Investigating the effects of Physical Activity Counselling on depressive symptoms, affect and physical activity in female undergraduate students with depression: A multiple baseline single-subject design.

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ABSTRACT

Background: In Canada, women aged 15-24 report the highest rate of depression, an age group which represents a significant proportion of undergraduate students (Hanlon, 2012). Although pharmacology remains the primary treatment for depression, it may not be the most sufficient (Stanton et al., 2014). Physical activity has been demonstrated to have a large and significant antidepressant effect in individuals with depression (Schuch et al., 2016), though what remains challenging is identifying the most effective way to activate this population. Physical Activity Counselling (PAC) has been shown in research to effectively increase levels of physical activity (Fortier et al., 2011). However, the effects of PAC have not been considered in a population of female students with depression specifically.

Purpose: To investigate the effects of PAC on depressive symptoms, affect and physical activity in female undergraduate students with depression.

Methods: Five female undergraduate students with depression received two months of PAC from a registered Kinesiologist. The study followed a multiple baseline, single-subject design in which measures were taken during four study phases: baseline, intervention, end point and follow-up. Data was collected, including daily objective measures of physical activity, using accelerometers, and self-reported measures of depressive symptoms, positive affect, negative affect and physical activity, using online surveys administered every second day.

Results: Visual analyses revealed that depressive symptoms decreased and self-reported physical activity increased from baseline throughout subsequent study phases in all five participants, as hypothesized. Statistical analyses supported these results. Estimated effect sizes of grouped averages indicated that decreases in depressive symptoms from baseline throughout each study

phase ranged from small to large, while increases in self-reported physical activity were in the medium to large range.

Conclusions: Findings of this study provide initial support for Physical Activity Counselling as a potential strategy to increase physical activity levels and reduce depression among female undergraduate students with depression. Future research is recommended on this important topic.

CHAPTER I: INTRODUCTION

Depression is defined by the World Health Organization (WHO) as, "a mental disorder, characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration" (Depression, para. 1). Depression is the most common mental disorder in society today, affecting over 350 million people worldwide (WHO, 2012). In Canada, the prevalence of depression is 3.2 million, comprising 11.3% of the total population (Statistics Canada, 2013). The highest rate of depression is reported for people ages 15 to 24 and is highest among women (Statistics Canada, 2013). This age group represents a significant proportion of undergraduate students, thus it is not surprising that depression is one of the most common health problems faced by students (Hanlon, 2012; Ibrahim, Kelly, Adams, & Glazebrook, 2013). University representatives have reported increasing antidepressant drug use among students with depression and have highlighted the need for additional mental health resources available to students (CBC News, 2012; La Rotonde, 2016; Ottawa Sun, 2014). In fact, the student's association at Algonquin College claim antidepressants are the highest drug expense out of all other medications among students (Algonquin Times, 2014).

As a result of increasing antidepressant prescription, it would be logical to presume that depression rates among students are decreasing. However, the rates of depression in Canada have remained stable over the last 15 years (Sunderland and Findlay, 2013). So, although medication remains the primary treatment for depression, it may not be the most effective treatment for depression (Stanton, Happell, Hayman, & Reaburn, 2014). This suggests the need to explore alternative strategies. Physical activity has been demonstrated in research to have a considerable impact not only on physical health but also mental health (Mammen & Faulkner, 2013; Ng et al.,

2012). Being physically active has been related to a decrease in depressive symptoms (Parker et al., 2016; Pereira, Geoffroy, & Power, 2014; Schuch et al., 2016; Wegner et al., 2014) and an increase in positive affective states post-physical activity (Guérin & Fortier, 2013; Mata et al., 2012; Rzezak et al., 2015; Stanton et al., 2014).

While research has demonstrated that getting people moving has numerous benefits, we still do not know the optimal way to get people more active. Physical Activity Counselling (PAC) is one approach which has been demonstrated in research to increase levels of physical activity (Fortier et al., 2011; Gao et al., 2016). The goal of PAC is to promote physical activity in an autonomy supportive environment, which is characterized by supporting patient perspectives and encouraging patient decision making (Markland & Tobin, 2010). If PAC has the ability to increase physical activity (Fortier et al., 2011; Gao et al., 2016), and these increases in activity reduce the severity of depressive symptoms (Parker et al., 2016; Pereira et al., 2014; Schuch et al., 2016) and bring about positive feelings (Guérin & Fortier, 2013; Mata et al., 2012), then PAC might be an important strategy to consider in the treatment of depression.

The overall purpose of this research was to investigate the effects of PAC on depressive symptoms, affect and physical activity in undergraduate women with depression. The specific objectives were to: (1) examine the influence of a two-month PAC intervention on the severity of depressive symptoms from baseline to intervention, end point and follow-up (2) examine the influence of a two-month PAC intervention on both positive and negative affect from baseline to intervention and end point (3) examine the influence of a two-month PAC intervention on both objective and self-reported physical activity levels from baseline to intervention, end point and follow-up.

CHAPTER II: LITERATURE REVIEW

Depression in Undergraduate Students

Depression is defined by WHO (2012) as, "a mental disorder, characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration" (Depression, para. 1).

A systematic review by Ibrahim et al. (2012) considered twenty-four articles which looked at the prevalence of depression in undergraduate university students from fifteen countries worldwide. The mean prevalence of depression was 30.6% on average, almost one-third of the total students. The authors of this review also indicated that depression rates among undergraduate students are higher than those of the general population, even though students are in a socially advantaged environment (Ibrahim et al., 2012). So why are students at a higher risk of depression compared to the general population?

Undergraduate students, experience drastic life changes which can cause stress and lead to mental disorders such as depression. Many students in their first year of university have moved away from home for the first time and find it difficult to cope without the support of their families (Ibrahim et al., 2012). Students may also experience changes in sleep and eating patterns, altered relationships, increases in academic pressure, greater financial struggles and decreases in physical activity (Eisenberg, Gollust, Golberstein, & Hefner, 2007; Ibrahim et al., 2012; Wilson et al., 2014). These stressors are common among students and are strong predictors of depression (Wilson et al., 2014).

In an article published in MacLean's magazine, Lunau (2012) considered the prevalence of mental health issues in Canadian universities and the potential reasons for them. Lunau (2012)

found that the highest rate of mental illness occurred in students who were in their late teens to early twenties. Among Canadian University students, 7.5% of those who entered university with no prior mental health issues, developed symptoms at some point during their post-secondary education. The reasons that were highlighted for the high rates of mental health issues among students were isolation, social pressure, high parental expectations, perfectionism, academic demands and concerns of securing a job after school. In 2011, the average entrance grade at Queen's University was 88.1%. Those who were lucky to be admitted started post-secondary education no longer as the top students in their class, but average in comparison, which caused them stress. In the past, those who completed an undergraduate degree were likely to secure a job after university. Today, since it is so common to complete an undergraduate degree, this no longer puts you ahead of your competition which may put some students at higher risk of developing mental health problems. The high prevalence of sub-optimal mental health in students, caused by a variety of contributing factors, is why the present thesis focused on the student population and on addressing depression in particular.

Depression in Women

When investigating the prevalence and causes of depression, almost all research reveals that women are at a higher risk of depression than men (Eisenberg et al., 2007; Ibrahim et al., 2012; Wong et al., 2014). Indeed, when considering the rates of depression among those ages 15-24, which represents the typical age group of undergraduate students, Canadian women are almost twice as likely as men to suffer from depression (9.0% vs. 5.3%) (Pearson, Janz, & Ali, 2013).

While it is widely demonstrated in research that women are at an increased risk of depression, the exact reasons why are inconclusive. Many studies have examined the possible

determinants for why women are at an increased risk of depression compared to men. From a biological standpoint, women experience hormonal fluctuations during puberty, while taking oral contraceptives, post pregnancy and during menopause (Kessler, 2003). Moreover, females who mature early have been shown to experience greater psychological distress than those who mature more slowly (Kessler, 2003). Women also have a higher prevalence of physical inactivity compared to men (Hallal et al., 2012). Since physical inactivity is positively associated with several chronic illnesses, including depression, physical inactivity represents a possible determinant of depression that can be targeted and improved (Warburton, Nicol, & Bredin, 2006). This research aimed to enhance the physical activity levels of female undergraduate students with depression to help improve their depressive symptoms.

Physical Activity and Depression

Numerous studies support the role of physical activity in improving not only physical health, but also mental health. A longitudinal study by Pereira et al. (2014) investigated the relationship between depression and physical activity among 11,135 participants over three decades at 23, 33, 42 and 50 years of age. The purpose of the study was to determine if improvements in physical activity over time had an influence on depressive symptoms. The results revealed a bidirectional relationship between depressive symptoms and physical activity, wherein greater physical activity predicted lower depressive symptoms and higher depressive symptoms predicted lower physical activity. In addition, findings demonstrated that those who remained inactive throughout the study had no change in depressive symptoms while those who increased their physical activity levels throughout the study showed reduced depressive symptoms. Accordingly, the authors suggested it might be beneficial for practitioners to consider physical activity as treatment for depression.

A study done by Taliaferro et al. (2009) measured physical activity levels and negative affect (feelings of hopelessness, depression and suicidal behaviour), in students aged 18-25 years. Results revealed that all negative affect feelings were significantly lower for active students compared to inactive students. The rate of depression in this study was extremely high as 46.1% of students reported feeling so depressed it was difficult to function one or more times in the past school year. This finding further reinforces that depression is a serious concern among undergraduate students and that physical activity is an important contributor.

Another study by Pasco et al. (2011) examined the correlation between physical activity and positive affect (feelings of interest, excitement, enthusiasm and alertness). The results revealed the highest rate of positive affect among those who were considered very active, and the lowest rate of positive affect among those who were sedentary. These results support the positive relationship between physical activity and positive affect.

In a systematic review on the influence of physical activity in preventing depression, Mammen and Faulker (2013) summarized a total of 30 studies and concluded that engaging in physical activity reduces the risk of depression. It was also suggested that females benefit more from the protective effects of physical activity than males, because of the social environment. Thus, this thesis examined the effect that increased physical activity had on the depressive symptoms of women.

Wegner et al. (2014) conducted a mega meta-analysis of 37 meta-analyses on the effects of physical activity on mood disorders. This powerful source of evidence concluded that physical activity has a moderate effect on reducing depression. The authors also found that the mental benefits of physical activity are greater for patients with depression compared to a non-clinical

population. For this reason, in this thesis we targeted individuals with depression, as they may benefit the most from increased physical activity.

Most recently, Schuch et al. (2016) performed a meta-analysis of 25 randomized controlled trials which compared physical activity interventions to control groups in a sample of individuals with depression. Results of this meta-analysis suggested that previous meta-analyses may have underestimated the benefits of physical activity on depression. The authors concluded that physical activity has a large and significant antidepressant effect in those with depression and as such, should be recognized as an evidence-based treatment for depression.

Taken together, it is clear that physical activity has the potential to improve the symptoms of depression by decreasing the severity of depressive symptoms, decreasing negative affect and enhancing positive affect (Cramp & Bray, 2010; Dunn & Jewell, 2010; Guérin & Fortier, 2012; Parker et al., 2016; Pasco et al., 2011; Taliaferro et al., 2009; Wegner et al., 2014).

Physical Activity Levels of Undergraduate Students

Physical activity has the potential to prevent and alleviate symptoms of depression. For people aged 18-64, a minimum of 150 minutes/week of moderate-to-vigorous physical activity (MVPA) in minimum bouts of ten minutes is recommended (Colley et al., 2011). However, according to the Canadian Health Measures Survey, only 15% of adults meet these guidelines and females are significantly more inactive than males (Colley et al., 2011).

The greatest decline in physical activity levels is suggested to be from late adolescence to early adulthood which occurs during the transition from high school to first year of university (Kwan, Cairney, Faulkner, & Pullenayegum, 2012). Kwan et al. (2012) performed a longitudinal study on physical activity behaviours of Canadian adolescents (N=640; ages 12-15 until ages 24-

27) during the transition into early adulthood. Results of the study found that physical activity levels decreased significantly by 24% throughout the transition period.

The widely held support of the positive effects of physical activity on depression suggests that physical activity could be the future medicine for this major health concern (Dunn & Jewell, 2010). What remains a challenge is getting and keeping individuals with depression active. One potential solution is Physical Activity Counselling. Therefore, this thesis focused on increasing physical activity, as treatment for depression, through Physical Activity Counselling.

Role of Physical Activity Counselling in Promoting Physical Activity

Physical activity counselling (PAC) is a style of counselling primarily based on Motivational Interviewing (MI) and the Self Determination Theory (SDT). Motivational Interviewing is a collaborative, client-centred counseling approach which facilitates behaviour change through a four stage process: 1) Engaging: establishing a trusting relationship 2) Focusing: guiding the client towards change 3) Evoking: eliciting and strengthening the client's own reasons and motivation for change 4) Planning: guiding the client to develop and implement a realistic change plan (Miller & Rollnick. 2013). Motivational Interviewing has been found to be effective in changing physical activity behaviour (Hardcastle, Blake, & Hagger, 2012; O'Halloran et al., 2014).

Self-Determination Theory is a theoretical framework developed by Ryan & Deci (1985) which describes the quality of human motivation. It has been used extensively as a promising framework to describe the motivations people have to engage in physical activity (Fortier, Duda, Guérin, & Teixeira, 2012; Gourlan et al., 2016; Teixeira et al., 2012). The SDT consists of three types of motivation along a continuum (i.e., intrinsic motivation, extrinsic motivation and

amotivation) which can be further classified by six behavioural regulations. Along this continuum there are two further distinctions which describe each regulation according to autonomy. An autonomous or self-determined regulation is an action done out of volition, which reflects personal needs, values and a sense of one self (Deci & Ryan, 2010). Alternatively, controlled regulation is an action performed without choice, resulting from demands and/or pressure (Deci & Ryan, 2010).

Intrinsic motivation is the most self-determined form of motivation which involves doing an action (such as engaging in physical activity) for the inherent satisfaction that it brings (Deci & Ryan, 2010). Extrinsic motivation involves doing an action for instrumental reasons such as for expected outcomes (Deci & Ryan, 2010). Lastly, amotivation involves a complete lack of motivation (Deci & Ryan, 2010).

There are four types of regulations within extrinsic motivation including: integrated, identified, introjected and external. Integrated regulation is the most self-determined extrinsic regulation which involves engaging in an action believed to facilitate personal goals and values (Deci & Ryan, 2010). Identified regulation is a self-determined regulation which involves engaging in an action considered valuable and important (Deci & Ryan, 2010). Introjected regulation is a controlled regulation which involves engaging in an action to avoid feelings of guilt or shame (Deci & Ryan, 2010). Finally, external regulation is the most controlled extrinsic regulation which involves engaging an action for a reward or to avoid punishment (Deci & Ryan, 2010).

The Basic Needs Theory is a sub-theory of SDT which describes three basic human psychological needs including competence, autonomy and relatedness. Competence is a feeling of accomplishment in tasks of various aspects of life (Deci & Ryan, 2010) Autonomy is the

freedom of choice (Deci & Ryan, 2010). Relatedness is a feeling of connectedness with and caring for others (Deci & Ryan, 2010). Satisfaction of these basic needs has been shown to lead to self-determined motivation and greater psychological health and well-being (Deci & Ryan, 2010; Ng et al., 2012).

A meta-analysis performed by Ng et al. (2012) considered the relationship between various components of SDT (i.e., fostering an autonomy supportive climate, different regulations and the three psychological needs) and outcomes of both mental and physical health. Their findings revealed that facilitating an autonomy supportive climate positively predicts higher patient autonomy, competence and relatedness. In turn, greater satisfaction of the psychological needs positively predicts mental health (measured by levels of depression, anxiety and quality of life) and physical health (measured by tobacco usage, diet and physical activity). Moreover, the authors suggested that more self-determined regulations have a positive association with mental and physical health. Overall, this meta-analysis demonstrates that SDT concepts are important for health promotion interventions to consider.

Although the intervention of MI was not initially developed based on SDT, research has recognized strong similarities between SDT and MI. Specifically, the spirit of MI facilitates the three basic psychological needs which promote self-determined motivation and future behaviour such as physical activity (Markland, Ryan, Tobin, & Rollnick, 2005; Miller & Rollnick, 2012; Teixeira et al., 2012). Being empathetic, avoiding judgement and developing a trusting partnership between the counsellor and client are core MI techniques which contribute to a client's feelings of relatedness (Resnicow & McMaster, 2012). Through motivational language, such as providing positive feedback, the counsellor is able to enhance a clients' perceived competency to make a behaviour change (Resnicow & McMaster, 2012). Finally, autonomy is a

fundamental element of MI which is facilitated through the use of many techniques such as asking for permission to provide information and offering a variety of change options for the client to choose from (Miller & Rollnick, 2012; Teixeira et al., 2012). In addition to the counselling approach of MI and facilitating the psychological needs of the SDT, PAC also utilizes several evidence-based behaviour change techniques such as open questions, reflective statements and affirmations (Michie et al., 2013).

Physical Activity Counselling aims to improve physical activity levels by increasing quantity and quality of motivation. The goal of a physical activity counsellor is to have the client find their own motivation and talk themselves into physical activity behaviour change. The client chooses if they want to change, why they are going to change and how they are going to make that change. Some PAC strategies include: resolving ambivalence, determining the clients' values, developing discrepancy between goals and status quo, exploring the pros and cons of behaviour change, assisting in goal setting, and enjoyment enhancement (Fortier et al., 2007; Miller & Rollnick, 2013). There have only been a few studies which have considered the effectiveness of PAC in promoting physical activity, however the results have been very promising.

To illustrate, Fortier et al. (2007) performed a randomized controlled trial where participants were assigned to receive either a) a brief three-minute intervention regarding physical activity from their physician during a primary care visit or b) intensive physical activity counselling from a physical activity counsellor over three months. The results showed significantly higher quantity and quality of motivation, and greater self-reported physical activity levels at 6 weeks and 13 weeks in the group who received intensive PAC over three months (Fortier et al., 2007; Fortier et al., 2011). These findings suggest that PAC is associated with

increased physical activity. However, there is limited research on the effectiveness of PAC in promoting physical activity, which is one reason why this thesis is so significant. In fact, to our knowledge, no previous studies have considered the role of PAC in promoting physical activity in a population of female undergraduate students with depression.

Purposes of the Study:

The specific objectives and associated hypotheses of this study were to:

(1) Examine the influence of a two-month PAC intervention on the severity of depressive symptoms of female undergraduate students with depression (main outcome). It was hypothesized that the severity of depressive symptoms would reduce from baseline to intervention (Schuch et al., 2016; Soucy-Chartier & Provencher, 2014). The improvement in depressive symptoms was anticipated to be maintained at end point and follow-up.

(2) Examine the influence of a two-month PAC intervention on both positive and negative affect of female undergraduate students with depression (secondary outcomes). It was hypothesized that positive affect would improve from baseline to intervention and negative affect would reduce from baseline to intervention (Mata et al., 2012; Taliaferro et al., 2009). The improvement in positive and negative affect was anticipated to be maintained at end point.

