbasset & Alqahtani, 2019; Hoffman et al., 2011; Blumenthal et al., 2007; Danielsson et al., 2016; Danielsson et al., 2014; De la Cerda et al., 2011; Dimeo et al., 2001; Doose et al., 2015; Dunlop et al., 2008; Dunn et al., 2002; Dunn et al., 2005; Gerber et al., 2019; Heinzel et al., 2018; Jaworska et al., 2019; Kerling et al., 2015; Knubben et al., 2007; Legrand & Neff, 2016; Meyer et al., 2016; Minghetti et al., 2018; Nasstasia et al., 2017; Olson et al., 2017; Salehi et al., 2016; Schuch et al., 2011; Schuch et al., 2015; Sherwood et al., 2016; Siqueira et al., 2016), In six articles, exercise interventions were partially supervised and partially

unsupervised (De Groot et al., 2019; Mota-Pereira et al., 2011; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2011, Trivedi et al., 2006). There were no studies where the exercise intervention was completely unsupervised. Within this review, both supervised and partially unsupervised exercise groups had significant decreases in depression scores. Both approaches may be effective, but it appears supervised exercise interventions have greater efficacy.A recent meta analysis by Schuch et al. (2016) found a large effect size and lower drop out rates for supervised exercise interventions provided by trained exercise professionals compared to unsupervised interventions. Several studies also found that supervised exercise group participants demonstrated higher average heart rates during the exercise intervention and reported higher ratings of perceived exertion compared to individual home-based, partially supervised exercise participants (Sherwood et al., 2016; Blumenthal et al., 2007). This is important because greater energy expenditure is related to greater reductions in depressive symptoms (Abdelbasset & Alqahtani, 2019; Carneiro et al., 2015; Gerber et al., 2019; Trivedi et al., 2011). Furthermore, having supervised exercise interventions are important as the trained exercise professionals ensure and encourage the participants exercise at the correct intensity and use correct form to maximize benefits while preventing injury (Danielsson et al., 2016). These findings align well with the most recent Cochrane review (Cooney et al., 2013), the CANMAT guidelines (Ravindran et al., 2016) and the NICE guidelines (NICE, 2009), all of which recommend a supervised exercise intervention.

Intensity of the Exercise Intervention

Within this review, the intensity of exercise commonly ranged from moderate to vigorous, with intensity measured in a variety of ways including rating on exertion scales (Borg exertion scale), the use of percentage of maximum heart rate, caloric expenditure per an exercise

session, and other unique modalities. The studies that utilized the Borg exertion scale had participants exercising from 11 (light/moderate), 13 (moderate) to 14-17 (vigorous/hard) on the scale (Borg, 1974). The majority of the studies that utilized the Borg scale fell within the moderate to hard range (11-17) of exercise intensity (Danielsson et al., 2014; Danielsson et al., 2016; De Groot et al., 2019; De la Cerda et al., 2011; Dimeo et al., 2001; Kerling et al., 2015; Meyer et al, 2016; Olson et al., 2017). Another way exercise intensity was measured was with the percentage of maximum heart rate. Most of the studies that used this measurement had participants exercising at moderate to vigorous intensity, with the person's corresponding maximum heart rate 64% - 76% (moderate) to 77% to 93% (vigorous) (Abdelbasset et al., 2019; Babyak et al., 2000; Blumenthal et al., 2007; Gerber et al., 2019; Heinzel et al., 2018; Hoffman et al., 2011; Jaworska et al., 2019; Knubben et al., 2007; Legrand & Neff, 2016; Sherwood et al., 2016; Siqueira et al., 2016). In three of the studies, no intensity was stated; rather, participants had to expend an individually calculated amount of calories per week based on public health activity recommendations (Dunn et al., 2005; Dunn et al., 2002; Siqueira et al., 2016). Other unique ways intensity was measured included prescribing each participant's exercise intensity based on a maximal power output (Minghetti et al., 2018), using an accelometer (Mota-Pereira et al., 2011) and monitoring participant's maximum rate of oxygen consumption (VO2 max) (Salehi et al., 2016). In seven of the studies, participants self-selected their exercise intensity (Doose et al., 2015; Nasstasia et al., 2017; Schuch et al., 2011; Schuch et al., 2015; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2011; Trivedi et al., 2006).

Despite the different techniques used to monitor exercise intensity, the majority of the studies had participants exercising at a moderate to vigorous intensity. Overall, studies where participants were both prescribed an intensity and where the intensity was self-selected were

effective in reducing depression scores. However, the study by Meyer et al. (2016) compared the effectiveness of self-selected exercise and prescribed exercise and found that the prescribed exercise intensity session's produced superior improvements in depression scores (Meyer et al., 2016). Meyer et al. (2016) explain that participants reported the self-selected intensity session lacked a goal to attain, and thus they did not feel it was as beneficial as the prescribed intensity sessions. These findings align well with the recommendations of the recent meta-analysis (Schuch et al., 2016), Cochrane review (Cooney et al., 2013) and practice guidelines (Ravindran et al., 2016; NICE, 2009) which state that the exercise intervention ought to be performed at a moderate to vigorous intensity.

Group or Individual Setting for Exercise

Within this review, 15 studies had participants exercise individually (De Groot et al., 2019; Dimeo et al., 2001; Dunn et al., 2005; Dunn et al., 2002; Gerber et al., 2019; Knubben et al., 2007; Meyer et al., 2016; Mota-Pereira et al., 2011; Schuch et al., 2011; Schuch et al., 2015; Siqueira et al., 2016; Toups et al., 2017; Trivedie et al., 2006; Trivedi et al., 2011; Trivedi et al., 2006) and 17 studies had participants exercise in a group (Abdelbasset et al., 2019; Babyak et al., 2000; Hoffmanet al., 2011; Blumenthal et al., 2007; Danielsson et al., 2016; Danielsson et al., 2014; De la Cerda et al., 2011; Doose et al., 2015; Heinzel et al., 2018; Jaworska et al., 2019; Kerling et al., 2015; Legrand & Neff, 2016; Minghetti et al., 2018; Nasstasia et al., 2017; Olson et al., 2017; Salehi et al., 2016; Sherwood et al., 2016). The remaining studies did not specify or had a combination of individual and group sessions. Exercise was effective in both a group and individual settings. It is important to note that studies in which exercise was performed in the group setting allowed participants to share their experience with other participants going through similar issues, creating an opportunity for social interaction and peer support (Hess et al., 2019;

Danielsson et al., 2016; De la Cerda et al., 2011; Blumenthal et al., 2007). The findings also indicated that group sizes should be kept small so that participants can receive personalized attention and still be closely supervised (Carneiro et al., 2015). Most practice guidelines and meta-analyses do not have a recommendation on whether the exercise intervention should be performed in a group setting or individually, with the exception of the NICE Guidelines for the Management of MDD (2009) which recommend that exercise interventions be delivered in a structured group setting. As outlined above, the findings from this current review of the literature indicate that using a group setting is recommended, but acknowledge that for some participants, an individual setting may be preferred.