(3) Examine the influence of a two-month PAC intervention on both objective and self-reported physical activity levels of female undergraduate students with depression (tertiary outcomes). It was hypothesized that objective and self-reported physical activity levels would increase from baseline to intervention (Fortier et al., 2011; Gao et al., 2016). The improvement in physical activity levels, both objective and self-reported, was anticipated to be maintained at end point and follow-up.

Significance of the Study

Medication is the most common form of treatment for depression (Stanton et al., 2014; Wong et al., 2014). However, Canadians with depression reported counselling as their greatest medical health care need, above medication, and the lowest health care need met (Sunderland & Findlay, 2013). Physical activity is usually only prescribed, with little direction, as a self-managed, adjunct therapy to antidepressants despite strong evidence of its effectiveness in reducing depression (Craft & Perna, 2004). While some doctors might recommend physical activity to their patients with depression, many patients do not have the skills and/or motivation to be active without guidance and direction. If physical activity is a mere recommendation prescribed with medication, it is very unlikely that the patient will engage in physical activity on their own. This is where physical activity counsellors can play an important role.

Unlike antidepressants, being physically active yields not only mental benefits, but physical benefits as well. Additionally, being physically active improves self-efficacy and increases social interaction (Pasco et al., 2011). Better mental health is related to increased productivity and performance on daily tasks, such as schoolwork (Eisenberg et al., 2007). This has the potential to increase the academic success of students which may help improve their depression and also help them gain employment opportunities after university (Eisenberg et al., 2007). Students are the future leaders of society, which is why it is so important for them to succeed.

From an economic point of view, the costs related to physical inactivity and depression are huge. Alison et al. (2007) estimated that the costs associated with physical inactivity in Canada are $2.1 billion annually. Since then, the direct and indirect costs of physical inactivity in Canada have gone up substantially to an estimated $6.8 billion annually (Janssen, 2012). In

regards to mental health, Wong et al. (2014) found that individuals with depression have 1.5 times more visits with primary care providers than those who do not have depression. Their results also indicated that one in four patients with depression also had a chronic illness. Taken together, these findings demonstrate the high costs associated with depression. Alison et al. (2007) suggested that a 1% increase in physical activity will save $15 million annually in health care costs. However, most doctors do not have the time or the training to provide patients with counselling on physical activity (Fortier et al., 2007). It would be much more feasible to refer patients to a physical activity counsellor as opposed to paying a doctor to provide sufficient counselling (Fortier et al., 2007; Hogg et al., 2011). It is important to provide appropriate care by the appropriate provider.

Many studies have looked at the effects of physical activity on affect (Ekkekakis, Hargreaves, & Parfitt, 2013; Guérin, Fortier & Sweet, 2014), and a few studies have investigated the effects of PAC on physical activity levels (Fortier et al., 2007, 2011; Gao et al., 2016). To my knowledge, none have combined the two aspects; investigating whether PAC increases physical activity levels and whether the increased physical activity levels promote positive affect and reduce negative affect. Also, there has not been any research on PAC which focusses on a specific population of undergraduate, female students with depression. Since previous research has suggested that female undergraduate students are the most at risk of poor mental health, and since physical activity has the potential to benefit these individuals the most, it is important to target this population in particular. This research aimed to address these gaps in literature. With regards to theoretical contributions, given that the PAC intervention is based on the SDT, any improvements in physical activity and ensuing depression resulting from this study provide further support for the use of SDT as the theoretical foundation of PAC.

CHAPTER III: JOURNAL ARTICLES

ARTICLE 1: Rationale and methodology for a multiple single-subject Physical Activity Counselling study examining female undergraduate students with depression

There has been increased emphasis on the need for study protocol papers which adequately describe the methodology of exercise-based interventions (Abell, Glasziou, & Hoffmann, 2015; Hoffman et al., 2016). Indeed, providing a detailed description of methodology is essential in order to translate effective research interventions into clinical practice. The following article provides an extensive description of the PAC intervention followed in this Master's thesis. This article has been submitted to *Journal of Physical Activity and Health*. This academic journal welcomes manuscripts describing the development of health interventions that promote physical activity and which aim to translate research to practice.

ARTICLE 2: Investigating the effects of Physical Activity Counselling on depressive symptoms, affect and physical activity in female undergraduate students with depression: A multiple baseline single-subject design.

The following article describes the outcomes of the two-month PAC intervention, delivered in this Master's thesis. This article has been prepared for submission to the journal *Mental Health and Physical Activity* which aims to publish research interventions describing the effects of physical activity on mental health.

Article Contributions: As the primary author, my contributions to these articles included: study design, participant recruitment, data collection, data analyses and all manuscript writing. Dr. Michelle Fortier's contributions included: study design and article revisions. Dr. Eva Guérin's contributions included: data analyses and article revisions.

Rationale and methodology for a multiple single-subject Physical Activity Counselling study examining female undergraduate students with depression

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Abstract

Background: Depression is a serious health concern among university students. Although pharmacotherapy remains the primary treatment for depression, it may not be the most sufficient. Many recent meta-analyses support that physical activity significantly reduces depression, though we have yet to determine the best way to get people moving. One potential strategy is Physical Activity Counselling (PAC). Physical Activity Counselling focuses on motivating individuals to be more physically active for personally derived reasons. The present article outlines the rationale and methodology for a peer-to-peer PAC program which aims to reduce depressive symptoms among female university students.

Methods: The study follows a multiple baseline single-subject design, in order to conduct an initial validation of a PAC intervention for this important population. Participants are recruited from university campus via advertisement posters or upon referral by their physician or mental health counsellor at the university health clinic. Participants receive a maximum 2 months of PAC and data is collected using accelerometers and online questionnaires administered every two days.

Discussion: The results of this study may help in supporting the role of physical activity as a form of treatment for depression and in promoting collaborations between health professionals and physical activity counsellors on university campuses.

Keywords: exercise psychology, physical activity, mental health, intervention study, research design.

1. Background

Depression is defined by the World Health Organization (WHO) as, "a mental disorder which consists of feelings of sadness, guilt, tiredness, loss of positive feelings and interest, and disturbed sleeping and eating patterns."[1] Depression is the most common mental disorder in society today, affecting approximately 350 million people worldwide.[1] In Canada, the prevalence of depression is 3.2 million, comprising 11.3% of the total population.[2] The rate of depression is highest among women as well as among people aged 15 to 24.[2] This age group represents a significant proportion of undergraduate university students, thus it is not surprising that depression is reported as one of the most common health problems faced by students.[3,4] In fact, depression is the third most common cause of disability in the general population and evidence suggests depression ranks even higher among university students.[3] A recent article in an Ontario University student newspaper highlighted an increase in depression and antidepressant use among students and advised a need for more accessible mental health programs. When investigating the prevalence and causes of depression, almost all research reveals gender differences. In those aged 15-24, Canadian women are almost twice as likely as men to experience depression (9.0% vs. 5.3%).[5] Indeed, numerous studies show that women are at a much higher risk of depression than men.[6,7] As a result of the high prevalence of sub-optimal mental health in female undergraduate students, the present study focuses on enhancing physical activity to help improve levels of depression in this population in particular.

It would be reasonable to assume that depression rates among students are decreasing as a result of the rise in antidepressant prescriptions. However, the rates of depression in Canada have remained stable over the last 15 years.[8] So, while pharmacotherapy remains the primary treatment for depression, it may not be the best or most sufficient treatment for depression; focus

on supplemental treatment should be considered.[9] In particular, there is growing evidence to support that physical activity has a considerable positive impact not only on physical health but also mental health.[10-12] Being physically active is associated with fewer depressive symptoms,[12-14] and an increase in positive affective states both post-physical activity,[11,15] as well as more generally.[16]

In a randomized controlled trial evaluating the effectiveness of interventions aimed at reducing depression in young adults (15-25 years), Parker et al[12] concluded that the greatest reduction in depressive symptoms was shown in participants who received physical activity interventions compared to those who received non-physical activity interventions (i.e. problem solving therapy).

Similarly, a longitudinal study by Pereira, Geoffroy and Power[14] measured depression and physical activity among 11,135 participants over three decades at 23, 33, 42 and 50 years of age. The results indicated a bidirectional inverse relationship between depressive symptoms and physical activity; greater physical activity predicted lower depressive symptoms and higher depressive symptoms predicted lower physical activity. The results also indicated that those who remained inactive throughout the study had no change in depressive symptoms while those who increased their physical activity levels throughout the study showed reduced depressive symptoms. Accordingly, the authors suggested it might be beneficial for practitioners to consider physical activity as treatment for depression.

Indeed, the role of physical activity in improving mental health in a young adult population is widely supported in research. Interestingly, a recent meta-analysis revealed that previous research has actually underestimated the benefits of physical activity on depression and the authors conclude that exercise is an evidence-based treatment for depression.[17]

While research has demonstrated that getting people moving has numerous and significant benefits, we have yet to figure out how to best activate people. Indeed, according to Canada's physical activity change agenda, Active Canada 20/20, shifting from knowledge to action is one of the main challenges that remains. One strategy which has been successful in increasing levels of motivation and physical activity is Physical Activity Counselling (PAC).[18-21] Physical Activity Counselling is a counselling approach based on Motivational Interviewing and the Self-Determination Theory. As such, PAC focuses on promoting physical activity in an autonomy supportive environment, which is characterized by respecting patient perspectives and facilitating patient decision making.[22] Physical Activity Counselling also incorporates evidence-based behaviour change techniques such as goal setting and enjoyment enhancement. Since PAC has the ability to increase physical activity,[20] and increases in activity can reduce the severity of depressive symptoms,[14] and bring about positive feelings,[23] then PAC has the potential to aid in the treatment of depression. While there is vast evidence on the effectiveness of physical activity interventions for chronic conditions, one major challenge in implementing these interventions in practice is the poor description of their methodology.[24] To illustrate, Hoffman, Erueti & Glasziou[25] analyzed 137 non-pharmacologic interventions (including physical activity interventions) and concluded that 61% were missing essential methodological details required for effective replication. Without adequate description of physical activity interventions, clinicians are unable to effectively implement in practice. Therefore, the purpose of this article is to outline the rationale and methodology for a peer-to-peer PAC program which aims to improve levels of physical activity in order to reduce depressive symptoms and promote mental health among female university students.

The Current Study

The specific objectives and hypotheses of this research are as follows:

(1) Examine the influence of a two-month PAC intervention on the severity of depressive symptoms of female undergraduate students with depression (main outcome). It is hypothesized that the severity of depressive symptoms will reduce from baseline to intervention.[17,26] The improvement in depressive symptoms is anticipated to be maintained at end point and follow-up.

(2) Examine the influence of a two-month PAC intervention on both positive and negative affect of female undergraduate students with depression (secondary outcomes). It is hypothesized that positive affect will improve from baseline to intervention and negative affect will reduce from baseline to intervention.[i,11,26] The improvement in positive and negative affect is anticipated to be maintained at end point.

(3) Examine the influence of a two-month PAC intervention on both objective and self-reported physical activity levels of female undergraduate students with depression (tertiary outcomes). It is hypothesized that objective and self-reported physical activity levels will increase from baseline to intervention.[19-21] The improvement in physical activity levels, both objective and self-reported, is anticipated to be maintained at end point and follow-up.

PAC Intervention: Theoretical and Intervention Framework

Physical activity counselling (PAC) is a style of counselling primarily based on Motivational Interviewing (MI) and the Self Determination Theory (SDT). Although the intervention of MI was not initially developed based on SDT, research has recognized strong

similarities between the SDT and MI. This combined approach has been used in previous Physical Activity Counselling interventions.[18,27] Motivational Interviewing is an interpersonal/communication, one-on-one, counselling approach which facilitates behaviour change by increasing an individuals' own motivation for change.[28,29] Motivational Interviewing has been found to be effective in increasing physical activity levels.[30,31]

Motivational interviewing involves a four-stage process: 1) Engaging: developing a trusting relationship with the client 2) Focusing: helping the client to find a clear focus and direction towards change 3) Evoking: eliciting and strengthening the client's own motivation for change 4) Planning: guiding the client to develop and implement a realistic change plan.[29] Motivational Interviewing also involves the use of several evidence-based behaviour change techniques, such as open-questions, reflective statements and importance rulers.[32]

Physical activity counselling is also based on SDT. Self-Determination Theory is a theoretical framework developed by Deci & Ryan[33] that describes people's motivation to act a certain way. It has been used extensively, and with much support, in the physical activity context.[27,34] To illustrate, in a recent meta-analysis involving 82 interventions, Gourlan et al[35] concluded that interventions based on theory, especially SDT, are effective in promoting physical activity.

The SDT consists of three types of motivation along a continuum (intrinsic motivation, extrinsic motivation and amotivation). Extrinsic motivation is broken down into four behavioural regulations. There are two further distinctions which describe each extrinsic regulation according to autonomy. An autonomous (self-determined) motivation describes an action done out of choice that reflects psychological needs, values and a sense of one self.[36] Alternatively, a more controlled style of motivation would describe an action done out of pressure without choice.[36]

Intrinsic motivation is the most self-determined form of motivation which involves doing an action (such as engaging in physical activity) for the pure satisfaction and enjoyment that it brings.[36] Extrinsic motivation involves doing an action for instrumental reasons such as for expected outcomes.[36] It can be further qualified into four types of regulations that vary in the degree to which they are self-determined: integrated, identified, introjected and external. Integrated regulation is the most self-determined regulation and it involves engaging in physical activity because it is congruent with personal beliefs or values and is believed to facilitate life goals.[36] Identified regulation involves engaging in physical activity out of choice for the value of the action itself, for example a person may train at the gym to feel strong. [36] Introjected regulation is a controlled regulation which involves engaging in physical activity to avoid feelings of guilt or shame.[36] External regulation is the most controlled regulation type and it involves engaging in physical activity for a reward or to avoid punishment. [36] Lastly, amotivation involves a complete absence of motivation.[36]

Self-Determination Theory also includes the Basic Needs Theory, which describes three basic psychological human needs that enhance self-determination: competence, autonomy and relatedness. [36] Competence is a feeling of effectiveness regarding physical activity, whereas autonomy is the freedom to make one's own decisions, and relatedness is a feeling of connectedness and belonging in the physical activity context. [36] Facilitating these three psychological needs helps to promote more self-determined forms of motivation which in turn is related to physical activity adherence.[37] This is important because the goal of any physical activity intervention should be for participants to achieve physical activity maintenance following the completion of the intervention program.

Additionally, interventions based on SDT, which promote satisfaction of the three psychological needs, have revealed improvements in both physical health and mental health.[27,38] A meta-analysis performed by Ng et al[39] considered the relationship between various components of SDT (including the facilitation of an autonomy supportive climate in health care, the three psychological needs and the different regulations) and both mental and physical health outcomes. An autonomy supportive climate is characterized by understanding client perspectives, involving a client in the decision making process, optimizing choice and minimizing control.[33] For example, having a client come up with a list of their own ideas for how they could be more physically active. The findings of Ng et al[39] indicated that facilitating an autonomy supportive climate is positively associated with higher patient autonomy, competence and relatedness. In turn, greater satisfaction of the psychological needs positively predicted self-determined motivational regulations and mental health (measured by levels of depression, anxiety and quality of life) and physical health (measured by tobacco usage, diet and physical activity). The authors also revealed that more self-determined regulations had a positive association with mental and physical health. Overall, the results of this meta-analysis, along with that of Gourlan et al[35], demonstrated that SDT concepts are highly relevant components to consider for physical activity interventions.

Experts have recognized strong similarities and overlap between the SDT and the intervention of MI, although the latter was not initially developed based on SDT.[40] Specifically, the spirit/counseling style of MI addresses the three basic psychological needs which promote self-determined motivation and future behaviour such as physical activity.[40,41] Being empathetic, avoiding judgement and developing a trusting partnership between the counsellor and client are core MI techniques which contribute to a client's feelings of relatedness.[42] Through motivational

language, such as providing positive feedback, the counsellor is able to enhance a clients' perceived competency to make a behaviour change.[42] Finally, autonomy is a fundamental element of MI which is facilitated through the use of many techniques such as asking for permission to provide information and offering a variety of change options for the client to choose from.[40,41] The goal of a physical activity counsellor is to have the client find their own motivation and talk themselves into physical activity behaviour change. The client chooses if they want to change, why they are going to change and how they are going to make that change. In addition to the counselling approach of MI and facilitating the psychological needs of the SDT, PAC also incorporates the use of several evidence-based behaviour change techniques such as goal setting, self-monitoring and enjoyment enhancement.[32]

Research Rationale

From a theoretical perspective, although there is evidence of similarities between the theory of SDT and the MI intervention, which PAC is based on, there remains disconnect between the two; SDT has yet to be fully accepted as the theoretical framework for MI. Thus, given that the PAC intervention in the present study is based on facilitating the basic needs of the SDT and follows the counselling style of MI, if levels of physical activity and ensuing depression improve during this PAC intervention, support would be provided for the use of SDT as the theoretical foundation of MI.

From a knowledge standpoint, many studies have looked at the effects of physical activity on affect,[11,15,43] many at the effects of physical activity on depression,[12,14,17] and a few trials have investigated the effects of PAC on physical activity levels.[19-21] To our knowledge, none have combined these aspects, that is investigating whether PAC increases physical activity levels and whether the increased physical activity levels promote better affect and reduce

depression. Also, this will be the first PAC study to focus on a specific population of undergraduate, female students with depression.

From an applied stance, current research and media have drawn increasing attention to the issue of depression among university students.[3,44] Students, especially undergraduate students, experience drastic life changes such as changes in sleep and eating patterns, increases in academic pressure and decreases in physical activity.[3,6,45] These common student stressors are all strong predictors of depression.[45] From an applied standpoint, the current research aims to reduce the severity of depressive symptoms and improve affect of female undergraduate students with depression in an effort to reduce the rising rates of depression among university students. Since previous research has suggested that female undergraduate students are the most at risk of poor mental health,[5] and since physical activity has the potential to benefit these individuals the most,[10] it is important to target this population in particular.

Finally, unlike antidepressants, being physically active yields not only mental benefits, but physical benefits as well.[24] Improved mental health is also related to increased productivity and performance on daily tasks, such as schoolwork.[6] Both physical activity and better mental health have been linked to academic success,[46,47] which may lead to employment opportunities after university.[6] Students are the future leaders of society, it is important for them to be physically and mentally healthy in order to succeed academically, which will prepare them for success in the workforce and in other future endeavours.

2. Methodology

Research Design

The study follows a single-subject design and more specifically a multiple baseline design. Participants act as their own control group by comparing ten days of baseline measures (control condition) to their measures during PAC (intervention condition) to their end point measures once the intervention has ended (again for 10 days). The multiple baseline design involves staggering the days when participants receive PAC to minimize the influence of confounding variables that might be causing changes across all participants at a particular time. For example, if all participants were to receive PAC on a particularly sunny day, their changes in affect might be a result of the weather rather than the intervention. Staggering PAC and taking repeated measures of dependent variables at baseline and during the intervention help to ensure internal validity of this study.[48]

This study consists of four measurement periods: baseline, intervention, endpoint and follow-up (Figure 1). For each participant, baseline measures are taken every second day for ten days prior to receiving PAC. Intervention measures begin after the first PAC session and are taken every second day for a maximum of two months. Following the last PAC session, end point measures are taken every second day for ten days. At the end of these ten days, several variables are measured. One month after end point, the researcher follows-up with each participant to administer two questionnaires.

The independent variable is PAC which consists of a maximum two-month intervention with a physical activity counsellor. The dependent variables are physical activity, depressive symptoms, positive affect and negative affect.

Participants

Six female, undergraduate students with mild to severe depression are recruited to participate in the study. This recruitment number is suitable based on the single-subject design of the study.[48] Since there is only one treatment group, acting as its own control, a large sample size is not necessary.

The inclusion criteria are as follows: female, between the ages of 18-24, full time undergraduate student status (registered for 12 credits or more during a semester), inactive or slightly active (i.e., scored less than 24 on the Godin Leisure-Time Exercise Questionnaire (LTEQ)),[49] and present mild to severe depression according to the Patient Health Questionnaire (PHQ-9),[50] administered by the researcher during the screening stage (i.e., scored between 5 and 27). The participants were not clinically diagnosed with depression, but rather the severity of their depressive symptoms was assessed. Antidepressant medication use was noted but was not an exclusion characteristic.

Procedures

Recruitment for the study occurs one of three ways:

1. Recruitment from primary care physicians working at University Health Services:

During scheduled visits, physicians are invited to refer undergraduate female patients who are inactive or slightly active and who are diagnosed with mild to severe depression, to participate in the proposed study and to receive PAC. More specifically, using provided exercise prescription pads,[51] physicians are asked to assess activity levels of students who express that they are experiencing depressive symptoms and those who have previously been identified as presenting

signs of depression. Students who are identified as inactive and who present signs of depression are then referred by their physician to participate in the study and to receive PAC.

2. Recruitment from mental health counsellors working at University Health Services

Inactive female students who present symptoms of depression are also referred by their mental health counsellors working for the University who provide these students with the contact information to participate in the study and to receive PAC. Physical Activity Counselling is provided as a supplemental service to their current counselling service.

3. Recruitment through posters on University billboards:

Finally, participants are also recruited through posters posted on campus billboards at three time points throughout the study (December, January, February). Participants who respond to the posters are accepted to participate in the study if they meet the inclusion criteria during the initial screening meeting with the researcher.

Following recruitment, the researcher first meets with each participant to describe the study and to administer a paper questionnaire composed of three validated scales to determine whether the participant fits the inclusion criteria and whether it is safe for them to begin physical activity. At this time, if the participant meets all inclusion criteria, she is asked to sign a consent form and is provided with an Actical accelerometer (Mini Mitter Co., Inc., Bend, Ore) to objectively measure baseline physical activity levels for ten days prior to receiving the first PAC session. Baseline measures also include online surveys (i.e., FluidSurveys), which are sent to participants via e-mail at the end of every second day (20:00).

Following ten days of baseline, participants begin one-on-one, individual PAC which involves 60-90 minute sessions at the campus Counselling Centre, every 1-2 weeks, over a maximum

duration of two months (approximately 5-6 sessions). Physical Activity Counselling is provided by a physical activity counsellor on University campus. One physical activity counsellor provides counselling to all participants of the study in order to avoid any confounding influence related to intervention delivery. The physical activity counsellor in this study has received a University degree in Human Kinetics and is enrolled in a Master's in Human Kinetics program. As such, the physical activity counsellor has extensive knowledge in anatomy, physiology, biomechanics, exercise psychology and the prevention and treatment of chronic illnesses. In addition, the physical activity counsellor is a certified Kinesiologist who has received supplemental training and practice in motivation building and behaviour change counselling.[ii]

The maximum duration of the intervention was selected based on feasibility for the project, to avoid seasonality, based on the six session PAC Trial,[52] and based on the recommendations made in previous intervention studies aimed at improving depression.[12,53] With participants receiving PAC every 1-2 weeks, the total number of sessions in a two-month period equals approximately 5-6 sessions. There is no minimum number of counselling sessions that participants are required to receive as this depends on the specific needs of each client (i.e. one participant may be on the way to changing her behaviour after two sessions while another may require five or more sessions). Allowing the client to choose whether or not they want to receive counselling, when they want to receive it and how frequently they want to attend sessions ensures the intervention is as real-world-like and as client-centered as possible.[54] The physical activity counselling approach combines MI based counselling with SDT. The physical activity counsellor utilizes the techniques of MI while also promoting the basic needs of autonomy, competency and relatedness. Participants are required to wear the accelerometer every day throughout the intervention and are reminded through email at the end of every second day

(20:00) to respond to online surveys which measure positive and negative affect. Depressive symptoms and self-reported physical activity are assessed at baseline and also via the online surveys every two weeks during the intervention.

When a participant decides that she no longer requires further PAC sessions, or after two months of receiving PAC, end point measures are taken via online surveys every second day for ten days following the last session. Thereafter, the participant returns for a final assessment session at which time the researcher collects the accelerometer and administers a paper questionnaire composed of two validated scales to measure self-reported physical activity and severity of depressive symptoms.

Finally, the researcher follows up with each participant over the telephone one month following end point. At this time, the researcher administers the same questionnaire as the final assessment, which assesses the participants' current level of physical activity and severity of depressive symptoms, to see if changes were maintained after the intervention ended.

Throughout the study, several cautionary measures are taken. First, all participants are required to fill out the PAR-Q questionnaire during the initial meeting with the researcher and are only permitted to begin PAC if they are safely cleared according to this measure. Second, the physical activity counsellor has taken several courses in Psychology and is knowledgeable in detecting red flags such as expressed feelings of hopelessness and despair, violence towards self or others and noticeable weight gain or weight loss, which indicate that the participant is not improving and might be at risk of self-harm. Urgent and non-urgent situations are assessed and necessary action is taken according to university guidelines for Identifying and Assisting a Student in Distress. In the case of an urgent situation, participants will be withdrawn from the study.

Data Collection

Screening: Participants fill out a paper questionnaire composed of three validated scales which assess: depressive symptoms, physical activity behaviour and physical activity readiness. If all inclusion criteria are met, participants begin baseline.

Baseline (10 days pre first physical activity counselling session): Participants wear the accelerometer to objectively measure pre intervention levels of physical activity. At the end of every second day participants respond to online surveys which assess positive and negative affect.

Intervention (for up to 2 months): Throughout the duration of the intervention, participants wear the accelerometer to objectively measure their physical activity. At the end of every second day participants respond to online surveys which assess positive and negative affect. Additionally, depressive symptoms and self-reported physical activity are assessed via online surveys every two weeks.

End Point (10 days post last physical activity counselling session): Participants wear the accelerometer to objectively measure post intervention levels of physical activity. At the end of every second day participants respond to online surveys which assess positive and negative affect. Participants then return the accelerometer to the researcher and they complete a paper questionnaire composed of two validated scales which provide an end point measure of depressive symptoms and self-reported physical activity.

Follow-up (1 month after end point): The researcher contacts each participant via phone to assess the participant's current level of depressive symptoms and self-reported physical activity.

This allows the researcher to determine whether changes during the intervention persist once the intervention has ended.

INSERT FIGURE 1

Measures

Screening Measures:

Depressive Symptoms: The Patient Health Questionnaire (PHQ-9) is a self-administered version of the Primary Care Evaluation of Mental Disorders (PRIME-MD) which is used to assess and monitor the severity of depressive symptoms.[50] The PHQ-9 is used to screen for depression and is the main outcome measure of the study. This questionnaire involves ten questions in total. The first nine questions begin by asking participants *over the last 2 weeks, how often have you been bothered by [depressive symptom]?* Responses range from 0= not at all to 3= nearly every day. The last question asks participants *how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?* In which participants can respond with *not difficult at all, somewhat difficult, very difficult,* or *extremely difficult*. A total score between 0-27 is generated to indicate the severity of depression which can range from absent/minimal (0-4) to severe (20-27).[55] The PHQ-9 is deemed a valid and reliable tool to both diagnose and monitor depression.[56]

Self-reported Physical Activity: The Godin Leisure-Time Exercise Questionnaire (LTEQ) was developed by Godin & Shepard[49] to assess the frequency and intensity of physical activity that individuals engage in per week. The LTEQ is used to screen for the inclusion/exclusion criteria and is a tertiary outcome measure of the study. Participants are asked *during a typical 7-day period (a week), how many times on the average do you do the following kinds of exercise for*

more than 15 minutes during your free time? Participants provide a number per week that they engage in strenuous (heart beats rapidly), moderate (not exhausting) and mild exercise (minimal effort). For the tertiary outcome measure, a total score is obtained based on the following formula:

Total leisure activity score= (9 x strenuous) + (5 x moderate) + (3 x mild)

For screening purposes, a sum of strenuous and moderate physical exercise alone is used. Participants who obtain a score of less than 24, are considered "insufficiently active" while those who score 24 or above are considered "active".[49] The LTEQ has been demonstrated in research to be a valid and reliable measure of physical activity and has shown good correlation with other objective measures of physical activity.[57]

Physical Activity Readiness: The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) was developed by the Canadian Society for Exercise Physiology in 2011 as a tool to screen people prior to engaging in physical activity in order to determine whether it is safe for them to begin or whether it is necessary to seek further advice from a licensed health care professional before becoming physically active. The questionnaire consists of three separate sections. The first section includes seven yes or no questions regarding general health (i.e. *has your doctor ever said that you have a heart condition OR high blood pressure?*). If all questions are answered *no*, the participant is cleared for physical activity and is instructed to sign the declaration form in section 3. If one or more of the questions is answered *yes*, the participant is asked to complete section 2 which involves nine additional yes or no questions related to chronic medical conditions (i.e. *do you have arthritis, osteoporosis, or back problems?).* If all questions are answered *no*, the participant is cleared for physical activity and is instructed to sign the declaration form in section 3. If one or more of the questions is answered *yes*, the participant is

not cleared for physical activity and is advised to seek further information from a licensed health care professional before becoming more active.

Main Outcome Measure:

Depressive Symptoms: The Patient Health Questionnaire (PHQ-9) is not only used as a screening measure for depression, but also throughout the PAC intervention as the main outcome measure of the study. The PHQ-9 is included every two weeks in the online questionnaires, at end point and at follow-up

Secondary Outcome Measure:

Affect: The Positive and Negative Affect Scale (PANAS), developed by Watson, Clark & Tellegan[58] is used as the secondary outcome measure of the study. The PANAS includes a list of 20 emotions consisting of 10 that describe positive affect (i.e. *determined*) and 10 that describe negative affect (i.e. *guilty*). Participants are asked to indicate to what extent they feel each emotion at the moment that they are filling out the questionnaire (at the end of every second day). They rate each emotion on a numerical scale ranging from 1=very slightly or not at all to 5= extremely. A positive affect score is calculated by adding the scores of all 10 positive emotions together and a negative affect score is calculated by adding the scores of all 10 negative emotions together. The PANAS is frequently used in exercise psychology research as it is a reliable and valid measure of affective states.[15,59]

Tertiary Outcome Measures:

Self-reported Physical Activity: The Godin Leisure-Time Exercise Questionnaire (LTEQ) is not only used as a screening measure for self-reported physical activity, but also throughout the PAC

intervention as a tertiary outcome measure. The LTEQ is included every two weeks in the online questionnaires, at end point and at follow-up.

Objective Physical Activity: Physical activity is objectively measured using the Actical accelerometer. The accelerometer is worn at the hip, as recommended by Trost, McIver & Pate.[60] Heil[61] tested the reliability and validity of this device by measuring energy expenditure using both the Actical device and measures of oxygen consumption during physical activity. Heil[61] found that the Actical accurately predicted energy expenditure during light, moderate and vigorous activities ($p>.05$) This device has been used in a variety of studies and has been found to be both a valid and reliable measure of predicting energy expenditure and thus physical activity levels in adults.[52,61-63] It is also a non-invasive device that can be worn at all times (except while sleeping or showering), which makes data collection more comfortable and convenient for participants. Participants are frequently in contact with the researcher and the physical activity counsellor throughout the duration of the study, which helps to encourage adherence to the accelerometer protocol (i.e. wearing the device every day over several months).[64]

Both self-reported and objective physical activity are assessed in order to account for the biases associated with each measure individually. For example, objective physical activity accounts for response bias associated with self-reported measures. Alternatively, self-reported physical activity accounts for lack of adherence associated with objective measures. Combining self-reported and objective measurements allows for a more comprehensive assessment of physical activity.

Data Analyses

Data Management:

All data will be downloaded and analyzed using Microsoft Excel 2016 (visual analyses) and the statistical software package SPSS version 22 (statistical analyses) on a password protected laptop. Additional statistical analyses will be run using the Simulation Modeling Analysis (SMA) version 9.9.28 software package. Actical data is uploaded to a laptop and saved after each PAC session and after end point. Epoch lengths are set at 0.50 which allows for approximately 22 days of data collection. An Epoch length of 0.25 collects data for 11 days whereas an Epoch length of 1.00 collects data for 45 days. Since participants receive counselling every 1-2 weeks (7-14 days) an Epoch length of 0.50 allows for ensuring data is collected at all times between PAC sessions while still remaining as short as possible, as recommended by Gabrys et al[65], and not being overly conservative.

Analyses of all self-reported data (depressive symptoms, affect and physical activity) will involve both visual and statistical analyses. Visual analyses are the most common form of evaluation for single-design research, especially in the field of psychology, as it can detect small effects which may be missed by statistical analyses.[66] However, statistical analyses are necessary to supplement visual analyses as it reduces bias caused by individual differences in perception, therefore adding support and credibility to results of visual analyses.[48]

Visual Analyses:

The averages of each continuous dependent variable (y-axis) will be graphed against time (x-axis). The time axis will differentiate between baseline measures (average scores from day 1-10), intervention measures (average scores during the PAC intervention.) end point measures

(average scores from 10 days after the final PAC session) and follow-up measures (scores one month after end point). The trend, which represents the direction in which the dependent variable is progressing with time, will be considered by drawing a line of best fit on the graph.[48] The slope of that line will represent the magnitude of change that occurred from one time point to the next. Finally, the level, which measures the change in the dependent variable when treatment is implemented, will be examined by comparing baseline means to intervention means.

Statistical Analyses:

Individual

The Simulation Modeling Approach (SMA), which is a readily available time-series program, will be used to provide statistical support to visual analyses. This approach is recommended for single-subject intervention research, as it evaluates statistical significance between study phases with short data streams (i.e., less than 30 observations).[67-69] More conventional time-series analyses, such as HLM and ARIMA, are recommended when greater than 30 data points per phase are available.[67] Given that the primary outcome variable of this study (i.e., depressive symptoms) will be measured less than 30 times, SMA is a more appropriate and reliable approach.[67] The SMA was also chosen because it includes a statistical test of level change, which calculates effect size and p-value, complementing visual analysis of level.[67] The SMA also calculates and controls for autocorrelation, which describes the serial dependency of observations, in which later observations are predicted by previous ones.[67] Given that multiple measures are taken in a single individual over time, autocorrelation is inevitable in single-subject research and must be accounted for in order to reduce the risk of making a Type I error.[67]

Grouped

While the single-subject design of the study does not involve a control group, dependent variables will be averaged for each participant according to each study phase and comparisons including all participants will be performed using one-way repeated measures analysis of variance (ANOVA). In addition, Cohen's d will be calculated to provide indication of effect sizes. Theses analyses, including mean comparisons of all participants, will provide a valuable summary of the effectiveness of the PAC intervention.

3. Discussion

Strengths and Limitations

As with any research, there are limitations associated with the present study. First, the data collection might be overly burdensome, particularly considering the sample of students with depressive symptoms, which may lead to lack of adherence to the protocol. Specifically, participants may not respond to the online surveys and may fail to wear the accelerometer throughout the study. Non-response has been identified as a serious concern for online surveys intended for student populations.[70] Previous research investigating challenges associated with accelerometer retention rates indicate that there are many reasons why participants may neglect to wear a hip accelerometer including forgetting to put it on, discomfort (when engaging in physical activity) and appearance under clothing (particularly with females).[64,71] Secondly, a two-month intervention may not be long enough to see significant changes in variables. The duration of the intervention was selected based on feasibility for the project and based on the six session recommendation made in previous intervention studies aimed at improving depression.[12,52,53]

However, based on qualitative feedback, participants might benefit more from a longer intervention. Finally, the small sample size and specific population restrict generalization.

There are also several strengths associated with the present study. First, the study involves both self-reported and objective measures of physical activity which reduces the bias associated with relying solely on self-reported measures. Second, examining the variables using time-series analysis will allow for determining the directionality of the relationships between variables. Finally, the study follows a multiple baseline, single-subject design which involves repeated measures of variables during different phases over time (baseline, intervention, end point and follow-up). The advantage of this research design is that it allows for drawing causal inferences regarding the effectiveness of the PAC intervention.

Conclusion

Pharmacotherapy is the most common form of treatment for depression.[7,9] However, Canadians with depression reported counselling as their greatest medical health care need, above medication, and the lowest health care need met.[8] Physical activity is usually only prescribed, with little direction, as a self-managed complimentary treatment despite strong evidence of its effectiveness in reducing depression.[17] Furthermore, although some doctors might recommend physical activity to patients with depression, many patients do not have the skills and/or motivation to be active without guidance and direction. If physical activity is a mere recommendation prescribed with medication, it is very unlikely that the patient will engage in physical activity on their own. This is where physical activity counsellors can play an important role. The findings of the present study may add to the growing body of literature showing the effectiveness of physical activity in reducing the severity of depression. This may help health care professionals to recognize the importance of physical activity when considering methods of

treatment for depression and may make them more willing to refer patients with depression to professional Kinesiologists.

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Footnotes

[i] Positive and negative affect are fluctuating/short-lived experiences of emotions. A single measure of affect would not have been representative of a participant's overall state, therefore positive and negative affect were not measured at follow-up.

[ii] Kinesiologist: a human movement professional whose job is to improve quality of life through promoting physical activity, prevent and manage the recovery of injury/chronic disease and improve overall health and performance.[72]

Figure

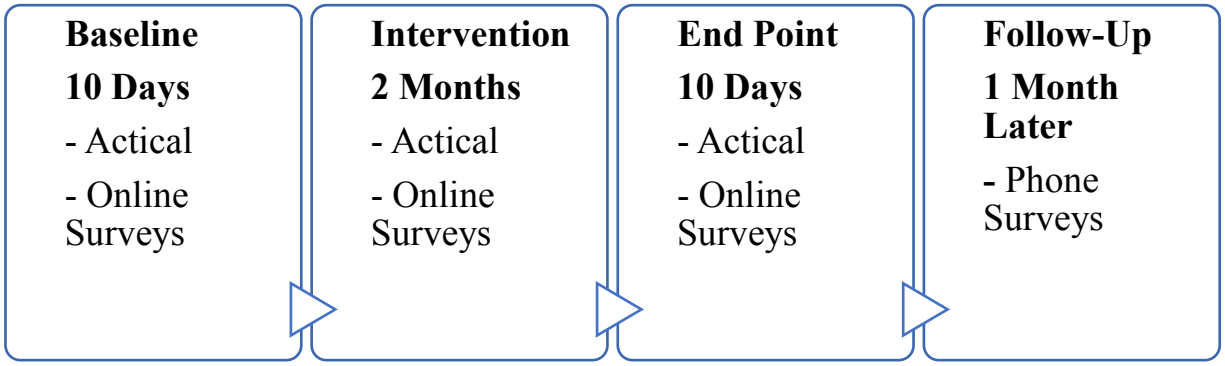

Figure 1. Measurement periods for the Physical Activity Counselling study including Baseline, Intervention, End Point and Follow-up.