Frequency of Exercise Sessions

Within this review there was a wide range in the frequency or number of days the exercise intervention occurred in a week, from 2 to 7 days a week. Three studies had the exercise intervention occur 2 times a week (Danielsson et al., 2016; Danielsson et al., 2014; Heinzel et al., 2018). Sixteen of the studies had participants exercising 3 times a week (Abdelbasset et al., 2019; Babyak et al., 2000; Hoffman et al., 2011; Blumenthal et al., 2007; De la Cerda et al., 2019; Doose et al., 2015; Gerber et al., 2019; Jaworska et al., 2019; Kerling et al., 2015; Minghetti et al., 2018; Nasstasia et al., 2017; Olson et al., 2017; Salehi et al., 2016; Schuch et al., 2011; Schuch et al., 2015; Sherwood et al., 2016). Six studies had participants exercising three to five days a week (Dunn et al., 2005; Dunn et al., 2002; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2011; Trivedi et al., 2006). Another study had participants exercising specifically 4 days a week (Siqueira et al., 2016), and another at 5 days a week (Mota-Pereira et al., 2011). Three of the studies had participants exercise daily for 10 days (Dimeo et al., 2001; Knubben et al., 2007; Legrand & Neff, 2016). Finally, the study by De Groot et al. (2019), gave no direction

for the amount of days per a week, just that the participants had to accumulate the public health recommendation of 150 minutes of exercise per week. The study by Dunn et al. (2005) compared exercising three times a week to five times a week and found no difference in effect, and both reduced depression scores. The Cochrane review by Cooney et al. (2013) did not analyze the frequency of exercise sessions, just the length of the overall exercise program. The CANMAT guidelines and the CANMAT exercise in depression toolkit (Ravindran et al., 2016; Glowacki & Faulkner, 2019) recommend exercising 2 to 3 times a week, which is similar to the NICE guidelines (2009), which recommend exercising 3 times a week. The findings from this current review align with the guidelines recommendations that an exercise program include at least 3 days of exercise a week.

Length of Exercise Sessions

In this review, the range of exercise session length was from 20 minutes to 60 minutes. Many of the studies (15) had 60 minute exercise sessions which included a 5-10 minute warm up, 30 minutes minimum of exercise and a 5-10 minute cool down (Abdelbasset et al., 2019; Babyak et al., 2000; Hoffman et al., 2011; Blumenthal et al., 2007; Danielsson et al., 2016; Danielsson et al., 2014; De la Cerda et al., 2011; Doose et al., 2015; Gerber et al., 2019; Heinzel et al., 2018; Jaworska et al., 2019; Kerling et al., 2015; Nasstasia et al., 2017; Olson et al., 2017; Salehi et al., 2016). Four of the studies' exercise sessions were 30 minutes long (Dimeo et al., 2001; Knubben et al., 2007; Legrand & Neff, 2016; Sherwood et al., 2016), one study's exercise session was 35 minutes long (Minghetti et al., 2018), and another ranged from 30 to 45 minute long sessions (Mota-Pereira et al., 2011). Finally, the study by Siqueira et al. (2016) had a large range of 20 to 60 minutes for their exercise sessions. Ten of the studies did not prescribe a specific amount of time per an exercise session; rather one asked participants to accumulate 150

minutes of exercise a week (De Groot et al., 2019), and the remaining eight studies asked the participants to exercise enough during the week to meet their caloric expenditure (kcal/kg/week) recommendation (Dunn et al., 2005; Dunn et al., 2002; Schuch et al., 2011; Schuch et al., 2015; Toups et al., 2017; Trivedi et al., 2006; Trivedi et al., 2011; Trivedi et al., 2006). All the durations were effective in reducing depression scores; however, of note, Babyak et al. (2000) found that each 50-minute increase of exercise per week was associated with a 50% decrease in the odds of being classified as depressed. In addition, Hoffman et al. (2011) found that the antidepressant effect of moderate to vigorous exercise may decrease after an average of 3 hours per week. The CANMAT guideline and toolkit for exercise in depression (Ravindran et al., 2016; Glowacki & Faulkner, 2019) recommend that exercise sessions be at least 30 minutes in duration. The NICE guidelines (2009) recommend exercise sessions last from 45 to 60 minutes. The Cochrane review by Cooney et al. (2013) did not recommend a length for each exercise intervention. The findings from this current review are in alignment with both the CANMAT and NICE guidelines and recommend each exercise session range from 30 to 60 minutes.

Length of Exercise Program

The length of the exercise program varied within the studies in this review, ranging from 4 days to 16 weeks, with all durations effective in lowering depression scores (Abdelbasset et al., 2019; Babyak et al., 2000; Blumenthal et al., 2007; Danielsson et al., 2014; Danielsson et al., 2016; De Groot et al., 2019; De la Cerda et al., 2011; Dimeo et al., 2001; Doose et al., 2015; Dunn et al., 2002; Dunn et al., 2005; Gerber et al., 2019; Heinzel et al., 2018; Hoffmann et al., 2011; Jaworska et al., 2019; Kerling et al., 2015; Knubben et al., 2007; Legrand & Neff, 2016; Meyer et al., 2016; Minghetti et al., 2018; Mota-Pereira et al., 2011; Nasstasia et al., 2017; Olson et al., 2017; Salehi et al., 2016; Schuch et al., 2011; Schuch et al., 2015; Sherwood et al., 2016;

Siqueira et al., 2016; Toup et al., 2017; Trivedi et al., 2006; Trivedi et al., 2006; Trivedi et al., 2011) . Depressive symptoms can even be temporarily reduced after single bouts of exercise (Rethorst & Trivedi, 2013; Dimeo et al., 2001; Knubben et al., 2007), although for sustained reductions in depression scores the intervention must continue over longer periods of time (Rethorst & Trivedi, 2013; Cooney et al., 2013; Hoffman et al., 2011). There is evidence that the positive effect of exercise on depressive symptoms may dissipate if the exercise intervention is discontinued (Gerber et al., 2019; Cooney et al., 2013; Doose et al., 2015; Legrand & Neff, 2016). The CANMAT guidelines and exercise in depression toolkit (Ravindran et al., 2016; Glowacki & Faulkner, 2019) recommend that the intervention be a minimum of 9 weeks long. This is close to the recommendations of the NICE guidelines (2009), reporting a minimum intervention length of 10 to 14 weeks. The Cochrane review by Cooney et al. (2013), suggests that any benefits gained from the exercise intervention at the end of treatment may be lost over time and therefore, exercise should be continued long term to maintain its benefits.