Investigating the effects of Physical Activity Counselling on depressive symptoms, affect and physical activity in female undergraduate students with depression:

A multiple baseline single-subject design.

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Abstract

Background: Depression is one of the most common health problems faced by university students, with the highest rates reported in females ages 15 to 24. There is strong evidence that physical activity can significantly reduce the risk of depression, though activating this population remains a challenge. One potential evidence-based strategy, to help people become more active, is Physical Activity Counselling (PAC). The current study examined the effects of a two-month PAC intervention on depressive symptoms, affect and physical activity in female undergraduate students with depression.

Methods: The study followed a multiple baseline, single-subject design with four separate study phases: baseline, intervention, end point and follow-up. Physical activity was measured objectively using accelerometers and self-reported measures of depressive symptoms, affect and physical activity were collected via online surveys administered every second day.

Results: Visual analyses revealed that depressive symptoms decreased and self-reported physical activity increased from baseline throughout the duration of the study in all five participants, as hypothesized. Statistical analyses supported these results. Effect size estimates of grouped averages revealed that decreases in depressive symptoms from baseline throughout each study phase were in the small to large range while increases in self-reported physical activity were in the medium to large range.

Conclusions: These results provide initial support for PAC as a potential method of increasing physical activity and reducing depressive symptoms in female undergraduate students with depression. Future research is recommended to further investigate PAC as a cost-effective way to promote physical and mental health among university students.

1.0 Introduction

Depression is a growing public health concern, with rates as high as 9.0% in females aged 15 to 24 (Statistics Canada, 2016). According to the most recent available data, the median age of Canadian university students is 22.8 years (Statistics Canada, 2010), thus it is not surprising that depression is reported as one of the most prevalent health issues among university students (Ibrahim, Kelly, Adams, & Glazebrook, 2013; Nunes et al., 2014).

University students are at a particularly high risk of mental illness for a variety of reasons including, high academic demands, transitioning to a new environment, changes in sleep and eating routines and a decrease in physical activity (Buchanon, 2012; Ibrahim et al., 2012; Wilson et al., 2014). It has been suggested that decreases in physical activity, that commonly occur as a result of the transition from high school to university, are associated with a decrease in mental health (Bray & Born, 2004). On the other hand, those who are able to maintain physical activity during entry into university, have reported better physical and mental health (Bray & Born, 2004). The psychological benefits of being physically active are comparable to pharmacology for depression (Stanton et al., 2014). Indeed, physical activity has been widely supported in research to reduce the risk of depression (Parker et al., 2016; Pereira, Geoffrey, & Power, 2014; Schuch et al., 2016; Wegner et al., 2014). In addition to the mental health benefits of being active, physical activity also reduces the risk of several chronic illnesses including, but not limited to, coronary heart disease, heart failure, osteoarthritis, diabetes and chronic obstructive pulmonary disease (Hoffman et al., 2016; Pedersen & Saltin, 2015). The Canadian Physical Activity Guidelines recommend adults ages 18-64 accumulate at least 150 minutes of MVPA per week, in bouts of 10 minutes or more in order to achieve these health benefits (CSEP, 2011). What is concerning, is that 4 in 10 university students are considered physically inactive (Pengpid et al., 2015).

Fortunately, physical activity is a modifiable risk factor (Thornton et al., 2016) and interventions have demonstrated to be effective in increasing physical activity levels among individuals with depression (Krogh, Nordentoft, Sterne, & Lawlor, 2010; Soucy-Chartier & Provencher, 2014). The problem is determining which physical activity interventions are the most effective in fostering short and long-term benefits.

Physical Activity Counselling (PAC) is one type of physical activity intervention that has gained support in research as an effective approach to increasing physical activity levels (Fortier et al., 2011; Gao et al., 2016). Physical Activity Counselling is based on Motivational Interviewing (MI; Miller & Rollnick, 2013) and is rooted in the Self-Determination Theory (SDT; Deci & Ryan, 1985). Motivational Interviewing is a type of counselling which guides individuals toward positive change by increasing one's motivation for change. Motivational Interviewing also utilizes evidence based behaviour change techniques such as reflections and goal setting (Miller & Rollnick, 2013; Michie et al., 2013). Interventions based on MI have shown significant increases in physical activity (Fortier et al., 2011; Hardcastle, Taylor, Bailey, & Castle, 2008)

A recent meta-analysis suggested that the most effective physical activity interventions are those based on theory, specifically SDT (Gourlan et al., 2016). The SDT describes the different motivations that people have to act in certain ways (Deci & Ryan, 1985). According to this theory, there are three types of motivation including amotivation (not at all motivated), extrinsic motivation (doing something for instrumental reasons, such as a reward) and intrinsic motivation (doing something for the satisfaction and enjoyment that it brings) (Deci & Ryan, 1985). Intrinsic motivation is the most self-determined motivation and is associated with maintenance of physical activity (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). Motivation

is not unalterable, in fact, a sub theory of SDT known as the Basic Needs Theory (BNT), suggests that self-determined motivation can be obtained by facilitating the three basic psychological needs of autonomy, competence and relatedness (Deci & Ryan, 2010). The results of a meta-analysis support the BNT, indicating that facilitating the three basic psychological needs results in increased self-determined motivation and ensuing physical and mental health (Ng et al., 2012). Experts have concluded that the spirit of MI optimally fosters the three psychological needs of the BNT to promote self-determined motivation and in doing so, foster physical and mental health during and following an intervention (Miller & Rollnick, 2012; Teixeira, Palmeira, & Vansteenkiste, 2012).

Although previous research has supported the effectiveness of PAC in improving levels of physical activity (Fortier et al., 2011; Gao et al., 2016), no previous research has investigated the effects of PAC in a population of female undergraduate students with depression specifically, which is why the present study is so novel. It is particularly important to target this population, as the rates of depression and antidepressant use are continually increasing among university students. Indeed, university representatives, media and research have emphasized the need for more accessible mental health resources for students (La Rotonde, 2016; Lunau, 2012; Nunes et al., 2014), making the present study particularly timely.

The Present Study:

The primary aim of this study was to improve levels of depression among female undergraduate students by implementing a two-month PAC intervention. The study involved four phases including: baseline, intervention, end point and follow-up. The specific objectives and hypotheses of the present study were to: 1) Examine the influence of a two-month PAC intervention on the severity of depressive symptoms of female undergraduate students with

depression (main outcome). It was hypothesized that the severity of depressive symptoms would reduce from baseline to intervention (Schuch et al., 2016; Soucy-Chartier & Provencher, 2014). The improvement in depressive symptoms was anticipated to be maintained at end point and follow-up. 2) Examine the influence of a two-month PAC intervention on both positive and negative affect of female undergraduate students with depression (secondary outcomes). It was hypothesized that positive affect would improve from baseline to intervention and negative affect would reduce from baseline to intervention (Mata et al., 2012; Taliaferro et al., 2009). The improvement in positive and negative affect was anticipated to be maintained at end point.[1] 3) Examine the influence of a two-month PAC intervention on both objective and self-reported physical activity levels of female undergraduate students with depression (tertiary outcomes). It was hypothesized that objective and self-reported physical activity levels would increase from baseline to intervention (Fortier et al., 2011; Gao et al., 2016). The improvement in physical activity levels, both objective and self-reported, was anticipated to be maintained at end point and follow-up. Physical activity was the tertiary outcome measure of this study, because ultimately the primary goal of the PAC intervention was to improve the mental health of female university students. Physical activity was measured in order to better understand the mechanism by which the PAC intervention had an effect on the mental health measures of depressive symptoms and affect.

2.0 Methodology

A more detailed description of the study methodology and the PAC intervention is available elsewhere (McFadden, Fortier, & Guérin, 2016).

2.1 Participants

Participants were recruited between December, 2015 and March, 2016 via posters on university billboards and through referrals from health care professionals working at Health Services. This time frame was chosen for recruitment in order to minimize seasonality effects. Participants were screened and included in the study if they met the following criteria: female, between the ages of 18-24, full-time undergraduate student status, insufficiently to moderately active (i.e., a score of less than 24 [Godin, 2011] in regards to strenuous and moderate physical activity on the Godin Leisure-Time Exercise Questionnaire [Godin & Shephard, 1985]) and with mild to severe depression (i.e., a score between 5 and 27 on the Patient Health Questionnaire [Spritzer, Kroenke, & Williams, 1999]). A total of eight potential participants were screened, and six were eligible to participate in the study. One participant presented red flags during the intervention period (i.e. expressed feelings of worthlessness) and was immediately withdrawn from the study and referred to emergency services. Table 1 provides individual characteristics of the final five participants, as assessed during screening. Each participant was provided a number (i.e., P1-P5), in order to ensure anonymity. In this study, participants' depressive symptoms ranged from 6 (mild) to 22 (severe) and physical activity levels ranged from 0 (insufficiently active) to 23 (moderately active). It is important to note that the severity of depressive symptoms was assessed during screening; participants were not clinically diagnosed with depression. However, for simplicity, the term depression will be used throughout this article to refer to participants who presented mild to severe depressive symptoms during screening. Participants were not compensated for being a part of the study, however PAC was provided to them for free.

INSERT TABLE 1

2.2 Procedure

Participants first met with the principal investigator who explained the study protocol and administered screening questionnaires. Eligible participants signed a consent form and were provided with an Actical accelerometer (Mini Mitter Co., Inc., Bend, Ore) to objectively measure levels of physical activity throughout the four phases of this study. In addition to the accelerometer, online surveys (FluidSurveys) were sent to participants via email at the same time (i.e., 8:00 pm) on every second day over the course of a 10-day baseline period. The baseline measurement phase began immediately after the initial meeting and included measures of positive affect and negative affect. After ten days of baseline monitoring, participants began PAC.

Grounded in MI and the SDT, PAC is an evidence-based counselling approach, which aims to improve levels of physical activity by fostering high quality motivation. Physical Activity Counselling is supplemented with effective behaviour change techniques such as goal setting and self-monitoring (Miller & Rollnick, 2013). In this study, each PAC session lasted approximately 60-90 minutes and occurred every 1-2 weeks, depending on the needs of each participant. The maximum length of the PAC intervention was 2 months. There was no minimum length, so if a participant decided they no longer required PAC before the maximum two-month duration, the intervention phase ended. To maximize ecological validity, participants also chose how often they wanted to meet with the counsellor during the intervention phase. In this study, all of the participants chose to receive the maximum two months of PAC which corresponded to an average of 6.2 PAC sessions in total. Table 1 provides a complete breakdown of how many PAC sessions each participant received. This number of counselling sessions is consistent with

recommendations from previous intervention studies aimed at improving physical activity and depression (Eskin et al., 2008; Fortier et al., 2007; Parker et al., 2016). The PAC sessions were provided by a registered Kinesiologist, who holds a Bachelor of Science in Human Kinetics and who has specific training and experience in PAC.[2] Having a single counsellor deliver the PAC intervention minimized confounding factors from influencing the results.

Objective measures of physical activity were taken daily using the accelerometers. Electronic surveys were administered via email, which measured positive and negative affect every second day. Depressive symptoms and self-reported physical activity were included in the electronic surveys once every two weeks throughout the intervention. Affect was measured frequently as it is a fluctuating variable, whereas depression and self-reported physical activity are more stable and as such, were measured less frequently.

At the end of the intervention phase, participants continued to wear the accelerometer every day for ten days. They responded to the online questionnaires assessing positive and negative affect, every second day during the 10-day end point phase. Once they completed end point measures, participants returned the accelerometer to the principal investigator.

One month after the end point phase, the principal investigator telephoned each participant to administer a follow-up questionnaire. The call lasted approximately ten minutes in length during which measures of depressive symptoms and self-reported physical activity were administered. Given the fleeting nature of affective states, a single measure of positive and negative affect was not administered at this time.

2.3 Research Design

The present study followed a multiple baseline, single-subject design involving measurements before, during and after a two-month PAC intervention, in which participants acted as their own control. In total, there were four study phases: baseline, intervention, end point and follow-up (Table 2). Baseline data was collected for ten days prior to the first PAC session. Then, intervention measures were taken for a maximum of two months while participants received PAC. Next, end point measures were collected for ten days following the last PAC session. Finally, follow-up measures were taken one month after end point. Consistent with multiple baseline designs, the days in which participants began receiving PAC were staggered. Staggering the days on which participants received the PAC intervention reduces the chance that confounding factors (such as the weather) were having an effect, strengthening inference that changes in outcome variables could be attributed to the PAC intervention. Ethics approval was obtained from the Research Ethics Board prior to data collection.

2.4 Measures

Details on all measures used in the present study are provided below. Additional information regarding the timing and frequency of measures can be found in Table 2.

INSERT TABLE 2

Physical Activity Readiness: The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+; CSEP, 2011) was used as a screening measure to ensure that it was safe for participants to begin engaging in physical activity. The questionnaire is comprised of three separate sections including *General Health* (7 questions)*, Chronic Medical Conditions* (9 questions + follow-up questions) and *Declaration*. If participants answered *NO* to all of the

General Health questions OR *YES* to any of the *General Health* questions but *NO* to all of the *Chronic Conditions* questions, they were cleared to engage in physical activity and were directed to sign the *Declaration* form. If participants answered *YES* to any of the *General Health* questions AND *YES* to the *Chronic Conditions* questions, they were not cleared for physical activity and were advised to check with their doctor before engaging in physical activity.

Depressive Symptoms: Depressive symptoms were assessed during screening and as the primary outcome measure of the study using the Patient Health Questionnaire (PHQ-9; Spritzer et al., 1999). The PHQ-9 is a short, 10- item, self-administered tool deemed valid and reliable in assessing and monitoring the severity of depressive symptoms (Kroenke, Spritzer, & Williams, 2001). The questionnaire asks participants *over the last two weeks, how often have you been bothered by any of the following problems* and provides a list of 9 depressive symptoms (i.e. *little interest or pleasure doing* things) that are rated on a 4-point Likert scale (0 = *not at all* to 3 = *nearly every day*). A total score between 0 and 27 is generated to represent the severity of depressive symptoms. Total scores are interpreted as absent/minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19) and severe (20-27) (Kroenke & Spritzer, 2002). As the main outcome measure, the PHQ-9 was administered every two weeks throughout the intervention phase, at end point and at follow-up. Reliability of the PHQ-9 was considered adequate with Cronbach alphas ranging between 0.70 and 0.76.

Positive and Negative Affect: The Positive and Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988) was used throughout the intervention as a secondary outcome measure of positive and negative affect. Participants were asked to indicate, on a 5-point Likert scale (1= *very slightly or not at all* to 5= *extremely*), *to what extent do you feel this way right now, that is, at the present moment* and were provided a list of 20 words, 10 describing positive affect (i.e.

proud) and 10 describing negative affect (i.e. *afraid*). The responses to the 10 positive affect scores and the responses to the 10 negative affect scores were summed independently to obtain a positive and negative affect score respectively. The PANAS scale showed good internal consistency with Cronbach alphas ranging between 0.87 and 0.90 for positive affect, and between 0.78 and 0.80 for negative affect.

Self-Reported Physical Activity: The Godin Leisure-Time Exercise Questionnaire (LTEQ), developed by Godin & Shepard (1985), was used to assess self-reported physical activity for screening and as a tertiary outcome measure in the study. The LTEQ is used extensively in research and is deemed a valid and reliable self-report measure of physical activity in the adult population (Jacobs, Ainsworth, Hartman, & Leon, 1993; Krista & Caspersen, 1997). Participants were asked to indicate on average how many times per week they engage in *strenuous, moderate* and *mild* exercise for more than 15 minutes. For the tertiary outcome measure, the frequencies of exercise were multiplied by 9, 5 and 3, to represent respective metabolic equivalents, and summed to obtain a total score (Godin & Shepard, 1985). The LTEQ was included in the online survey every two weeks throughout the two-month PAC intervention and at follow-up. To categorize levels of physical activity for screening purposes, a sum of strenuous and moderate exercise alone was used (Godin, 2011). This is recommended by Godin (2011) and is consistent with the Canadian Physical Activity Guidelines which suggests that moderate and vigorous physical activity play the most significant role in achieving health benefits. A score of less than 14 indicated that a participant was “insufficiently active”, 14-23 “moderately active”, and a score of 24 and above suggested that she was “active” (Godin & Shepherd, 1985).

Objective Physical Activity: Physical activity was objectively measured using Actical accelerometers (Mini Mitter Co., Inc., Bend, Ore). Participants were instructed to wear the

device on their dominant hip, at all times (except when sleeping or showering) throughout baseline, intervention and end point. This device has been used extensively in research and has been deemed a valid and reliable tool for measuring physical activity levels in adults (Heil, 2006; Hooker et al., 2011; Hughes et al., 2013). The accelerometer measured energy expenditure and activity counts in 30 second epochs. Using algorithms and American College of Sports Medicine's most recent recommended activity cut-points (ACSM, 2013), activity counts were converted to the total number of minutes per day engaged in light, moderate, vigorous and total physical activity. None of the participants accumulated vigorous physical activity minutes throughout the study, thus data analyses only consider light, moderate and total physical activity.

2.5 Data Analyses

Data were analyzed using both visual analyses and statistical analyses. While visual analyses are the most common form of analyses in single-subject designs, statistical analyses are necessary to reduce bias associated with individual differences in perception (Barker et al., 2011). All data from the online surveys and the accelerometers were downloaded and analyzed using Microsoft Excel 2016 (visual analyses) and the statistical software package (SPSS) version 22 (statistical analyses). The Simulation Modeling Analysis (SMA) version 9.9.28 software package was used to run additional statistical analyses.

2.5.1 Visual Analyses

Visual inspection was performed according to Barker et al. (2011) guidelines. The means for each dependent variable (y-axis) were graphed against study phases (x-axis). The study phases were baseline, intervention, end point and follow-up. The *level*, which represents the change in means from baseline to intervention, was visually inspected. The *trend*, which

represents the direction of change in the dependent variable over time, throughout all phases of the study, was also visually inspected. Linear trend lines were computed and the slopes were used to represent the direction and magnitude of change over time.

2.5.2 Statistical Analyses

Individual Level

Simulation Modeling Analysis (SMA version 9.9.28), which is a readily available time series analysis program, was used to determine whether there were statistically significant changes for each of the dependent variables between baseline and intervention, and between intervention and subsequent phases to see if changes were maintained following the intervention. The SMA approach has been deemed a reliable method for analyzing short time-series data streams with less than 30 data points per study phase (Borckardt, 2006; Borckardt, Nash, Murphy, Moore, & O'Neil, 2008; Frankel & Macfie, 2010; Gray, 2010). Preferred and more conventional time-series analyses, such as HLM and ARIMA are not recommended for analyses with less than 30 data points per phase (Borckardt et al., 2008).