Type of Exercise to Include in Program

The majority of the studies in this review utilized aerobic exercises in their intervention including the use of treadmills (running and brisk walking), elliptical machines, bike ergometers, cross trainers, walking and running, or a combination of these activities (Abdelbasset et al., 2019; Babyak et al., 2000; Hoffman et al., 2011; Blumenthal et al., 2007; Danielsson et al., 2016; Danielsson et al., 2014; De Groot et al., 2019; Dimeo et al., 2001; Doose et al., 2015; Dunn et al., 2005; Dunn et al., 2002; Heinzel et al., 2018; Jaworska et al., 2019; Kerling et al., 2015; Legrand & Neff, 2016; Meyer et al., 2016; Minghetti et al., 2018; Mota-Pereira et al., 2011; Olson et al., 2017; Salehi et al., 2016; Schuch et al., 2011; Schuch et al., 2015; Sherwood et al., 2016; Siqueira et al., 2016; Siqueira et al., 2016; Toups et al., 2017; Trivedi et al., 2006; Trivedi

et al., 2011; Trivedi et al., 2006). One study utilized a combination of resistance and aerobic exercise in its sessions (Nasstasia et al., 2017). Two others used a high intensity interval-training (HIIT) format on the treadmill (Knubben et al., 2007; Gerber et al., 2019). Finally, one study included a combination of aerobic gymnastics, dance and brisk walking in their exercise intervention (De la Cerda et al., 2011). A meta-analysis by Schuch et al. (2016) found that of the 25 studies they reviewed, 19 utilized aerobic exercise in their intervention, three used resistance exercise and three studies used mixed aerobic and resistance exercises. Both aerobic and mixed exercise interventions had large effect sizes. Overall, aerobic or mixed interventions are recommended in the findings from this current review which is in agreement with the most recent Cochrane review by Cooney et al., (2013), as well as the CANMAT guidelines on exercise in MDD (Ravindran et al., 2016).

Congruency With Public Health Recommendations on Exercise

It is important to note that the findings of this review, in addition to the guidelines (Ravindran et al., 2016; NICE, 2009), meta analysis (Schuch et al., 2016), and Cochrane review (Cooney et al., 2013) are congruent with the Canadian Society for Exercise Physiology Activity Guidelines for adults (18-64 years) (n.d.), which states that to achieve the physical and psychological health benefits of exercise, adults should accumulate a minimum of 150 minutes of moderate to vigorous aerobic exercise a week, in bouts of 10 minutes or more and should include at least two days of muscle and bone strengthening activities in this time. The public health "dose" of exercise is effective not only for reducing depressive symptoms, but also for preventing many other chronic medical conditions, such as cardiovascular disease, and diabetes (Dunn et al., 2005; Canadian Society for Exercise Physiology, n.d.). Dunn et al. (2005) found that the most effective amount of exercise necessary to reduce depressive scores is equivalent to

public health recommendations. In addition, Dunn et al. (2005) found that amounts of exercise less than the public health guidelines were not as effective and were similar to placebo controls on reducing depressive scores.

Barriers to Utilizing Exercise in the Treatment of MDD

One of the main barriers to utilizing exercise in the treatment of MDD is lack of participant adherence to the exercise intervention (Monteiro et al., 2020; Nasstasia et al., 2017; Gerber et al., 2019). Adherence issues may be attributed to participants with MDD having limited exercise self-efficacy, a lack of confidence, low mood, low energy, and low motivation (Danielsson et al., 2016; Gerber et al., 2019; Monteiro et al., 2020). It is important to note that even though adherence is one of the main issues in implementing an exercise intervention in MDD participants, the adherence rates for exercise are comparable to antidepressant trials and psychotherapeutic interventions (Nasstasia et al., 2017; Hess et al., 2018; Cooney et al., 2013; Rethorst et al., 2009). This is important to note because it suggests that, although adherence is a barrier, it appears to be no more impactful than the barriers presented by non-adherence to psycho-pharmacotherapies. A second barrier to the utilization of exercise in the treatment of MDD is a lack of access to supervised, structured group exercise programs (Glowaki et al., 2017). In Canada, there is no existing structure for health care professionals to explore exercise as a treatment option for their participants with MDD (Glowaki et al., 2017).

Facilitators to Utilizing Exercise in the Treatment of MDD

There are several facilitators that may help in improving adherence to and thus efficacy of an exercise intervention in participants with MDD such as providing a scheduled, group exercise class supervised by a certified exercise professional (Danielsson et al., 2016; Doose et al., 2015; Glowacki et al., 2017; Schuch et al., 2016; Jaworska et al., 2019; Kerling et al., 2015;

Nasstasia et al., 2017). In the qualitative study by Danielsson et al. (2016), the researchers found that merely suggesting a person with MDD start exercising is insufficient to yield results; rather, having scheduled classes and a teacher expecting them helped participants build a routine and overcome the lack of motivation and drive they felt as a result of their illness.

In this participant population, it is particularly important that the exercise professionals supervising the class be taught to foster and value a positive and welcoming environment that promotes adherence first and improving physical fitness second (Doose et al., 2015). This can be done by having exercise professionals provide a person-centered approach through individual tailoring of goals of the exercise program, as well as having a strong emphasis on the therapeutic relationship (Danielsson et al., 2016; Gerber et al., 2019). A therapeutic relationship in this context goes beyond effective communication to providing empathetic support for participants during moments of uncertainty related to the exercises being performed and when extra support is needed, whether it is encouragement or extra guidance with how to perform an exercise (Danielsson et al., 2016). Adherence may also be bolstered by increasing participants' self-confidence and belief in their ability to participate in exercise as well as by increasing exercise intensity gradually (De Groot et al., 2019). People with MDD often have lower cardiovascular endurance, due to increased amounts of time spent sedentary; therefore "starting low and going slow" by increasing intensity and frequency gradually may help participant's adherence to the intervention (Doose et al., 2015; Minghetti et al., 2018). Although some participants may be starting their exercise intervention at doses well below the current recommendations, they will still receive some benefit from the intervention (Rethorst & Trivedi, 2013; Dunn et al., 2005). Therefore, participants should be encouraged to partake in an exercise intervention even if they begin with a lower amount and intensity of exercise with a goal of increasing their exercise

tolerance over time. Another way to increase adherence to an exercise intervention is to make it more enjoyable by allowing the participants to select exercises included within the class such as spin, aerobics, circuit training, high intensity interval training and dance (Schuch et al., 2011; Nasstasia et al., 2017). Finally, providing a group exercise intervention may increase adherence because it allows an opportunity for the development of a supportive social networks (Monteiro et al., 2020).

As mentioned in the barriers section of this review, within Canada, there is no existing structure for health care providers to explore exercise as a treatment option for their participants with MDD (Glowaki et al., 2017). Supervised exercise interventions for people with MDD could be implemented by utilizing community resources such as community center fitness areas and providing extra training to exercise professionals (certified group exercise leaders, physiotherapists, physiatrists) on working with participants with MDD. Details on a proposed program are provided in Appendix C of this current review.

Implication for Practice, Policy, and Research

Implications for Health Care

Despite a recent increase in the availability of mental health services in Canada, the annual prevalence of MDD has only decreased from 4.8% to 4.7% between 2002 and 2012 (Lam et al., 2016). It is clear that novel approaches to the treatment of MDD are needed to tangibly improve the mental health of Canadians. One effective treatment option includes providing a supervised group exercise intervention. Unfortunately, there is no current resource or program in British Columbia nor Canada to help participants with MDD begin and maintain exercise therapy (Glowacki et al., 2017).

Implications for Future Research and Need for Pilot Program

Future research into exercise in the treatment of MDD is needed as gaps in the literature were noted particularly in the following areas: barriers and facilitators of exercise interventions; qualitative studies exploring the meaning of exercise interventions to participants; longitudinal studies; and, how exercise programs could be adapted using a diversity, equity and inclusion lens to ensure factors such as physical ability and income are accounted for (e.g., cost, feasibility, location, health personnel) (Minghetti et al., 2018).

My proposed pilot program addresses the implementation gap in the literature and has the potential to improve outcomes for participants with MDD through increasing access to treatment options other than strictly pharmacotherapy and psychological therapy. Both pharmacotherapy and psychological therapy can be expensive if the participant does not have extended health coverage and they may carry a higher stigma than participating in exercise (Dunn et al., 2005; Gartlehner et al., 2017; Hess et al., 2019). In my professional experience as a Registered Nurse, treatments that require out-of-pocket expenses such as prescription medications and psychotherapy can result in barriers to service that disproportionately impact historically and currently oppressed people such as those living in poverty. In addition to basic services available through the publicly funded health care system, exercise is a low cost, relatively safe and effective monotherapy and adjuvant therapy option for participants with MDD (Cooney et al., 2013; NICE, 2009; Ravindran et al., 2016; Glowacki et al., 2017).

Conclusion

MDD is often treated with psychological and/or pharmacological therapies (Lopresti, 2019; Krogh et al., 2012). Unfortunately, not all participants respond to these therapies, and no single treatment plan is effective for every participant (Blumenthal et al., 2007; Danielsson et al., 2014). From the literature review conducted in this paper it is clear exercise is an effective

primary and adjuvant treatment option for MDD, especially when supervised and lead by an exercise-professional in a group setting; with 3-5 exercise sessions per week; a duration of 60 minutes per a session; a program length of at least 9 weeks; and containing a variety of exercises performed at a moderate to vigorous intensity. Based on the results from this literature review, and as the second component of my culminating project, I have created a proposal for a pilot exercise program for the treatment of MDD (see Appendix C.) The creation of a pilot program proposal was selected as one of the outcomes of my culminating project because currently there is no program available in British Columbia that provides exercise as a treatment option for participants with major depressive disorder. Improving access to care and creating additional programs, such as exercise for depression, could be important components in improving the treatment of MDD for people living in British Columbia.

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Appendix A

Table 1 - Search Method: Medline Ovid

Search #	Search Terms/Keywords	Number of Articles Resulted	Number of Articles Chosen
Final Result	Manually reviewing titles and abstracts of 426 articles	422	40
S9	Limit 8 to (english language and humans and yr="1990 -Current" and ("adult(19 to 44 years)" or "young adult and adult (19-24 and 19-44)" or "middle age (45 to 64 years)") and english and "humans only (removes records about animals)")	422	
S8	3 AND 7	739	
S7	4 OR 5 OR 6	501852	
S6	"Physical activit*".mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	122133	
S5	Gymnastics/ or muscle stretching exercises/ or physical conditioning, human/ or running/ or walking/ or dancing/ or boxing/ or weight lifting/	67301	
S4	Exercis*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	400753	
S3	1 OR 2	43925	
S2	Depressive disorder, major/ or depressive disorder, treatment-resistant/	32178	
S1	"Major depress* disorder".mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	25721	

Table 2 - Search Method: Embase (Ovid)

Search #	Search Terms/Keywords	Number of Articles Resulted	Number of Articles Chosen
Final Result	Manually reviewing titles and abstracts, reading whole article if necessary of 194 articles	194	14
S10	Limit 9 to (conference abstract or conference paper or “conference review” or editorial or erratum or letter or note)	194	
S9	Limit 8 to (English language and humans and yr="1990 -Current" and ("adult (19 to 44 years)" or "young adult and adult (19-24 and 19-44)" or "middle age (45 to 64 years)") and English and "humans only (removes records about animals)") [Limit not valid in Embase; records were retained]	1021	
S8	3 AND 7	1079	
S7	4 OR 5 OR 6	759725	
S6	"Physical activit*".mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]	227969	
S5	Exercise/ or aerobic exercise/ or anaerobic exercise/ or arm exercise/ or circuit training/ or dynamic exercise/ or endurance training/ or high intensity interval training/ or leg exercise/ or pilates/ or resistance training/ or sport/ or body building/ or jogging/ or running/	391334	
S4	Exercis*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]	551790	
S3	1 OR 2	44418	
S2	Major depression/di, dm, dr, rh, th [Diagnosis, Disease Management, Drug Resistance, Rehabilitation, Therapy]	14072	
S1	"Major depress* disorder".mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]	35711	

Appendix B

Table 1 – Inclusion and Exclusion Criteria with Number of Articles Excluded

Inclusion Criteria		
1. Language: English, including articles translated into English. 2. Adults, age range 19-64 3. Human subjects 4. Publication types: clinical trials, meta-analysis, randomized controlled trials and systematic reviews, opinion/discussion articles, grey literature, study protocols 5. Participants have a diagnosis of major depressive disorder, ranging from mild to severe. 6. Include articles from 1990 to 2020 7. Types of exercise included (exercise that can be done in a group setting within a facility: aerobic, resistance, cardiovascular endurance, high intensity interval training (HIIT), group training, weight training, walking, running, jogging, circuit based training, boxing 8. Outpatient and inpatient population 9. Exercise intervention is done over more then one session.		
Exclusion Criteria	Medline Ovid articles excluded	Embase (Ovid) articles excluded
1. Pediatric and geriatric (pediatric (age 0-18) and geriatric (64 plus) depression are specialty areas).	N=47	N=22
2. Articles on the prevention or prediction of depression using exercise, and risk factors of developing depression.	N=14	N=4
3. Articles on dysthymia, seasonal affective disorder, depression with psychotic features, mixed depression and anxiety, bipolar I and II disorder, postpartum depression, schizophrenia, schizoaffective disorder, social phobia disorder, alcohol use disorder, substance use disorder, eating disorder, agoraphobia, and psychogenic movement disorders.	N=89	N=51
4. Articles on participants experiencing depressive symptoms, or experiencing a depressive episode, no diagnosis of MDD, or those recovered from depression.	N=26	N=5
5. Exercise that must be done outside of a group studio setting: swimming, cycling, trail running, Nordic walking, skiing, snowboarding, roller skating, ice	N=13	N=4