Autocorrelation, which is the dependency of sequential observations, is inevitable when measuring change in a single individual over time (Smith, 2012). When left unaccounted for, there is a high risk of making a Type I error, which is concluding that the intervention had a significant effect when in reality it did not (Borckardt et al., 2008). Visual analyses can be affected by autocorrelation, leading to overestimation of intervention effects (Smith, 2012). The benefit of using SMA for time-series analysis is that the program calculates autocorrelation and accounts for it when running statistical analyses (Borckardt et al., 2008).

Simulation Modeling Analyses involves a variety of complimentary statistical tests (Borckardt et al., 2008). The most relevant SMA tests to supplement visual analyses, which were used in the present study, are autocorrelation and *level* change. Autocorrelation was computed and controlled for to reduce the risk of Type I error. Statistical *level* is the same as visual *level* in that it represents the difference in mean scores of a given variable from one study phase to another. However, statistical *level* provides additional information regarding the effect size (r) and p-value (p) to determine whether or not the change between phases is in fact, significant.

All of the study variables had less than 30 data points per phase, with the exception of objective physical activity which was measured daily throughout the intervention phase. In order to maintain a uniform statistical approach across all variables, objective physical activity data was truncated to abide by the 30-point recommendation of the SMA approach. This was done by calculating 2-day means of adjacent measures, similar to Frankel & Macfie (2010). To ensure that the truncated data was not significantly different than the original data, paired t-tests were performed. Results of the t-tests revealed no significant differences between truncated and original data ($p<0.05$). Therefore, truncated objective physical activity data was used in the SMA analyses.

Group Level

Although data from single-subject designs are traditionally analysed individually for each participant, between-subject analyses provides additional information regarding the overall effectiveness of an intervention. The following grouped subject analyses are based on the work of Ouellet & Morin (2007) who led a similar multiple subject, single-case experimental design. Given the small sample size, these group level analyses are exploratory.

Averages of depressive symptoms, positive affect, negative affect, self-reported physical activity and objective physical activity (total, light and moderate) were calculated for each participant and for each phase of the study. The means were compared across subjects using various One-Way Repeated Measures Analysis of Variance (ANOVA) tests for each outcome variable. Differences were deemed significant at an alpha level of 0.05.

In addition, effect sizes were calculated using Cohen's d to provide an indication of the magnitude of difference between baseline averages to averages of each subsequent study phase. Effect sizes were interpreted using Cohen's (1988) recommendation cut-off values of 0.2 (small effect), 0.5 (medium effect) and 0.8 (large effect).

3. Results

3.1. Visual Analyses

It is not feasible in the scope of this paper to present all outcome variables visually. For brevity, only depressive symptoms and self-reported physical activity are presented visually for each participant at baseline, intervention, end point and follow-up (Figures 1 & 2). In addition, there was insufficient data to visually analyze affect and objective physical activity in Participant 1 due to an extremely low response rate to online surveys (6%) and failing to wear the accelerometer.

INSERT FIGURES 1 & 2

Level: represents the change in means of dependent variables from baseline to intervention.

The *level* in the depressive symptoms data (Figure 1) was negative in Participants 1, 2 & 3, indicating decreases in depressive symptoms from baseline to intervention. There were two

cases (Participants 4 & 5) where the *level* was positive, representing an increase in depressive symptoms from baseline to intervention. Participant 2 revealed the greatest decrease in depressive symptoms, as indicated by the largest change in mean from baseline to intervention. Participant 4 showed the least improvement in depressive symptoms, as indicated by the greatest increase in mean from baseline to intervention

The *level* in the self-reported physical activity data (Figure 2) was positive in Participants 1, 2, 3, & 5, demonstrating an increase in self-reported physical activity levels from baseline to intervention. Participant 4, who showed an increase in depressive symptoms from baseline to intervention, was the only participant who showed a slight decrease in self-reported physical activity from baseline to intervention. Participant 2, who had the greatest decrease in depressive symptoms from baseline to intervention, revealed the greatest increase in self-reported physical activity, as indicated by the largest change in mean.

The *level* in positive affect data was positive in Participants 2 & 3, indicating improvements in positive affect from baseline to intervention. Alternatively, the *level* was negative in Participants 4 & 5, indicating a decrease in positive affect. The *level* in negative affect was negative in Participants 2, 3 & 5, indicating a decrease in negative affect from baseline to intervention. The *level* was positive in Participant 4, indicating an increase in negative affect.

The *level* in total objective physical activity was negative in Participants 2, 3 & 4 and positive in Participant 5. The *level* in light objective physical activity was negative in Participants 2, 4 & 5 and positive in Participant 3. Finally, the *level* in moderate objective physical activity was positive in Participants 2, 4 & 5 and negative in Participant 3.

Trend: represents the direction and magnitude of change throughout all study phases.

The results demonstrate clear reductions in depressive symptoms in all participants from baseline throughout study phases, as indicated by the overall negative *trend* in data (Figure 1). There were also increases in self-reported physical activity levels in all participants from baseline throughout study phases, as shown by the overall positive *trend* in data (Figure 2). This provides indication that improvements in depressive symptoms and self-reported physical activity were maintained in all participants at the 1-month telephone follow-up. More specifically, at follow-up, depressive symptoms remained lower and self-reported physical activity remained higher than baseline measures in all five participants. Participant 2, who had the most severe baseline depressive symptoms, displayed the greatest decrease in depressive symptoms from baseline to follow-up and the most improvement in terms of depression over time as demonstrated by the largest magnitude slope compared to the other participants (slope= -2.69). She also displayed the greatest increase in self-reported physical activity from baseline to follow-up as indicated by the largest magnitude slope compared to the other participants (slope= 24.83). Participant 4, who had the lowest baseline depressive symptoms, revealed the least amount of improvement in severity of depressive symptoms over time, as shown by the smallest magnitude slope compared to the other participants (slope= -0.93).

The results of *trend* in positive and negative affect are less consistent. The overall *trend* in positive affect from baseline throughout study phases was positive in Participants 3 & 5 and negative in Participants 2 & 4. The *trend* in negative affect was negative in Participants 3, 4 & 5 and positive in Participant 2.

Similarly, the results of *trend* in objective physical activity were inconsistent, varying between participants. The *trend* in total objective physical activity from baseline throughout

study phases was positive in Participant 5 and negative in Participants 2, 3 & 4. The *trend* in light objective physical activity was positive in Participants 5 & 3 and negative in Participants 2 & 4. Finally, the *trend* in moderate physical activity was positive in Participants 2, 4 & 5 and negative in Participant 3.

3.2. Statistical Analyses:

3.2.1. Individual Level

INSERT TABLE 3

Simulation Modeling Analyses (SMA):

Participant 1. Response rate to the online surveys was extremely low during the intervention phase (6%). Therefore, there were insufficient data points to run statistical analyses using SMA.

Participant 2. Results of autocorrelation were insignificant for all study variables. Results of the *level* change analyses indicated a significant decrease in depressive symptoms and a significant increase in self-reported physical activity from baseline to intervention. These results support visual analyses of *level*. The decrease in depressive symptoms was maintained at end point and follow-up, as indicated by insignificant *level* change results between intervention and end point (r= 0.04, p=0.96) and intervention and follow-up (r= 0.04, p= 0.96). The increase in self-reported physical activity was maintained from intervention to end point, as shown by insignificant *level* change results (r= -0.61, p=0.57). At follow-up, self-reported physical activity was also maintained as indicated by insignificant *level* change results (r= 0.48, p= 0.65). Results of the *level* change analyses were insignificant for positive affect, negative affect as well as total, light and moderate objective physical activity ($p > 0.05$).

Participant 3. Findings from the *level* change analyses indicated that there was a significant decrease in negative affect from baseline to intervention, supporting visual analyses. The decrease in negative affect from baseline to intervention was maintained, as shown by insignificant *level* change results between intervention and end point (r= 0.30, p= 0.14). Contrary to the hypotheses, after controlling for autocorrelation, *level* change revealed a decrease in moderate objective physical activity from baseline to intervention, though not reaching statistical significance. Results of the *level* change analyses were insignificant for depression, positive affect, self-reported physical activity, total objective physical activity and light objective physical activity ($p > 0.05$).

Participant 4. Results of autocorrelation approached significance for light and moderate objective physical activity, which was controlled for in *level* change analyses. No statistically significant results were obtained from the *level* change analyses for any of the outcome variables, meaning that these variables did not differ significantly from baseline to intervention. However, *level* change approached significance for negative affect and total objective physical activity, both in directions contrary to the hypothesis, but consistent with visual analyses. Given that the *level* change results did not reach statistical significance; subsequent phases were not tested.

Participant 5. There was significant autocorrelation in total, light and moderate objective physical activity, meaning previous values predicted subsequent values. After accounting for autocorrelation, results of the *level* change analyses revealed a decrease in negative affect and an increase in moderate objective physical activity, both approaching significance. The decreases in negative affect were not only maintained, they continued to decrease from intervention to end point, as per results of *level* change (r= -0.46, p= 0.04). The increase in moderate objective physical activity from baseline to intervention was maintained at end point, as indicated by

insignificant results of *level* change (r= -0.40, p= 0.12). *Level* change results of depressive symptoms, positive affect, self-reported physical activity, total objective physical activity and light objective physical activity were insignificant.

3.2.2. Group Level

One-Way Repeated Measures ANOVA:

Several one-way repeated measures ANOVA were conducted to compare the grouped averages on the dependent variables across study phases (baseline, intervention, end point and follow-up). Effect sizes were calculated, using Cohen's d, to further describe the difference between baseline averages and averages of each subsequent study phase. Grouped means and standards deviations are presented in Table 4.

INSERT TABLE 4

Results of the ANOVA tests comparing grouped means of depressive symptoms, positive affect, negative affect, total, light and moderate objective physical activity were insignificant ($p<$ 0.05), likely due to the small sample size. However, valuable information can be gained from considering the grouped means of these dependent variables throughout study phases, regardless of the insignificant results.

For instance, means in depressive symptoms decreased from baseline to intervention, to end point and to follow-up. Results of Cohen's d calculations revealed small to large effect sizes from baseline to intervention (d= -0.43), baseline to end point (d= -0.69) and baseline to follow-up (d= -0.93). Similarly, negative affect decreased from baseline throughout all subsequent study phases, though effect sizes were small. Light and total objective physical activity decreased from baseline throughout subsequent study phases, while moderate objective physical activity increased from baseline to intervention and decreased from intervention to end point. Effect sizes

for total, light and moderate objective physical activity were all small. Results of the ANOVA test comparing grouped means of self-reported physical activity between study phases approached significance [F (3,15) = 2.13, p= 0.13] and showed, as hypothesized, increases from baseline throughout subsequent study phases. Cohen's d revealed medium to large effect sizes from baseline to intervention (d= 0.57), baseline to end point (d= 0.96) and baseline to follow-up (d= 1.51). The grouped analyses provide a summary perspective on the effect of the PAC intervention for each of the study variables.

4. Discussion

Depression is a growing public health concern, with the highest rates reported in females ages 15-24, the typical age range of undergraduate university students (Statistics Canada, 2016). As such, universities have drawn attention to the need for more accessible mental health resources to be made available to students (La Rotonde, 2016; Lunau, 2012). Physical Activity Counselling has been shown to improve physical activity levels (Fortier et al., 2011) and to be a cost-effective intervention (Hogg et al., 2011). Moreover, there is strong evidence that increases in physical activity are associated with reduced depression (Mammen & Faulker, 2013; Pereira, Geoffroy, & Power, 2014; Stanton et al., 2014; Wegner et al. 2014), making PAC a promising approach to further examine. The purpose of this study was to investigate the effects of PAC on depressive symptoms, affect and physical activity levels in female undergraduate students with depression.

Overall, the study results suggest that two months of PAC may be an effective approach in reducing depressive symptoms and increasing self-reported physical activity in this important population. Objectively measured increases in moderate physical activity over the course of subsequent study phases were also detected. The results at one-month follow-up suggest that

changes in depressive symptoms and self-reported physical activity can be maintained, and even improved, following the PAC intervention. The findings regarding the effect of PAC on positive and negative affect varied according to participants, though there was some support that negative affect reduced from baseline to intervention.

4.1. Effects of Physical Activity Counselling on Depressive Symptoms

Consistent with our hypothesis, and with previous research on physical activity interventions for depression (e.g., Soucy-Chartier & Provencher, 2014), visual analyses revealed an overall negative *trend* in depressive symptoms for all five participants from baseline throughout intervention, end point and follow-up. This demonstrates that the severity of depressive symptoms reduced throughout the duration of the study, as expected.

Contrary to our hypothesis, visual and statistical analyses of the *level* revealed that two of the five participants (P4 & P5) had a slight increase in depressive symptoms from baseline to intervention. Upon further inspection of the timing of the intervention data, it was found that the intervention phase for both of these participants overlapped with the final exam period at the end of April, 2016. Participants 1, 2 & 3 started the intervention earlier, finishing the intervention prior to the final exam period. The popular media (e.g., The Globe and Mail, 2016), as well as scientific research (Trueba, Smith, Auchus, & Ritz, 2013; Zunhammer, Eberle, Eichhammer, & Busch, 2013) have reported that exam periods are the most stressful times for students. Thus, it is plausible that additional stress experienced by P4 and P5 during this time may have contributed to the perception of more severe depression during the intervention phase. Another potential explanation could be that these participants perceived the change of incorporating physical activity into their daily routine, as a stressful experience. Studies support that change and transition can be particularly stressful for students, including changes to physical activity

behaviour (Kwan, Cairney, Faulkner, & Pullenayegum, 2012). As such, it might be important for future research considering the effectiveness of a PAC intervention to ensure that the timing of the intervention phase does not overlap with other stressful periods, such as exam time.

It should also be noted that overall, P4 had the lowest baseline depressive symptoms and the least improvement from baseline to intervention, end point and follow-up. Alternatively, P2 had the highest baseline depressive symptoms and the greatest improvement from baseline to intervention, which was maintained at end point and follow-up. This is consistent with a recent meta-analysis which indicated that the severity of depressive symptoms may have an effect on the outcomes of physical activity interventions, suggesting that the anti-depressant effects of physical activity are greater in those with major depressive disorder (i.e., more severe depressive symptoms) (Schuch et al., 2016). This suggests that it might be necessary to consider and control for levels of depression in future research investigating the effects of PAC on depressive symptoms.

Nevertheless, all five participants in this study reported lower depressive symptoms at follow-up compared to baseline, with a large effect size (d = -0.93), indicating that although the amount of improvement varied among participants, overall PAC had a positive effect on depression.

4.2. Effects of Physical Activity Counselling on Positive and Negative Affect

Contrary to the hypothesis, and to previous physical activity research (Fortier, Guérin, Williams, & Strachan, 2015; Mata et al., 2012; Pasco et al., 2011), individual and grouped analyses revealed no significant differences in positive affect from baseline to intervention, end point and follow-up. Though not reaching statistical significance, P2 & P3 showed slight increases in positive affect from baseline to intervention, while P4 & P5 showed slight decreases

in positive affect from baseline to intervention, as shown in individual visual and statistical results. However, this may be related to the increase in depressive symptoms previously discussed.

Grouped analyses revealed no significant changes in negative affect from baseline to intervention, end point and follow-up. However, consistent with the hypothesis, individual visual and statistical analyses showed a significant decrease in negative affect from baseline to intervention in P3 and approached significance in P5. These decreases in negative affect were maintained at end point in both P3 and P5. Conversely and contrary to the hypothesis, P2 and P4 did not show significant decreases in negative affect from baseline to intervention.

Overall, the analyses on positive and negative affect did not provide support for the research hypotheses. One potential reason for this, could be the timing of measurement. Previous research considering the effects of physical activity on affect has suggested that the greatest benefits are achieved immediately post physical activity and these benefits increasingly diminish over time (Guérin, Fortier, & Sweet, 2013; Reed & Ones, 2006; Winchers et al., 2012). In the present study, measures of affect were taken in the evening, as opposed to immediately post-physical activity, in order to minimize participant burden. It is possible that the women engaged in physical activity earlier in the day, and by the time they completed the survey, the affective benefits were no longer apparent with other events interfering. Indeed, experts suggest that it is important to consider the timing of measurement when investigating changes in affect in response to physical activity (Guérin et al., 2013; Reed & Ones, 2006; Winchers et al., 2012).

Additionally, previous research considering affective responses to physical activity, found benefits in a non-clinical population (Guérin & Fortier, 2012; Pasco et al., 2011; Taliaferro et al., 2009). Given that the present study examined individuals with depression, their affective

responses to physical activity may have been unique compared to a more general population. Indeed, experts have found significant differences in the variability of affective states between individuals with depression and those without depression. For example, those with major depression have shown decreased reactions to positive events (Pizzagalli, Iosifescu, Hallett, Ratner, & Fava, 2008) and less variability in day-to-day positive affect in comparison to a healthy population (Chepenik et al., 2006). In addition, some studies have found no significant differences in negative affect when comparing pre- to post- physical activity in those with depression (Mata et al., 2012; Winchers et al., 2012). This suggests that the affective responses of individuals with depression may differ to a healthy population, and future research is important to better understand the nature of these responses in a physical activity context specifically.

4.3. Effects of Physical Activity Counselling on Self-Reported and Objective Physical Activity

Consistent with previous research (Fortier et al. 2013; Soucy-Chartier & Provencher, 2014) and our hypothesis, visual analyses revealed an overall positive *trend* in self-reported physical activity from baseline throughout intervention, end point and follow-up phases for all five participants, indicating self-reported physical activity increased throughout the duration of the study (see Figure 2).

Similarly, visual and SMA statistical analyses revealed that the *level* for self-reported physical activity from baseline to intervention was positive in P1, P2, P3 and P5, as hypothesized. Contrary to our hypothesis, the *level* for self-reported physical activity was negative from baseline to intervention in P4, though this did not reach significance. Interestingly, P4 also had a slight increase in depressive symptoms from baseline to intervention (see Figure 1) which might be related to her decrease in self-reported physical activity. It is possible that this

participant was feeling guilty about not making any improvements in physical activity, resulting in an increase in self-reported depressive symptoms. Indeed, maladaptive guilt is higher in those who suffer from depression, compared to those who do not (Beck & Alford, 2009; Duggal, 2016). Or, vice versa, this participant may have been feeling particularly down and did not have the motivation or energy to engage in more physical activity. Lack of motivation is a common feature of depression (Beck & Alford, 2009; Duggal, 2016). The main goal of PAC is to improve the quality of motivation towards physical activity; perhaps the participant required a more intensive intervention (i.e., more frequent sessions over a longer period) in order to adequately target her motivation for physical activity. These findings suggest that it might be valuable to explore the relationship between motivation and changes in physical activity levels when investigating the effects of a PAC intervention on depressive symptoms.