skating. Excluding exercises with mindfulness based component including yoga and stretching exercises.		
6. Studies about sedentary behaviour.	N=4	N=0
7. Exercise therapy administered using "Fit bit" or electronic apps (phone apps).	N=8	N=2
8. Excluding very specific biomarkers: Literature on the genetics of MDD in relation to physical activity AND the effects of specific neurotransmitters or measuring neurotransmitters when using exercise as a treatment for major depressive disorder symptoms. Studies where the main focus is on the changes in biological components to major depressive disorder: blood markers such as HDL, BNP, ANP, cortisol, cytokines, CRP.	N=37	N=35
9. Exercise intervention done once (one exercise episode, not a program or repeated exercise sessions).	N=9	N=0
10. Articles with no exercise intervention included (studies that do not have any exercise intervention or reports physical activity occurred but does not describe the exercise prescription/intervention the participants did (exercise duration, frequency, type, intensity)).	N=113	N=37
11. Outcome measure does not include depressive symptoms.	N=22	N=6
12. Updated version of article available (this mostly pertains to guidelines).	N=1	N=0
Additional Embase exclusion criteria		
1. Study not done on humans (done on another animal species, such as rats and mice)		N=2
2. Conference abstract/summary of full article, which is already included in review (having the abstract adds no knew information).		N=10
3. Duplicates removed	N =1	N= 2

Appendix C

Exercise for Depression:

Pilot Program Proposal

Issue and Background:

By the year 2030 depression will be the leading cause of disability worldwide (World Health Organization, 2011). Depression is currently the most common mental disorder in Canada with a prevalence of 11.3% (Patten et al., 2015; Kessler et al., 2003). This disorder can negatively impact people's quality of life, as well as cause significant economic impact due to associated medical service and occupational costs. There are also emotional, psychological and financial costs for families and communities when a person dies by suicide (Lam et al., 2016).

Depression is commonly treated pharmacologically, psychologically or with a combination of both modalities (Lopresti, 2019). Unfortunately, only 30% to 50% of participants respond to treatment with antidepressants, and only 15% to 40% achieve remission (Gerber et al., 2019; Trivedi et al., 2006). Additionally, many participants do not want to try antidepressant medication due to negative side effects, skepticism about potential addiction and a preference for more natural interventions (Gartlehner et al., 2017; Gerber et al., 2017; Minghetti et al., 2018). In fact, studies have found 20% to 60% of primary care participants stop their antidepressant medication in the first three weeks of treatment (Cassano & Fava, 2002). Up to 63% of participants on second-generation antidepressant medications such as selective serotonin reuptake inhibitors (escitalopram, fluoxetine, citalopram, sertraline etc.) and serotonin norepinephrine reuptake inhibitors (venlafaxine, duloxetine, atomoxetine, etc.), experience side effects (Gartlehner et al., 2017). Further, psychological and pharmacotherapy can be expensive if

the participant does not have extended health insurance and, unfortunately, there is still the barrier of stigma associated with these interventions (Dunn et al., 2005; Gartlehner et al., 2017; Hess et al., 2019). Stigma is the feeling of being shamed and unwanted; it includes negative attitudes (prejudice), plus negative responses (discrimination) from others for having a mental illness or seeking help for a mental illness (CAMH, 2021). There is no single treatment plan effective for every participant with major depressive disorder, and there is an urgent need for additional and alternative therapies (Blumenthal et al., 2007; Danielsson et al., 2014; Lopresti, 2019).

Exercise is a low cost, safe and effective monotherapy and adjuvant therapy for participants with major depressive disorder (MDD) (Cooney et al., 2013; NICE, 2009; Ravindran et al., 2016; Glowacki et al., 2017). In addition to exercise's effectiveness in treating MDD, it is also beneficial to participants' overall health, by helping to prevent cardiovascular events, decrease blood pressure, lower blood lipid levels, and decrease the risk of developing Diabetes Mellitus type two and certain type of cancers (Doose et al., 2015; Dunlop & Self, 2008; Kerling et al., 2015). This is particularly important because participants with MDD are twice as likely to develop metabolic syndrome, type two diabetes and cardiovascular disease as compared to people without MDD (Doose et al., 2015; Gerber et al., 2019; Kerling et al., 2015; Lam et al., 2016).

For people with the means and capacity to access the Internet, a simple web search of exercise routines will reveal lists of exercises to follow, as well as how to perform them. From a clinical perspective, an inherent limitation with relying on this kind of information online, however, is that for depressed participants, where motivation to participate in activities can be low as a result of their illness, merely advising them to partake in exercise is often not sufficient

to ensure participation (Danielsson et al., 2014). People with MDD often report that they need scheduled appointments, or classes with someone expecting them to attend, to overcome the lack of drive and motivation they experience as a result of their illness (Danielsson et al., 2014). Danielsson et al. (2014) demonstrate the need for a supervised exercise program that health care providers can refer their participants with MDD to as part of an effective treatment plan. Unfortunately, there are no supervised exercise programs available or designed specifically for participants with MDD in British Columbia.

Purpose/Desired Outcome:

With this pilot program, my goal is to create a resource that will help people ages 19 to 64 years old diagnosed with MDD begin and maintain exercise as a treatment for their major depressive disorder. This initiative is significant because there currently is no resource or program of this type in British Columbia (Glowacki et al., 2017). Health care practitioners will be able to refer their participants with mild to moderate MDD to this pilot program, thus increasing the percentage of participants receiving effective care for MDD. This program is also important because it allows people who face multiple barriers to engaging in self-directed exercise the opportunity to utilize exercise as an intervention in their recovery journey

Monitoring Impact

The goal of this exercise program is to improve depression scores, reduce depressive symptoms and improve treatment outcomes for participants with MDD. Additionally, a secondary goal would be to decrease participants' use of emergency health services, hospitalizations and increase social functioning and occupational attendance as a result of improved and proactive symptom management over time. Exercise also reduces the likelihood of developing comorbidities commonly seen in participants with MDD, such as diabetes type two,

cardiovascular disease and metabolic syndrome (Doose et al., 2015; Dunlop & Self, 2008; Kerling et al., 2015). The effectiveness of the exercise program will be evaluated by a nurse practitioner (NP) embedded within a health authority mental health program. The NP will administer a pre-program and post-program Participant Health Questionnaire 9 (PHQ9) scale (Kroenke, 2001) to assess depression severity and monitor program efficacy, in addition to engaging in a pre- and post-program discussion with participants. With participants' consent, the results of the PHQ9 scales and discussions will be included in a discharge letter sent to the primary care provider or referring provider at the end of the 9 weeks. Participants will also be asked for consent to use assessment information (PHQ9 and discussion notes) to monitor the program's efficacy. Lastly, participants will receive a certificate of completion at the end of the program, which they can add to their health records.

The individual pre- and post-program discussion with the NP will evaluate the effectiveness of other outcomes related to MDD beyond the PHQ9 including:

- Depressive symptoms: sleep quality and quantity, anhedonia, feelings of guilt, energy levels, ability to concentration, appetite, any psychomotor slowing or agitation, and suicidal and/or homicidal ideation.
- Social functioning: How would the participant describe their social functioning including social contact (with friends, family, significant others), improved relationships, etc.
- Occupational functioning: How would the participant describe their occupational situation (like or dislike their job), attendance and absences in the last 3 months? How does the participant feel about their job? Do they feel engaged or disengaged, productive or unproductive?

- Hospital admissions: Has the participant had any hospital admissions related to MDD since the beginning of the program? If yes, how many? For what reason?
- Comorbid chronic illness: does the participant have any other medical conditions, such as diabetes mellitus type two, high cholesterol, high blood pressure, obesity? Post-program specific question: Has there been any changes in these conditions since you did the exercise program?

An NP has been selected as the program coordinator and participant assessor, as they can assess, examine, prescribe, order tests, diagnose and write referrals as needed (BCCNM, 2021). A registered nurse (RN) or registered psychiatric nurse (RPN) will also be a part of the team and share tasks with the NP, and eventually perhaps the RN/RPN could take over the NP's role once the program is established. Once the program is established the RN/RPN would work closely with a participant's primary care provider for any needed out-of-scope support (e.g., referrals, diagnosis, etc.). Participants are referred to the program by their primary care provider having already received a diagnosis of depression. If a potential participant does not have a primary care provider, the NP is able to connect the participant with a primary care provider using services such as the Health Link 8-1-1 phone line.

Client Inclusion and Exclusion Criteria:

Inclusion Criteria:

1. Outpatient population (recently discharged inpatients included)
2. Participants with mild to moderate major depressive disorder as diagnosed using DSM-V criteria by their primary care provider, psychiatrist or other medical provider.
3. Participants aged 19 to 64 years old

Exclusion Criteria:

1. Any condition or state that impairs a person's level of consciousness/cognition such as advanced dementia, active endangering psychosis, and/or severe or untreated substance use disorder (this exclusion criteria is present because there is a risk that a participant could injure themselves if they have a decreased level of consciousness or impaired cognition while exercising). This will be assessed by referring practitioner and recorded per the referral form (Appendix D).

2. Medical contraindications for exercise: unstable angina, recent myocardial infarction, uncharacterized arrhythmias, uncontrolled hypertension and decompensated heart failure (Thornton et al., 2016).

Exercise Program Components:

In accordance with the NICE (2009) and CANMAT (2016) guidelines and the most recent Cochrane review on exercise in depression (Cooney et al., 2013), the most effective exercise programs for participants with major depressive disorder include:

1. Supervision (led by an exercise professional: certified exercise instructor, kinesiologist or physiotherapist).
2. Group setting (no more than 10 participants per a group, so that one-on-one attention can be provided still as needed).
3. The exercise group will be offered 3 times a week and participants will be encouraged to attend all three days.
4. Each class will be 60 minutes long with a 10-minute warm up, 40-minute class, 10-minute cool down/stretching.
5. Participants will be encouraged to attend the entire 9-week exercise program. If, after participants finish the 9-week program, they want to continue exercising they will be

offered a list of exercise programs in their area. Encouraging the continuation of exercise is important as it appears that the benefits gained from an exercise intervention at the end of treatment may be lost over time if exercise is not continued (Gerber et al., 2019; Cooney et al., 2013; Doose et al., 2015)

6. The exercises in the program are aerobic based, including: high intensity interval training (HIIT), circuit training, spin bikes, and step classes.
7. Intensity: Participants will be encouraged to exercise at a moderate to vigorous intensity as determined by their maximum heart rate. Each participant's maximum heart rate will be calculated by subtracting their age from 220 (CDC, 2020). Participants will be taught to measure their heart rate by manually taking their pulse during the exercise classes.

Participants and Components Necessary For Implementation

The Program Team Would Include:

1. A certified exercise professional to lead the exercise classes and take participants' attendance prior to beginning class. The exercise professional supervising the class may be a certified exercise instructor, physiotherapist or kinesiologist, depending on whichever is more accessible and feasible. The class supervisor will be provided with a one-time orientation session delivered by the NP to prepare them for working with participants with MDD. They will also be provided a handout containing information on major depressive disorder, symptoms these participants may have that make it difficult for them to engage in exercise, how to intervene/lead effectively with this client population and the coordinating NP's contact information (Appendix E). The exercise professional would need to be available for 3 classes a week.

2. Access to the participant's primary care provider and/or referring partner who will manage the participants' ongoing psychiatric and general clinical care.
3. The NP will conduct the pre and post program participant discussion and administer the PHQ9 scale. The nurse practitioner will also be the coordinator of the program, receiving referrals, answering the exercise professional's questions, and safely storing participant's information and assessments.
4. A RN or RPN will work with the NP and share conducting the pre and post program participant discussion and administration of the PHQ9 scale. The RN or RPN will help screen referrals, call the participants to further screen for eligibility, explain the program, and calculate the maximum heart rate of the participant. The RN or RPN will also visit with the exercise professional and the participants' once weekly during a scheduled exercise session to check-in, answer questions, provide direction and referrals as necessary. The RN or RPN will report the weekly check-ins to the NP via phone or e-mail and will be able to phone the NP if they have any questions or concerns. Any urgent or confidential communication specific to individual participants such as any safety concerns related to worsening MDD symptoms will be addressed via phone in a timely manner.

Additional Components Needed:

1. Access to a gym facility such as a community center's group fitness room or a hospital's gym.
2. Funding to cover the cost of participating in the exercise program for participants (i.e., paying for the exercise professional's time), having it covered by existing health authority budgets and/or grant funding.

Proposed Timeline

1. One 60-90 minute orientation session led by the NP, with the opportunity for follow up as needed, with the RN/RPN, exercise professional & NP. In the orientation the NP will discuss MDD, working with participants with MDD and discuss program goals, structure, and protocol for emergency situations and review necessary exercise program components, as reported by the guidelines and literature review. The handout in Appendix E will also be reviewed in this session.
2. Promoting the program to primary care providers and mental health outpatient centers: this will be an ongoing task, but initially at least 6 to 8 weeks for active recruitment will be necessary to visit outpatient mental health facilities and primary care clinics to promote the program. Information will also be distributed via the local Division of Family Practice.
3. Participants would be enrolled in the exercise group for at least 9 weeks. After the 9-week program, if a participant wants to continue exercising they will be referred to opportunities within their community by the exercise professional, NP or RN/RPN.