In regards to objective physical activity, the mean data for P2, P4 and P5 reveals that while light physical activity decreased from baseline to intervention, moderate physical activity increased. However, these results should be interpreted with caution as they did not reach statistical significance. There were no significant differences in total physical activity for these participants. The ActivityStat hypothesis may provide a potential explanation for these results (Gomersall, Rowlands, English, Maher, & Olds, 2013). Based on results of a systematic review, the ActivityStat hypothesis describes a compensatory phenomenon whereby physical activity is increased in one domain (i.e., moderate physical activity) and subsequently decreased in another domain (i.e., light physical activity); ultimately resulting in a stable level of total physical activity (Gomersall et al., 2013). To illustrate, Colley, Hills, King, & Byrne (2010) examined total energy expenditure in adult women during an 8-week physical activity intervention. Results of the study found a decrease in light activity and an increase in moderate-to-vigorous activity

(MVPA) in response to the exercise intervention. As such, the author's concluded that participants had replaced light activity with MVPA. Although the results of the present study are in line with the ActivityStat hypothesis, it should be noted that physical activity compensation is a relatively new area of research and the findings to date are mixed, which suggests the need for further investigation before drawing concrete conclusions (Ridgers, Timperio, Cerin, & Salmon, 2014).

Nevertheless, the results of the present study suggest that although total and light PA did not significantly increase, there were increases in moderate physical activity from baseline to intervention and end point. There is consistent evidence, which are in line with the Canadian Physical Activity Guidelines, that engaging in MVPA is the recommended intensity to achieve health benefits (CSEP, 2011; McKinney et al., 2016). Though participants did not reach the recommended guidelines, their gradual increases in moderate physical activity are promising. In fact, experts have suggested that those who are the least active, gain the largest health benefits from even slight increases in physical activity (McKinney et al., 2016). Perhaps a longer intervention period would have allowed for even greater increases in moderate physical activity.

Ideally, the self-reported and objective physical activity data should be in agreement with one another. However, in the present study, and in line with previous research (Arbour & Martin Ginis, 2009; Fortier et al., 2011; Loney, Standage, Thompson, Sebire, & Cumming, 2011) they were somewhat discrepant. There were greater increases in self-reported physical activity compared to objective physical activity from baseline throughout the study. Previous research has suggested that there are limitations with measuring physical activity objectively, which might explain this measurement discrepancy. For instance, there are issues with failing to wear the device and inability to capture arm movements, which result in underreporting of physical

activity (Loney et al., 2011; Prince et al., 2008). In addition, objective physical activity is subject to physical activity compensation (Gomersall et al., 2013). Given this measurement discrepancy, future work should carefully consider the limitations associated with self-reported and objective physical activity assessments in order to determine which method is optimal.

4.4. Strengths, Limitations and Future Directions

There were several noteworthy strengths associated with this study. First, no previous research has investigated the effects of PAC specifically on female undergraduate students with depression. Given that this population is among the most at risk for poor mental health (Statstics Canada, 2016), and that universities and research are emphasizing the need for more alternative mental health resources (La Rotonde, 2016; Nunes et al., 2014), this study was particularly novel and timely.

In addition, the PAC intervention is considerably unique compared to other traditional physical activity interventions. Indeed, the PAC intervention includes a counselling component which in itself, may contribute to improvements in depressive symptoms. This is what makes the PAC intervention so well suited for not only increasing physical activity, but also improving depression.

From an applied standpoint, the results of this study suggest that PAC might be an effective approach in increasing physical activity and reducing depressive symptoms in female undergraduate students with depression. However, it is necessary to replicate this study, taking into consideration the limitations and future research recommendations, before conclusions can be made.

Further, the PAC intervention is grounded in the SDT. Previous research has suggested that facilitating the three basic psychological needs of autonomy, competence and relatedness postulated by SDT can predict both mental and physical health (Ng et al., 2012). Recently, a meta-analysis concluded that interventions based on SDT are the most effective in changing physical activity (Gourlan et al., 2015). The mental and physical improvements shown in several of the participants of this study suggest that underlying SDT constructs targeted through PAC may be effective, albeit future research is needed.

Finally, in regards to methodology, the multiple baseline single-subject design of the study was a unique and individualized approach to conducting this research. The American Medical Association describes this research design as the gold standard for providing evidence of effective treatments (Naughton & Johnston, 2014). This is because repeated measurements within individuals, provides valuable information regarding directions of causality (Naughton & Johnston, 2014).

There were also several limitations associated with the present study which require cautious interpretation of the results and which should be considered in future research. First, the short length of the intervention (i.e., two-months) meant there were a limited number of depressive symptom data points that could be collected and statistically analyzed. As a result, more conventional time-series analyses such as HLM and ARIMA were not appropriate for the present study. In addition, even though SMA is known for improving statistical power in short time-series data analysis, power remained low (Borckardt et al., 2008). Also, all five participants opted to partake in the maximum two months of PAC, and informal qualitative feedback suggested they would have liked to continue further PAC sessions. A longer intervention period would reduce the influence of confounding variables, such as exam period, on the results. In

addition, a longer intervention period might allow for more fluctuation and changes in affect. Taken together, and in line with previous recommendations (Fortier et al., 2011), future research should consider lengthening the duration of the PAC intervention.

Second, the small sample size was another major limitation of the study. Results of the five participants in this study may not be generalizable to the broader population of female students with depression. Future research, replicating the findings of this study, are recommended to provide support for generality. Additionally, the small sample size restricted the statistical approaches that could be used and contributed to low statistical power. Moreover, the small sample size precluded running complex analyses to account for multiple confounding variables, such as medication use. Small sample size also excluded testing physical activity as a mediator variable to better understand the underlying mechanism by which PAC influences depressive symptoms and affect. Future research should consider including a larger sample size of female students with depression in order to address these limitations.

Third, the data collection may have been overly burdensome, particularly among a population of students with depression. The frequency of measurement (i.e., wearing the accelerometer every day and responding to online surveys every second day) may have caused additional stress on the participants. This may have contributed to the increases in depressive symptoms and decreases in positive affect from baseline to intervention, previously discussed. Participant burden may have also have contributed to the low response rate (6%) seen in Participant 1. Indeed, non-response has been identified as a serious concern for online surveys intended for student populations (Larose & Tsai, 2014). Future research should consider administering surveys less frequently to minimize participant burden and to facilitate high response rates among participants.

Finally, there were many rich conversations between the counsellor and participants, and between the researcher and participants, which could have provided interesting insights about how and why the intervention was or was not exerting its intended effect. Combining quantitative and qualitative research methods may provide a greater understanding of the changes in depressive symptoms, affect and physical activity, which may not be fully captured using solely a quantitative approach (Venkatesh, Brown, & Bala, 2013). Future research should consider using a mixed methods approach when investigating the effects of a PAC intervention.

4.5 Conclusion

Overall, findings of the present study revealed that depressive symptoms decreased and self-reported physical activity increased from baseline throughout the PAC study. These findings, in line with previous research, provide initial support for the role of PAC as an effective strategy to increase physical activity levels and reduce depression among students. However, although this study presents practical findings, future research is recommended to address the limitations of the study.

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Competing Interests

The authors declare no competing interest.

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Footnotes

[1] Positive and negative affect are fluctuating/short-lived experiences of emotions. A single measure of affect would not have been representative of a participant's overall state, therefore positive and negative affect were not measured at follow-up.

[2] Kinesiologist: a human movement professional whose job is to improve quality of life through promoting physical activity, prevent and manage the recovery of injury/chronic disease and improve overall health and performance (Ontario Kinesiology Association, 2014).

List of Tables

Table 1. *Demographics and baseline characteristics of the participants.*

Participant (N=5)	Age	Medication	Depressive Symptoms (severity)	Physical Activity	Total # PAC Sessions
1	20	Yes	20	23	6
2	21	Yes	22	0	6
3	19	No	10	0	7
4	20	No	5	5	7
5	18	No	15	14	5
Mean	19.6	NA	14.6	11.1	6.2

Note. Depression symptoms severity: 0-4 absent/minimal, 5-9 mild, 10-14 moderate, 15-19 moderately severe, 20-27 severe (Spritzer et al., 1999)
Note. Physical activity: < 14 insufficiently active, 14-23 moderately active, ≥ 24 active. Score calculated using self-reported moderate and vigorous physical activity only (Godin, 2011)

Table 2. *Research design and summary of data collection for the PAC intervention.*

	Screening	Baseline *10 Days*	Intervention *2 Months*	End Point *10 Days*	Follow-Up *1 Month Later*
Once					
Physical activity readiness	X				
Depressive symptoms	X				X
Self-reported physical activity	X				X
Every 2 weeks					
Self-reported physical activity			X		
Depressive symptoms			X		
Every 2nd day					
Positive affect		X	X	X	
Negative affect		X	X	X	
Daily					
Objective physical activity		X	X	X	

Table 3. *Autocorrelation and level change for measures of depressive symptoms, positive affect, negative affect, self-reported physical activity and objective physical activity (total, light, moderate) from baseline to intervention.*

Participant	**Measure**	**Autocorrelation Lag -1**	***p***	***Level* Change (*r*)**	***p***
2	Depression	-0.42	0.26	-0.94	<0.01**
	Positive Affect	0.06	0.30	0.26	0.16
	Negative Affect	-0.20	0.16	-0.01	0.95
	Self-Reported PA	-0.28	0.30	0.999	<0.001**
	Total PA	<-0.01	0.60	-0.27	0.21
	Light PA	-0.02	0.57	-0.30	0.16
	Moderate PA	-0.17	0.24	0.22	0.24
3	Depression	-0.01	0.75	-0.70	0.31
	Positive Affect	0.26	0.06*	0.26	0.31
	Negative Affect	0.07	0.24	-0.51	0.01**
	Self-Reported PA	-0.25	0.23	0.50	0.64
	Total PA	0.04	0.34	-0.08	0.71
	Light PA	0.22	0.07*	0.11	0.66
	Moderate PA	0.33	0.02**	-0.46	0.08*
4	Depression	-0.36	0.38	0.49	0.48
	Positive Affect	-0.04	0.54	-0.39	0.16
	Negative Affect	-0.21	0.25	0.35	0.09*
	Self-Reported PA	-0.27	0.43	-0.14	0.85
	Total PA	-0.19	0.24	-0.30	0.10*
	Light PA	0.28	0.05*	-0.34	0.19
	Moderate PA	0.24	0.07*	0.09	0.73
5	Depression	<0.01	0.31	0.52	0.28
	Positive Affect	0.13	0.18	-0.25	0.24
	Negative Affect	0.18	0.11	-0.37	0.09*
	Self-Reported PA	-0.37	0.32	0.12	0.84
	Total PA	0.30	0.02**	0.18	0.42
	Light PA	0.37	<0.01**	-0.12	0.63
	Moderate PA	0.57	<0.001**	0.51	0.07*

Note. **Significantly Different p<.05 *Approached Significance p<.10
Note. PA= Physical Activity
Note. Total, Light and Moderate PA refer to objective accelerometer data.
Note. Autocorrelation was accounted for in level change analyses.

Table 4. *Means ± standard deviations for grouped data according to study phase.*

Dependent Variable	**Baseline**		**Intervention**		**End Point**		**Follow-Up**	
	Mean ± SD	**N**	**Mean ± SD**	**N**	**Mean ± SD**	**N**	**Mean ± SD**	**N**
Depressive Symptoms	14.6± 6.7	4	12.0± 5.4	4	11.0± 3.8	4	9.4± 4.5	4
Positive Affect	22.3± 5.4	5	21.5± 3.4	5	21.3± 6.1	5	----------	5
Negative Affect	21.3± 9.4	5	20.5± 9.4	5	19.3± 9.5	5	----------	5
Self-Reported PA	11.1± 8.5	4	18.4± 17.4	4	21.6± 13.5	4	41.9± 32.2	4
Total PA	270±60.1	5	247.4±72.2	5	229±128.1	5	----------	5
Light PA	230.7±64.2	5	198.2±44.6	5	189.5±111.4	5	----------	5
Moderate PA	39.5±11.7	5	48.2±32.3	5	37.9±16.8	5	----------	5

Note. PA= Physical Activity

Note. Total, Light and Moderate PA refer to objective accelerometer data.

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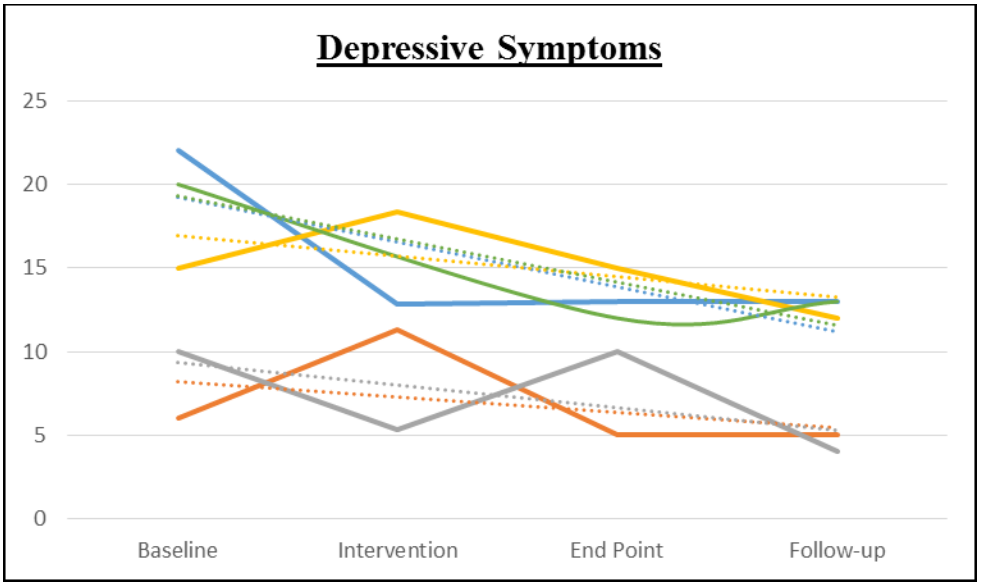

Figure 1. Depressive symptoms of each participant throughout the PAC study as measured by the Patient Health Questionnaire (PHQ-9).

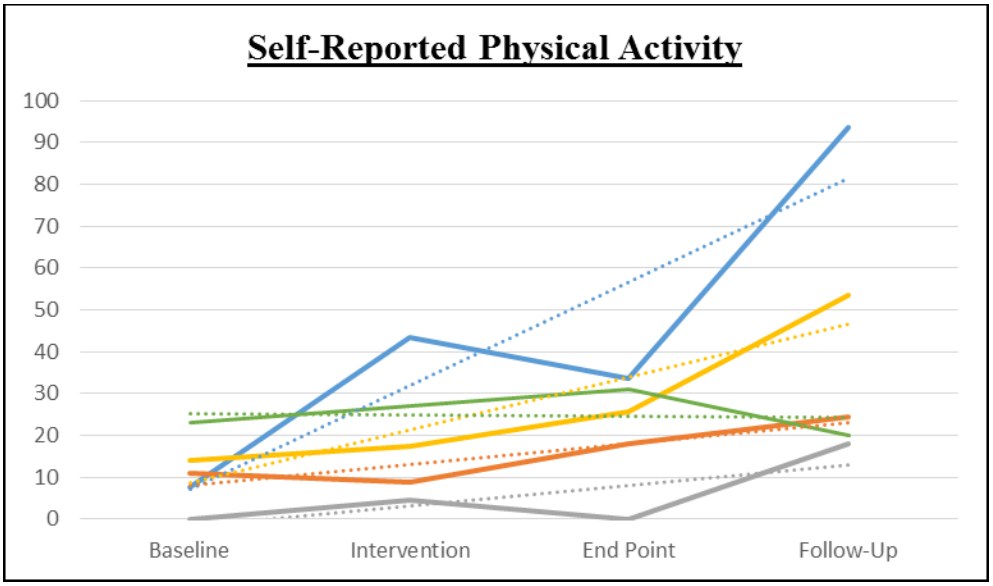

Figure 2. Self-reported physical activity levels of each participant throughout the PAC study as measured by the Godin Leisure-Time Questionnaire (LTEQ).

CHAPTER IV: GENERAL DISCUSSION

Effects of Physical Activity Counselling on Depressive Symptoms

The primary aim of this study was to examine the influence of a two-month PAC intervention on the severity of depressive symptoms of female undergraduate students with depression. Grouped statistical analyses revealed mean depressive symptoms decreased from baseline throughout all subsequent study phases, showing a large effect size at follow-up, as anticipated. Consistent with the hypothesis, visual and statistical analyses of *trend* revealed an overall decrease in depressive symptoms from baseline to intervention, end point and follow-up in all five participants. *Level* analyses revealed a decrease in depressive symptoms from baseline to intervention in P1, P2 and P3, as predicted. Contrary to the hypothesis, *level* analyses showed a slight increase in depressive symptoms from baseline to intervention phases in P4 and P5. There are several potential reasons for this.

First, P4 & P5 began the study later than the other three participants, resulting in an overlap of the intervention phase with the final exam period. Given that exam times are highly stressful for students (Trueba, Smith, Auchus, & Ritz, 2013; Zunhammer, Eberle, Eichhammer, & Busch, 2013) this additional stress may have resulted in higher perceived depressive symptoms. In addition, previous research has demonstrated that change, such as implementing physical activity, can result in increased stress (Kwan, Cairney, Faulkner, & Pullenayegum, 2012). It is possible that initially, these women had a slight increase in depressive symptoms in response to incorporating physical activity into their lives and that once they adjusted to this change, subsequent depressive symptoms decreased. Visual analysis of depressive symptoms included an average of all scores during the intervention phase, not considering the potential differences in scores during the beginning, middle and end of the intervention. Thus, visual

analysis may not have adequately represented the progression of depressive symptoms during the two-month intervention. In order to better understand why there was an increase in depressive symptoms from baseline to intervention, future research should consider visually analyzing the data using raw scores, as opposed to averages. This would also allow for analyzing specifically when the PAC intervention had a significantly positive influence on depressive symptoms (i.e. how many sessions did participants require to attain benefits?). In addition, future studies should consider including qualitative research in order to better understand why P4 and P5 reported higher depressive symptoms during the intervention phase.

Another potential variable, which may have influenced the changes in depressive symptoms throughout this study, is the use of prescription medication (i.e., antidepressants). Medication use was noted during screening, but due to the small sample size, it was not accounted for in the analyses. Reviews have recommended physical activity as an effective adjunct treatment to antidepressants for reducing depressive symptoms (Carek, Laibstain, & Carek, 2011; Mura, Moro, Patten, & Carta, 2014). Indeed, P2 who showed the greatest decrease in depressive symptoms throughout the study, was on medication, while P4 who showed the least decrease in depressive symptoms throughout the study, was not. It is possible that the use of medication, in combination with increased physical activity, was enhancing the antidepressant effects of the PAC intervention.

Moreover, the severity of depressive symptoms at baseline may also have influenced the effectiveness of the PAC intervention on depressive symptoms. To illustrate, P2 who had the greatest decrease in depressive symptoms throughout the study, had the most severe baseline depressive symptoms, while P4 who showed the smallest decrease in depressive symptoms throughout the study, had the least severe baseline depressive symptoms. Research has suggested

that the anti-depressant effects of physical activity interventions are more prevalent in those with more severe depressive symptoms (Schuch et al., 2016), which may explain why P4 showed the greatest improvements in depressive symptoms compared to P2.