Risks and Benefits Associated With This Idea:

Risks Associated With Implementing the Idea:

Within the literature very few risks or adverse events are reported from the use of exercise interventions in participants with MDD (Dunn et al., 2005; Mota-Pereira et al., 2011; Ravindran et al., 2016; Siqueira et al., 2016). Within the review I conducted only one study reported adverse events, which included chest pain, joint swelling and joint pain (Dunn et al., 2005). Adverse events can be mitigated by assessing each participant's cardiopulmonary risk and taking a complete medical history prior to beginning the exercise program, which is required of the referring provider as shown in Appendix D (Dunlop & Self, 2008). To enhance safety, the

exercise professional will be provided emergency contact numbers, which will be the NP's contact information and the participant's primary care provider contact information, in case a participant's cardiac, physical or mental health worsen during an in-person exercise session. If a participant is at imminent and immediate risk of harm to themselves or others, the exercise professional will call 9-1-1 as per usual crisis response protocols. Any emerging risks may also be identified and addressed or followed up on during the RN/RPN's weekly visits to the exercise class.

Benefits of Implementing the Idea:

Exercise is an inexpensive, relatively accessible, and sustainable treatment modality for participants with MDD. Exercise helps to prevent the development of chronic disease such as diabetes mellitus type two, metabolic syndrome and cardiovascular disease, all of which participants with MDD are at a heightened risk of developing due to their decreased physical activity and exercise levels (Doose et al., 2015; Gerber et al., 2019; Kerling et al., 2015; Lam et al., 2016). Exercise also brings additional health benefits such as improved sleep and energy and can be effective and useful in treating depressive symptoms while waiting the 3-4 weeks for antidepressant medications to take effect (Dimeo et al., 2001; Mota-Pereira et al., 2011; Rethorst et al., 2013; Siqueira et al., 2016; Toups et al., 2017). In fact, when exercise is used as an adjuvant treatment alongside antidepressant medications, smaller doses of medications are necessary to achieve antidepressant efficacy compared to those with no exercise intervention taking antidepressant medication (Siqueira et al., 2016).

Risks If the Idea Is Not Implemented:

Despite the recent increase in mental health services within Canada, 1 in 5 Canadians continue to report a mental health concern at some point in their life (CMHA, 2021). As such, it

is clear the current model and pillars of treatment (pharmacological and psychotherapy) are insufficient to meaningfully reduce the rates of MDD in Canada, and novel approaches, such as exercise therapy, may be part of the solution in improving treatment outcomes for those suffering from MDD.

Sustaining the Changes Once the Idea is Implemented

After the Program Ends:

It would be beneficial for the participant to engage in an exercise program indefinitely, both for their depressive symptoms and overall health (Dunn et al., 2005; Canadian Society for Exercise Physiology, n.d.). The literature is clear that once the participant finishes the exercise program, the benefits may not last after the intervention is completed (Gerber et al., 2019; Cooney et al., 2013; Doose et al., 2015; Legrand & Neff, 2016). Once the participant has completed 9 weeks of the exercise program, they may be comfortable enough and have seen a sufficient enough reduction in depressive symptoms to then participate in exercise opportunities in their community's, which the NP, RN or exercise professional can inform them of.

The Referral Process:

Participants can be referred to the program by their primary care provider or mental health provider, as long as the participant meets all of the inclusion and none of the exclusion criteria. The referrals will be faxed directly from the referring partner to the nurse practitioner coordinating the pilot program, who will then, with the RN or RPN, screen the referrals and call the participants to further screen for eligibility, explain the program, confirm consent to participate in the program and calculate the maximum heart rate of the participant.

Potential Barriers to Utilizing the Exercise Program:

The main barrier to utilizing an exercise intervention in the treatment of MDD is low or reduced adherence (Monteiro et al., 2020; Nasstasia et al., 2017; Gerber et al., 2019). This is attributable to participants with MDD experiencing, largely as a result of their illness, limited exercise self-efficacy, low mood, lack of confidence, low energy and low motivation (Danielsson et al., 2016; Gerber et al., 2019; Monteiro et al., 2020). Notably, however, the adherence rates for exercise are comparable to antidepressant trials and psychotherapeutic interventions and thus this alone ought not to be a reason for not pursuing exercise programs as a treatment or adjuvant for addressing MDD (Nasstasia et al., 2017; Hess et al., 2019; Cooney et al., 2013; Rethorst et al., 2009). This is important to note because it suggests that, although adherence is a barrier, it appears to be no more impactful than the barriers presented by non-adherence to psycho-pharmacotherapies.

Addressing the Barriers:

There are several ways that adherence, the main barrier, can be addressed. One way is by providing a scheduled, professionally supervised, group exercise intervention, which this pilot program proposes (Danielsson et al., 2016; Doose et al., 2015; Glowacki et al., 2017; Schuch et al., 2016; Jaworska et al., 2019; Kerling et al., 2015; Nasstasia et al., 2017). Having scheduled classes and someone expecting the participants helps them to overcome the low motivation and drive they feel and helps them to build an exercise routine (Danielsson et al., 2016). In addition, providing the exercise intervention in a group setting may increase adherence by providing an opportunity for the development of supportive social networks with class peers (Monteiro et al., 2020). Participants with MDD often have decreased cardiovascular endurance/fitness levels, due to being highly sedentary (Doose et al., 2015; Minghetti et al., 2018). Therefore, adherence to the exercise intervention can be increased by not starting the intensity of the exercise program too

high, and tailoring the exercise intervention to each participant's max heart rate and fitness level (De Groot et al., 2019). Ideally, this means that participants would be encouraged to take breaks as needed, and modifications for certain exercises would be provided by the instructor for these participants. Although some participants may be starting the exercise intervention at doses below the current recommendations for population level physical activity targets in Canada, it is still anticipated that all participants will still receive benefits from it (Rethorst & Trivedi, 2013; Dunn et al., 2005). Finally, another way to improve adherence is by incorporating a variety of exercises into the program such as aerobics, spin, circuit training, dance and high intensity interval training (Schuch et al., 2011; Nasstasia et al., 2017).

Initial and Ongoing Training Needs:

As the program grows, more certified exercise professionals would be needed to lead the supervised exercise groups.

Key Roles and Resources Needed to Sustain The Program:

Key resources for sustaining this program include a facility and space where the exercise intervention can take place, certified exercise professionals, a NP, a RN or RPN and primary care providers willing to work in tandem with the program coordinator (NP). In addition, funding for the program would also be essential, whether this is from a grant or a health authority. The total cost of running this program would depend on several intersecting factors such as whether a space could be accessed for free within an existing facility and whether the NP and RN/RPN roles could be leveraged within existing job descriptions or if net new positions would need to be created. Ideally, wherever possible, this exercise program would build on already existing facilities and job roles.

Currently, there is no program available in British Columbia that provides the formal, clinically guided opportunity for people with major depressive disorder to use exercise as a treatment modality. Improving access to care and creating additional programs, such as exercise for depression, could be important components in improving the treatment of MDD.