Finally, there are many lifestyle factors, other than physical activity, which may have contributed to the overall results demonstrating improvements in depressive symptoms in all five participants from baseline throughout the PAC intervention. For instance, diet and sleep have been shown in previous research to significantly influence depressive symptoms (Lopresti, Hood, & Drummond, 2013). While the aim of PAC is to increase physical activity, other related behaviours do arise during the sessions, especially in goal setting activities. Future research should consider measuring additional lifestyle factors, such as diet and sleep, in order to identify potential mediators in the relationship between PAC and depressive symptoms.

Effects of Physical Activity Counselling on Positive and Negative Affect

The second objective of this study was to examine the influence of a two-month PAC intervention on both positive and negative affect of female undergraduate students with depression. Contrary to the hypothesis, individual and grouped statistical analyses revealed no significant differences in positive affect from baseline to intervention in all five participants. Moreover, grouped statistical analyses revealed no significant differences in negative affect from baseline to intervention in all participants. Individual statistical analyses of negative affect indicated no significant differences from baseline to intervention in P2 and P4, again contrary to the hypothesis. However, a significant decrease in negative affect from baseline to intervention was found in P3 and approached a significant decrease in P5. However, the reasons why the results did not come out as anticipated, need to be carefully considered.

First, the timing of data collection may have had a significant impact on the results. Previous research has suggested that the affective benefits of physical activity are more prominent immediately post-physical activity and diminish thereafter (Guérin, Fortier, & Sweet, 2013; Reed & Ones, 2006; Winchers et al., 2012). To illustrate, Winchers et al. (2012) considered positive affect in 90 minute intervals before and after physical activity in a sample of females with and without past history of major depressive disorder (MDD). When considering the sample as a whole, positive affect was highest immediately following physical activity, decreasing thereafter, but remaining significantly higher than pre-physical activity for up to 180 minutes. However, when considering the sub sample of those with a past history of MDD, increases in positive affect immediately post-physical activity were lower and diminished at a faster rate compared to those without a history of MDD. In fact, at 180 minutes post physical activity, positive affect actually decreased to lower than pre-physical activity in those with a history of MDD. Given that measures of affect were not taken immediately post-physical activity, but rather in the evening (20:00), it is quite possible that any acute benefits that may have resulted from engaging in physical activity during the day, were no longer evident at the time of assessment.

Second, as demonstrated above, the affective responses of individuals with depression may not be consistent with those who do not have depression (Rzezak et al., 2015; Winchers et al., 2012). For instance, individuals with depression perceive fewer experiences to be pleasant, compared to non-depressed individuals (Bylsma, Taylor-Clift, & Rottenberg, 2011). Perhaps, participants did not perceive physical activity as a pleasant experience, thus their positive and negative affect did not improve as anticipated. In addition, those with depression have shown decreased reactions to pleasant events (Chepenik et al., 2006; Pizzagalli, Iosifescu, Hallet,

Ratner, & Fava, 2008). Thus, even if the participants did perceive physical activity to be a positive experience, they may have had less of a positive reaction to it. Indeed, previous research considering individuals with depression found no relation between physical activity and negative affect (Mata et al., 2012). In regards to positive affect, Chepenik et al (2006) found less variability in positive affect in those with depression compared to a healthy population. Taken together, these findings suggest that the affective responses of individuals with depression are less pronounced than non-depressed individuals. Thus, it is important to continue to investigate affective responses to physical activity in those with depression, as they might be unique compared to a healthy population.

Finally, the grouped statistical analysis involved calculating averages for each study phase. As such, the entire intervention period was averaged, which may not have provided the best representation of affective changes over the two-month intervention. For instance, it is possible that initially, changes in affect were slow and quickly increased by the end of the intervention. Alternatively, it is also possible that participants had more prominent changes in affect at the beginning of the intervention and these changes leveled by the end of the intervention. In either case, an average would not have reflected these changes. Future research should consider breaking down the intervention phase in order to provide a better understanding of how the variables changed over the course of the intervention.

Effects of Physical Activity Counselling on Self-Reported and Objective Physical Activity

The final objective of this study was to examine the influence of a two-month PAC intervention on both objective and self-reported physical activity levels of female undergraduate students with depression. Consistent with the hypothesis, visual and statistical analyses of *trend* revealed an overall increase in self-reported physical activity from baseline throughout study

phases in all five participants. These results, taken together with the results demonstrating a significant decrease in depressive symptoms in response to the PAC intervention, provides indication that increased physical activity may be associated with reduced depressive symptoms, consistent with previous research including meta-analyses (Conn, 2010; Parker et al., 2016; Pereira et al., 2014; Schuch et al., 2016). Unfortunately, due to limited data points, it was not possible to test self-reported physical activity for mediation in accounting for the relationship between PAC and depressive symptoms.

Visual and statistical *level* analyses showed an increase in self-reported physical activity from baseline to intervention in participants 1, 2, 3 & 5, as anticipated. Participant 4 showed a slight decrease in self-reported physical activity from baseline to intervention, contrary to the hypothesis. This participant also showed a slight increase in depressive symptoms at this time, which may have been associated with her decrease in self-reported physical activity. Feeling tired and having little energy is a symptom of depression. It is possible that P4 was feeling particularly down which may have resulted in her having little energy and/or motivation to participate in physical activity. Alternatively, her lack of improvement in physical activity may have resulted in feelings of guilt, potentially contributing to an increase in depressive symptoms. Indeed, research suggests that maladaptive guilt is higher in those with depression compared to a healthy population (Beck & Alford, 2009; Duggal, 2016). Another factor to consider is that visual analysis of self-reported physical activity used an average intervention score. When looking at the raw data, P4 had slight decreases in self-reported physical activity at the start of the intervention, however, by the end of the intervention, her self-reported physical activity score was much higher than her baseline score. When averaging her intervention scores, even though by the end of the intervention her self-reported physical activity was higher than baseline, the

average score was not. Again, it might be important to analyze raw data or break down the intervention period in order to gain a better understanding of the results that did not support the research hypotheses.

In regards to objective physical activity, visual and statistical analyses of *level* revealed decreases in light physical activity and increases in moderate physical activity from baseline to intervention in P2, P4 & P5, though not significantly. Alternatively, P3 showed decreases in moderate physical activity and increases in light physical activity from baseline to intervention, again not reaching statistical significance. Taken together, these results reflect a compensatory phenomenon known as the Activitystat hypothesis whereby physical activity increases in one domain and decreases in another (Gomersall, Rowlands, English, Maher, & Olds, 2013). For example, P2 may go to the gym and as a result, drive to the grocery store instead of walking as she normally would. On the other hand, perhaps P3 normally drives to the grocery store, but she was unable to make it to the gym that day, so instead of driving to the store she choose to walk. However, considering the results did not reach statistical significance, and that there is variability in literature regarding the Activitystat hypothesis, future research is recommended to better understand physical activity compensation.

The results of grouped statistical analyses of self-reported and objective physical activity revealed disparities; increases in self-reported physical activity approached significance with a large effect while total, light and moderate objective physical activity were insignificant with small effect sizes. Previous research found similar inconsistencies between self-reported and objective measures of physical activity (Arbour & Martin Ginis, 2009; Fortier et al., 2011; Loney, Standage, Thompson, Sebire, & Cumming, 2011). There are a few potential reasons for this.

First, self-reported physical activity using the LTEQ (Godin & Shepard, 1985) measures leisure time physical activity while objective physical activity using an Actical accelerometer (Mini Mitter Co., Inc., Bend, Ore) measures all activity counts. Indeed, these two measures differ in which component of physical activity they measure specifically (Fortier et al., 2011).

Second, there are limitations associated with both self-reported and objective measures of physical activity. Self-reported physical activity can be subject to recall and response bias, which may cause participants to over report physical activity (Prince et al., 2008). Alternatively, objective physical activity is subject to compensation and inability to capture upper-body movements, resulting in underreporting of physical activity (Audrey, Bell, Hughes, & Campbell, 2012; Fortier et al., 2011). Failure to wear the accelerometer is another limitation associated with objectively measuring physical activity, which is particularly important to consider in this study, as non-adherence is common in adults with depression (Lavezzi, 2015). Future research is required to determine the most effective method of measuring physical activity, taking into consideration the limitations associated with each method and other factors, such as participant and study characteristics.

Strengths, Limitations and Future Directions

There were several notable strengths associated with the present study. First, with rates of depression and antidepressant use reaching an ultimate high among students, research has highlighted the need for more accessible mental health services (Ibrahim, Kelly, Adams, & Glazebrook, 2013; Nunes et al., 2014). This demonstrates the importance and timeliness of the present study.

In addition, the PAC intervention is considerably unique compared to other traditional physical activity interventions aimed at reducing depression. Indeed, the PAC intervention

includes a counselling component which in itself, may contribute to improvements in depressive symptoms. This is what makes this intervention so well suited for not only increasing physical activity, but also improving depression.

In regards to methodology, this study follows a multiple baseline single-subject design which primarily considers the effects of PAC within individuals. This type of research design is novel and offers valuable information regarding directions of causality, providing evidence for effective treatments (Naughton & Johnston, 2014). Given the multiple baseline, single-subject design of the present study, the findings provide support for the effectiveness of PAC in increasing self-reported physical activity and reducing depressive symptoms in female undergraduate students with depression.

From a theoretical perspective, PAC is grounded in the Self-Determination Theory (SDT) and Motivational Interviewing (MI). Given that the spirit of MI facilitates the three psychological needs of the SDT, the improvements shown in depressive symptoms and physical activity levels in this study, provide further support for the effectiveness of interventions based on SDT (Ng et al., 2012; Gourlan et al., 2015). However, future research should investigate the role that needs satisfaction and quality motivation play in increasing physical activity and decreasing depression.

Finally, there has been strong evidence in literature supporting the role of physical activity in reducing depression (Parker et al., 2016; Pereira, Geoffrey, & Power, 2014; Schuch et al., 2016; Wegner et al., 2014)), though what remains a challenge, is determining how to optimally get individuals with depression more active. In regards to practical implications, findings of the present study showed promising outcomes in support of PAC as an effective strategy to increase self-reported physical activity and reduce the severity of depressive

symptoms among female undergraduate students. As such, these findings suggest that PAC might be an important service for universities to consider implementing as a supplemental treatment for depression. Moreover, there is support for the cost-effectiveness of physical activity interventions (Hogg et al., 2012), yet another reason why universities should seriously consider offering PAC services to students.

As with any research, there are several limitations associated with the present study that should be taken into consideration. First, the short length of the intervention (i.e., two-months) was a limitation for several reasons. The duration of the intervention was selected based on feasibility for the project and based on the six session recommendation made in previous intervention studies aimed at improving depression (Eskin, Ertekin, & Demir, 2008; Parker et al., 2016). However, each participant completed the full two-month maximum intervention period and informal qualitative feedback suggested that they would have liked to continue PAC after the intervention ended. In addition, a two-month intervention may not have been sufficient to see significant changes in some of the outcome variables. Increasing the intervention may have allowed for identifying significant changes in variables, such as positive and negative affect. In addition, lengthening the intervention period would result in a greater number of data points to allow for running more conventional time-series analyses such as HLM and ARIMA which recommended greater than 30 data points per phase (Borckardt et al., 2008). Finally, a longer intervention period, continuing over several months, would reduce confounding variables such as stressful exam periods or seasonal effects, from having a significant influence on the outcomes of the study. Taking this all into account, and as recommended by Fortier et al. (2011), future research should consider implementing a six to twelve-month PAC intervention. In addition to lengthening the intervention phase, future research should also consider including “booster” PAC

sessions, post intervention, to help participants stay motivated and maintain the benefits they obtained during the intervention (Scott et al., 2011).

Second, small sample size was another major limitation of the study. Results of the five participants in this study may not be generalizable to the broader population of female students with depression. Future research, replicating the findings of this study, are recommended to provide support for generality. Additionally, the small sample precluded running complex statistical analyses and resulted in low statistical power. A larger sample size would have allowed for testing physical activity as a potential mediator in the relationship between PAC and depressive symptoms. Although several recruitment strategies were employed, including posters on campus and referrals from health care professionals at Health Services, the researchers were only able to recruit six eligible participants. In fairness, it was crucial for participants to begin counselling relatively close in time to one another, to reduce confounding variables such as weather from having an influence. As such, the recruitment period was time sensitive. Nevertheless, future research should utilize additional recruitment strategies, such as social media, in order to obtain a larger sample size.

Third, the data collection might have been overly burdensome, particularly considering a population of students with depression. Participant burden may have contributed to additional stress and lack of adherence to the protocol. For instance, the frequency of measurement (i.e., wearing an accelerometer every day and responding to online questionnaires every second day for two months) may have been demanding on the participants. This may have contributed to the increase in depressive symptoms and decreases in positive affect shown in some of the participants from baseline to intervention. In addition, participant burden may have resulted in a lack of adherence to the study protocol. For instance, P1 responded to a mere 6% of the online

surveys during the PAC intervention, severely limiting statistical data analyses. Non-response has been identified as a serious concern for online surveys intended for student populations (Larose & Tsai, 2014). Future research should consider administering fewer surveys to foster a high response rate in students (Larose & Tsai, 2014). There were also days when participants failed to wear the accelerometer, resulting in missing data. Previous research investigating challenges associated with accelerometer retention rates provide many reasons for why participants may neglect to wear a hip accelerometer including, forgetting to put it on, discomfort (when engaging in physical activity) and appearance under clothing (particularly with females) (Audrey, Bell, Hughes, & Campbell, 2012; Corder, Ekelund, Steele, Wareham, & Brage, 2008). Future research should consider using an alternative to a hip accelerometer, taking into consideration participant preferences while also ensuring the tool is both valid and reliable. For example a watch worn on the wrist, might be an appropriate alternative to improve adherence to the study protocol. Finally, research has indicated that individuals with depression have a high risk of dropping out of randomized control trials, thus participant burden is particularly important to consider when designing a physical activity intervention for those with depression (Cooper, & Conklin, 2016).

Fourth, the study did not take into consideration additional variables which may have had an influence on the outcome measures of the study. For instance, lifestyle factors such as diet and sleep, have been demonstrated in research to significantly affect depression, whereby those who maintain a healthy diet and adequate sleep present lower depressive symptoms (Lopresti, Hood, & Drummond, 2013). In addition, sociocultural factors such as economic status and religion raise unique barriers to physical activity participation. Lower economic status has been attributed to less participation in physical activity due to a variety of reasons such as restricted access to

facilities and high costs of participating in organized sport (Holt, Kingsley, Tink, & Scherer, 2011). Religion also has an influence on physical activity, wherein engaging in physical activity is considered a cultural taboo for women in certain cultures (Abbasi, 2014). As an example, it is not socially acceptable for Muslim women to participate in physical activity in the presence of males. Indeed, lack of access to gender-segregated facilities presents a major challenge for Muslim women (Abbasi, 2014). Future research should consider measuring and controlling for potential confounding variables, such as lifestyle and sociocultural factors, which may influence outcomes of depressive symptoms and physical activity.

Finally, there were several rich discussions between the counsellor and participants and between the researcher and participants that could have provided addition understanding to the quantitative data. For example, one participant mentioned to her counsellor that a main goal of hers was not only to increase her physical activity levels, but also to improve her diet. In ensuing sessions, she discussed major improvements in her diet, however this was not directly measured and thus was not included in the analyses as a factor which may have potentially influenced her depressive symptoms. As another example, during an end point assessment, one participant expressed being extremely stressed as she was on her way to write a final exam. This additional stress likely influenced her results in this final assessment. In these cases, it would have been extremely useful to have incorporated a combination of qualitative and quantitative analysis. Therefore, future research should consider evaluating a PAC intervention using a mixed methods approach to fully capture the reasons why the intervention was or was not exerting its intended effects.

Conclusion

There is strong evidence that physical activity can significantly reduce the risk of depression (Conn, 2010; Parker et al., 2016; Pereira et al., 2014; Schuch et al., 2016). In fact, the psychological benefits of physical activity are comparable to pharmacology for the treatment of depression (Stanton et al., 2014). However, what remains undetermined is how to best activate individuals with depression. Physical Activity Counselling is one approach which has been demonstrated to significantly increase levels of physical activity (Fortier et al., 2011; Gao et al., 2016).

Overall, findings of the present study revealed that depressive symptoms decreased and self-reported physical activity increased from baseline throughout the study. These findings, in line with previous research, provide initial support for the role of PAC as an effective strategy to increase physical activity levels and reduce depression among university students. Future research is recommended to further investigate this important area of research.

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APPENDICES

Appendix A- Ethics Approval

File Number: H06-15-12 **Date (mm/dd/yyyy):** 09/10/2015

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

Ethics Approval Notice

Health Sciences and Science REB

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

First Name	Last Name	Affiliation	Role
Michelle	Fortier	Health Sciences / Human Kinetics	Supervisor
Taylor	McFadden	Health Sciences / Human Kinetics	Student Researcher

File Number: H06-15-12

Type of Project: Master's Thesis

Title: Investigating the effects of Physical Activity Counselling on physical activity levels, depressive symptoms and mood in female undergraduate students suffering from depression

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)	Approval Type
09/10/2015	09/09/2016	Ia

(Ia: Approval, Ib: Approval for initial stage only)

Special Conditions / Comments:
N/A

550, rue Cumberland, pièce 154 550 Cumberland Street, room 154
Ottawa (Ontario) K1N 6N5 Canada Ottawa, Ontario K1N 6N5 Canada
(613) 562-5387 • Téléc./Fax (613) 562-5338

File Number: H06-15-12 **Date (mm/dd/yyyy):** 09/10/2015

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

This is to confirm that the University of Ottawa Research Ethics Board identified above, which operates in accordance with the Tri-Council Policy Statement (2010) and other applicable laws and regulations in Ontario, has examined and approved the ethics application for the above named research project. Ethics approval is valid for the period indicated above and subject to the conditions listed in the section entitled "Special Conditions / Comments".

During the course of the project, the protocol may not be modified without prior written approval from the REB except when necessary to remove participants from immediate endangerment or when the modification(s) pertain to only administrative or logistical components of the project (e.g., change of telephone number). Investigators must also promptly alert the REB of any changes which increase the risk to participant(s), any changes which considerably affect the conduct of the project, all unanticipated and harmful events that occur, and new information that may negatively affect the conduct of the project and safety of the participant(s). Modifications to the project, including consent and recruitment documentation, should be submitted to the Ethics Office for approval using the "Modification to research project" form available at: http://research.uottawa.ca/ethics/submissions-and-reviews.

Please submit an annual report to the Ethics Office four weeks before the above-referenced expiry date to request a renewal of this ethics approval. To close the file, a final report must be submitted. These documents can be found at: http://research.uottawa.ca/ethics/submissions-and-reviews.

If you have any questions, please do not hesitate to contact the Ethics Office at extension 5387 or by e-mail at: ethics@uOttawa.ca.

Signature:

[redacted]

Riana Marcotte
Protocol Officer for Ethics in Research
For Daniel Lagarec, Chair of the Health Sciences and Sciences REB

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Appendix B- Participant Consent Form

Title of the study: Investigating the effects of Physical Activity Counselling in female undergraduate students with depression.