Appendix D

Exercise for Depression Referral Form

Date:

Participant name:

PHN:

Provider:

1. Are you the participant's primary care provider: Yes ☐ or No ☐
   If not, please list the name and contact information of the primary care provider:

2. Diagnosis of depression based on DSM-V criteria: Yes ☐ or No ☐

3. Any condition or state that impairs a person's level of consciousness/cognition such as advanced dementia, active endangering psychosis, and/or severe or untreated substance use disorder.
   Yes (if yes, please explain in the space below) ☐ or No ☐

4. Is this participant medically cleared by their primary care provider to participate in moderate to vigorous aerobic exercise: Yes ☐ or No ☐

5. Does the person exhibit any of the following cardiac symptoms:

   a. Unstable angina Yes ☐ or No ☐

   b. Recent (within 6 weeks) myocardial infarction Yes ☐ or No ☐

   c. Uncharacterized arrhythmias Yes ☐ or No ☐

   d. Uncontrolled hypertension Yes ☐ or No ☐

   e. Decompensated heart failure Yes ☐ or No ☐

6. Other medical conditions:

7. Medications:

Thank you for referring your participant to the exercise for depression program. A consultation report will be sent to you after the exercise program is completed. In addition, we ask that you continue to monitor the participant's symptomology and primary care needs/issues. If you have any concerns please contact the program coordinator.

Appendix E

Exercise for Depression Handout for Exercise Professionals

Major depressive disorder is a mood disorder that negatively effects the way people feel, and causes physical and mental symptoms for long time periods.

Symptoms are present for 2 weeks or more and can include:

- An overwhelming feeling of depression (despair, sadness, hopelessness, emptiness and/or isolation)
- Diminished interest or pleasure in most activities
- Appetite changes (weight gain or loss)
- Sleep issues (insomnia or hypersomnia)
- Psychomotor retardation or agitation
- Fatigue or loss of energy
- Feelings of worthlessness or guilt
- Diminished concentration and/or cognition
- Recurrent thoughts about death

Some symptoms that may affect participant's ability to engage in self-guided exercise:

- Limited exercise self-efficacy
- Low mood
- Lack of confidence
- Low energy
- Low motivation

Participants with MDD may struggle with adherence to an exercise program. To improve adherence and to support clients:

- Be sensitive to and aware of each participant's body language monitoring specifically for signs of disengagement (e.g., crossed arms, limited eye contact, facing away from other participants, etc.)

- Be aware that some people need more help than others to support their physical activity.
- Be aware that participants with MDD often have decreased cardiovascular endurance/fitness levels, due to being highly sedentary. Improve adherence by not starting the intensity of the exercise program too high, and by tailoring the exercise intervention to each participant's maximum heart rate and fitness level.
- Encourage participants to take breaks as needed, and have modifications for exercises available.

An RN or RPN will check in with you and the participants once weekly. Participants may still attend class if they show up within the first 10 minutes. After 10 minutes, they will not be permitted to attend the class given the risks associated with participating in exercise without first warming up the body. People who miss a class will be contacted by the RN/RPN to check in and rebook the missed class. If a participant misses more then two classes in a row, they will be contacted by the RN/RPN and their readiness for the program reassessed.

If you have any questions or concerns please contact NP_____ at _____ during business hours (Monday to Friday, 9am to 5pm.) If you have to leave a voicemail, you can expect to hear back within 2 business days. If you have an urgent concern about a participant's health, please direct the participant to the nearest Emergency Department or call 911.

If a participant attends an Emergency Department or urgent medical appointment for any reason during the 9-week program and you become aware of this, please alert the NP at the phone number above prior to the participant attending the next exercise session. The NP will then alert the participant's primary care provider to coordinate follow-up care as needed.

Resources to learn more about major depressive disorder:

- Participant and Family Guide to Depression Treatment, from the Canadian Mental Health Association: https://www.canmat.org/wp-content/uploads/2019/07/Choice-D-Guide-Public.pdf

- Canadian Network for Mood and Anxiety Treatments (CANMAT): https://www.canmat.org/2019/03/17/2016-depression-guidelines/
- Healthlink BC Depression information and tools: https://www.healthlinkbc.ca/health-topics/hw30709

Exercise in the Management of Depression

Literature Review and Pilot Program Proposal

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Introduction

By the year 2030, depression will be the leading cause of disability worldwide; it is currently the third leading cause of disease burden (World Health Organization, 2011). Depression can significantly impact people's quality of life, as well as cause significant economic impact due to medical service and occupational costs.

The use of pharmacological and psychological treatments for depression is common practice (Lopresti, 2019; Krogh et al., 2012). Unfortunately, only 30 to 50% of patients respond to antidepressant medication (Gerber et al., 2019; Trivedi et al., 2006) and psychotherapeutic treatments carry a stigma that may limit their acceptance by some patients (Cooney et al., 2013; Gartlehner et al., 2017; Hess et al., 2019).

It is clear that no single treatment plan is effective for every person with depression. This has increased interest in developing and evaluating adjuvant therapies in the management of depression, including exercise (Lopresti, 2019).

Purpose, Significance & Aim

The purpose of this project is to review the literature on exercise and depression, and develop a pilot program proposal.

This project is significant because there currently is no resource or program in British Columbia or Canada to help patients with major depressive disorder (MDD) begin and maintain exercise therapy (Glowacki et al., 2017).

The aim of this project is to create a resource that health care practitioners could refer their patients with mild to moderate MDD to thus increasing the percentage of patients receiving effective care for MDD.

Methods/Process

The project began with a thorough literature review, examining the use of exercise in the treatment of MDD, including the strengths, barriers and limitations and effective/necessary components of an exercise program for depression.

The second component of this project was the development of a pilot program proposal. The components for this proposal were guided by the literature review, in addition to my committee's experience and suggestions, as well as as the Project Proposal Template from Providence Health Care (2019).

Results

Exercise is an effective monotherapy and adjunct therapy for mild to moderate MDD (Cooney et al., 2013; NICE, 2009; Ravindran et al., 2016; Glowacki et al., 2017).

An exercise program is most effective if it:

1. Is supervised by an exercise professional, such as a physiotherapist, kinesiologist, or certified exercise instructor.
2. Is performed in a group setting.
3. Is performed at a moderate to vigorous intensity.
4. Includes 3 exercise sessions a week.
5. Includes exercise classes which are at least 60 minutes long, with 10 minutes of warm-up, 40 minutes of work, 10 minutes of cool down.
6. Is a total length of 9 weeks.
7. Contains a variety of aerobic based exercises, including high intensity interval training (HIIT), circuit training, spin bikes, and step classes.

Discussion

My proposed pilot program addresses the implementation gap in the literature and has the potential to improve outcomes for patients with MDD through increasing access to a treatment option other than strictly pharmacotherapy and/or psychological therapy.

Conclusion

Improving access to care and creating additional programs, such as exercise for depression, could be important components in the improving the treatment of MDD.

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