Names of Investigators:

Taylor McFadden, Primary Investigator University of Ottawa School of Human Kinetics, 125 University Private, Ottawa ON K1N 6N5	Dr. Michelle S. Fortier, Thesis Supervisor University of Ottawa School of Human Kinetics, 125 University Private, Ottawa ON K1N 6N5

Invitation to Participate: I am invited to participate in a research project, conducted by Taylor McFadden, a 2nd year Master of Science student at the School of Human Kinetics at the University of Ottawa. Taylor is supervised by Dr. Michelle Fortier.

Purpose of this study: The purpose of this study is to encourage and guide participants to be more physically active in an effort to improve their current level of depression.

Participation: Participation includes the attendance of an initial meeting with the primary investigator (10-30 minutes), scheduled PAC sessions (individual 30-60 minute sessions, every 1-2 weeks, for a maximum duration of 2 months), an end point meeting with the primary investigator (10-30 minutes) and a follow-up telephone conversation with the primary investigator (5-10 minutes). The initial meeting, PAC sessions and end point meeting will be held in the Counselling Centre (Room 414), Montpetit Hall, 125 University, Ottawa, Ontario. The date of the PAC sessions will depend on the availability of myself and my counsellor. The PAC sessions will be individualized according to which stage of change and level of motivation for physical activity I am currently at. The PAC counsellors will act as guides to help me become more physically active through the use of specific behaviour change techniques. These techniques include resolving my ambivalence, determining my values and my goals, helping me to explore the pros and cons of physical activity, guiding me in setting realistic goals and helping me to develop a plan to become more physically active.

At the initial meeting with the primary investigator I will be asked to complete three screening paper questionnaires which will assess my current level of physical activity, my level of depressive symptoms and whether or not it is safe for me to begin physical activity. If I meet all inclusion criteria, and it is safe for me to become more physically active, I will be provided with a small, non-invasive accelerometer device to wear throughout the study until end point. I will be asked to complete electronic questionnaires through an online survey tool called FluidSurveys at the end of every second day for ten days prior to PAC for baseline measures, every second day following the first PAC session throughout the intervention and every second day for ten days

after my last PAC session for end point measures (5-10 minutes). The questionnaires during baseline, intervention and end point will assess whether or not I engaged in physical activity, and if so, the intensity, type, duration and social context of the activity, the type of motivation I had to engage in that physical activity, and how I felt after I engaged in that physical activity. Every two weeks throughout the study, there will be an additional questionnaire added to the online survey that will assess my level of depressive symptoms. At the end point meeting I will be asked to complete two paper questionnaires which will assess my level of physical activity and depressive symptoms after the intervention has ended. Finally, during the follow-up telephone conversation I will be asked questions regarding my current physical activity behaviours and my current level of depressive symptoms.

I will be asked to wear a small, non-invasive accelerometer device throughout the study until end point.

As a participant I WILL NOT be video recorded. My voice; however, will be recorded in order for the researchers to monitor the counsellors and ensure they are delivering the best quality of counselling. Only the scheduled PAC sessions will be video recorded. The initial meeting, end point meeting and follow-up telephone conversation will not be recorded.

Risks: I might experience minor psychological or emotional discomfort as a result of the discussions that I may have with my counsellor. I have received assurance from the researcher that every effort will be made to minimize these risks. I have also been provided with a copy of emergency services offered both on and off campus which is provided at the end of this form.

Benefits: Participation in this study could potentially improve my physical activity levels which may reduce the severity of my depressive symptoms and improve my mood. So, I may benefit both physically (i.e. increased physical activity which corresponds to improved cardiovascular fitness and strengthened muscles and bones) and mentally (i.e. reduced severity of depressive symptoms) from the research. This will contribute to the current field of study and help recognize physical activity as treatment for depression.

Confidentiality: I have received assurance from the researcher that the information I will share will remain strictly confidential. I understand that the recorded PAC sessions will be used only for monitoring the quality of counselling provided by the physical activity counsellors. I will not be quoted and/or cited in the analysis.

Anonymity: I have been guaranteed that my identity will be protected through the use of ID number codes to identify participants on all questionnaire data (both electronic and paper). My name will not be revealed in any future documents or publications.

Conservation of Data: I understand that all data collected such as electronic and paper questionnaires and video recordings will be on a locked computer with a protected passcode and hard copies will be kept both in the principal investigators locked office and the supervisors

office at the University of Ottawa with limited access. The electronic and hard copies of data will be conserved for 5 years following the end of data collection and will then be safely destroyed.

Voluntary Participation: I am under no obligation to participate and if I choose to participate, I can withdraw from the study at any time without suffering any negative consequences. If I choose to withdraw from the study, I will also have the option to withdraw my data. If I chose to withdraw from the study but I would like to continue PAC, this will have no effect on future PAC sessions.

Acceptance: I,_____, agree to participate in the above research study conducted by Taylor McFadden of the School of Human Kinetics, Faculty of Health Sciences at the University of Ottawa, which research is under the supervision of Dr. Michelle Fortier.

If I have any questions about the study, I may contact the researcher or her supervisor.

If I have any questions regarding the ethical conduct of this study, I may contact the University of Ottawa Office of Research Ethics and Integrity:

University of Ottawa, Tabaret Hall
550 Cumberland Street, Room 154
Ottawa, ON K1N 6N5.
Tel.: (613) 562-5387
Email: ethics@uottawa.ca

There are two copies of the consent form, one of which is mine to keep.

I understand that an ID number code will be utilized instead of my name:
yes____ no____

My PAC sessions can be recorded:
yes____ no____

Participant:

_____	_____	_____
(Print name)	(Signature)	(Date)

Principal Investigator:

_____	_____	_____
(Print name)	(Signature)	(Date)

Appendix C- PAC Counsellor Consent Form

Title of the study: Investigating the effects of Physical Activity Counselling in female undergraduate students with depression.

Names of Investigators:

Taylor McFadden, Primary Investigator University of Ottawa School of Human Kinetics, 125 University Private, Ottawa ON K1N 6N5	Dr. Michelle S. Fortier, Thesis Supervisor University of Ottawa School of Human Kinetics, 125 University Private, Ottawa ON K1N 6N5

Invitation to Participate: I am invited to participate in a research project, conducted by Taylor McFadden, a 2nd year Master of Science student at the School of Human Kinetics at the University of Ottawa. Taylor is supervised by Dr. Michelle Fortier.

Purpose of this study: The purpose of this study is to encourage and guide participants to be more physically active in an effort to improve their current level of depression.

Participation: Participation includes providing Physical Activity Counselling to a maximum of 10 participants. PAC sessions will be individual, 30-60 minutes in length, every 1-2 weeks, for a maximum duration of 2 months. The specific needs of each participant will vary and therefore the frequency of sessions will vary as well. So, while one participant might require only one PAC session every two weeks, another participant might be more demanding and require one PAC session every week. The PAC sessions will be held in the Counselling Centre (Room 414), Montpetit Hall, 125 University, Ottawa, Ontario. The date of the PAC sessions will depend on the availability of myself and the participant. The PAC sessions will be individualized according to which stage of change and level of motivation for physical activity each participant is currently at. I will act as a guide to help the participants become more physically active through the use of specific behaviour change techniques. These techniques include resolving ambivalence, determining each participant's values and goals, helping them to explore the pros and cons of physical activity, guiding them in setting realistic goals and helping them to develop a plan to become more physically active.

I WILL BE video recorded in order for the Principal Investigator to monitor the quality of counselling. My identity will remain anonymous in the report of the study.

Risks: To the best of our determination, there are no foreseen discomforts or harms associated with participating in the present research project. The level of risk is no greater than that encountered in daily life.

Benefits: Participation in this study could potentially help improve the physical activity levels of the participants which may reduce the severity of their depressive symptoms and improve their mood. My participation in this study will potentially contribute to the advancement of knowledge in the current field of exercise psychology and help recognize PAC as a method of increasing physical activity as treatment for depression.

Confidentiality: I have received assurance from the researcher that the information shared between the participants' and myself as the PAC counsellor will remain strictly confidential. I understand that the recorded PAC sessions will be used only for monitoring the quality of counselling. I will not be quoted and/or cited in the analysis.

Anonymity: I agree to be video recorded in the PAC sessions. I understand that this is for the sole purpose of monitoring the quality of counselling to ensure the appropriate behaviour change techniques are being used. My identity will remain anonymous. I will not be quoted and/or cited in the study.

Conservation of Data: I understand that all data collected such as electronic and paper questionnaires and video recordings will be on a locked computer with a protected passcode and hard copies will be kept both in the principal investigators locked office and the supervisors office at the University of Ottawa with limited access. The electronic and hard copies of data will be conserved for 5 years following the end of data collection and will then be safely destroyed.

Voluntary Participation: I am under no obligation to participate as a PAC counsellor and if I choose to counsel in the study, I can withdraw from the study at any time without suffering any negative consequences.

Acceptance: I, _____, agree to participate in the above research study conducted by Taylor McFadden of the School of Human Kinetics, Faculty of Health Sciences at the University of Ottawa, which research is under the supervision of Dr. Michelle Fortier.

If I have any questions about the study, I may contact the researcher or her supervisor.

If I have any questions regarding the ethical conduct of this study, I may contact the University of Ottawa Office of Research Ethics and Integrity:

University of Ottawa, Tabaret Hall
550 Cumberland Street, Room 154
Ottawa, ON K1N 6N5.
Tel.: (613) 562-5387
Email: ethics@uottawa.ca

There are two copies of the consent form, one of which is mine to keep.

My PAC sessions can be recorded:
yes____ no____

Counsellor:

_____	_____	_____
(Print name)	(Signature)	(Date)

Principal Investigator:

_____	_____	_____
(Print name)	(Signature)	(Date)

Appendix D- Research Assistant Confidentiality Agreement

This study, entitled "Investigating the Effects of Physical Activity Counselling on Physical Activity Levels, Depressive Symptoms and Affect in Female Undergraduate Students with Depression" is being undertaken by Principal Investigator Taylor McFadden under the supervision of Dr. Michelle Fortier at the University of Ottawa.

The study has five objectives:

1. Examine the influence of PAC on the physical activity levels of female undergraduate students with depression.
2. Examine the effect that changes in physical activity have on depression (main outcome) of female undergraduate students with depression.
3. Examine the effect that changes in physical activity have on both positive and negative affect (secondary outcome) of female undergraduate students with depression.
4. Examine the relationship between affective responses to physical activity on self-determined motivation (secondary outcome).
5. Examine the association between self-determined physical activity motivation and subsequent physical activity levels (secondary outcome).

I, Ana Vrzuc, agree to:

1. Keep all the research information shared with me confidential by not discussing or sharing the research information in any form or format (e.g. paper and electronic questionnaires) with anyone other than the Principal Investigator Taylor McFadden and her supervisor Dr. Michelle Fortier.
2. Keep all research information in any form or format secure while it is in my possession;
3. Return all research information in any form or format to the Principal Investigator when I have completed the research tasks;
4. After consulting with the Principal Investigator, erase or destroy all research information in any form or format regarding this research project that is not returnable to the Principal Investigator (e.g. information sorted on computer hard drive).

Research Assistant:

_____	_____	_____
(Print name)	(Signature)	(Date)

Principal Investigator:

_____	_____	_____
(Print name)	(Signature)	(Date)

If you have any questions or concerns about this study, please contact:

Taylor McFadden
Montpetit Hall, MNT 409a,
125 University Private
Ottawa, ON K1N 6N5

Dr. Michelle Fortier
Montpetit Hall, MNT 369,
125 University Private
Ottawa, ON K1N 6N5

This study has been reviewed and approved by the Research Ethics Board at the University of Ottawa. For questions regarding participants rights and ethical conduct of research, contact the University of Ottawa Office of Research Ethics and Integrity at:

University of Ottawa, Tabaret Hall
550 Cumberland Street, Room 154
Ottawa, ON K1N 6N5.
Tel.: (613) 562-5387
Email: ethics@uottawa.ca

Appendix E- Physician Script

This script is meant to be used during a follow-up visit with a patient who has already been identified by their physician during a previous visit as presenting signs of depression OR with a patient who expresses to their doctor that they are not feeling great and describe symptoms of depression during their visit.

The doctor will begin the session by going through all the different treatment options available to the patient to help improve their current level of depression. Once the patient has been provided with information on all treatment options, the doctor will then ask the patient about their current physical activity (PA) patterns according to the provided Exercise Prescription Pads. This will determine whether or not the patient reaches the current recommended guidelines of physical activity and thus whether or not Physical Activity Counselling might be an option for them to consider.

If the Patient MEETS the PA Guidelines:

Physical Activity Counselling is not a suitable option for the patient as they are already physically active. The doctor will help the patient choose a more suitable treatment option to help improve their current level of depression.

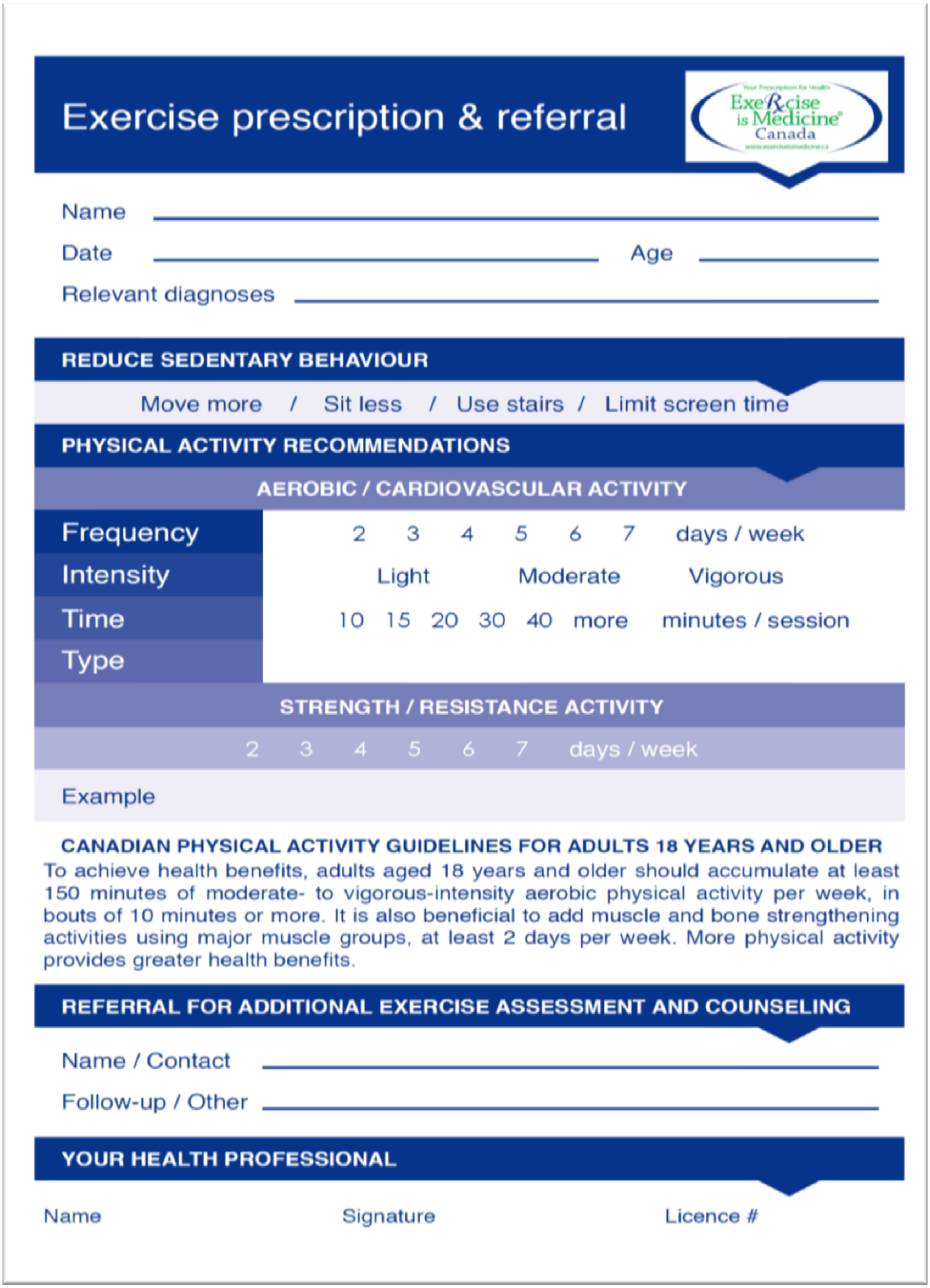
If Patient DOES NOT Meet PA Guidelines (after all other forms of treatment have been provided):

"OK, I see here that you are experiencing symptoms of depression. Being a student is not easy, and can be overwhelming and stressful at times. Let's talk about physical activity. I see here that you are not physically active on a regular basis. It's hard to make time for that. However, I strongly believe that you would significantly benefit from increasing your physical activity and that specifically it could help to improve your mood. Physical activity is a powerful tool to improve your physical AND mental health. A peer-to-peer Physical Activity Counselling program has just been implemented here at the University of Ottawa and I believe that this service could benefit you physically and may help to improve your depressive symptoms. The Physical Activity Counselling program involves 30-60 minute individual sessions, every 1-2 weeks where a specialist in physical activity will help you to overcome barriers which may be preventing you from being physically active. Counsellors will also help increase your motivation and help you to develop and reach your physical activity goals. In addition to this service, the researchers who developed the program are assessing the effectiveness of the program through a study. The data collected in the study will remain completely anonymous and confidential. Participation in the study is completely voluntary and is NOT mandatory in order to receive counselling. If you would like to receive Physical Activity Counselling but do not want to participate in the study, you will still receive the same quality of care from both myself and from the Physical Activity Counsellors. It is completely your decision whether or not you would like to receive this free service, and if you choose not to, we can continue to discuss other treatment options to help improve your current depression."

If Patient Wants to Receive Counselling: “I think physical activity is so important for you and can help to improve your mood. I am going to refer you to the peer-to peer Physical Activity Counselling program. The contact information to set up an appointment is provided at the bottom of this prescription pad (Appendix B). It will be your choice to book appointments and your choice to participate in the research study. If you choose to participate in the study, you may withdraw at any point and there will be no negative consequences” The doctor will provide the patient with both the prescription pad (Appendix B) with the referral to receive Physical Activity Counselling and with the recruitment poster (Appendix E) for the patient to consider whether or not they would like to participate in the study as well.

If Patient Does Not Want to Receive Counselling: “There are many other forms of treatment I can suggest to help improve your mental health. I will ensure that you receive the best care possible.” The doctor will help the patient choose a more suitable treatment option to help improve their current level of depression.

Appendix F- Exercise Prescription Referral Pads



Exercise prescription & referral

Name _____

Date _____ Age _____

Relevant diagnoses _____

REDUCE SEDENTARY BEHAVIOUR

Move more / Sit less / Use stairs / Limit screen time

PHYSICAL ACTIVITY RECOMMENDATIONS

AEROBIC / CARDIOVASCULAR ACTIVITY

Frequency	2 3 4 5 6 7 days / week
Intensity	Light Moderate Vigorous
Time	10 15 20 30 40 more minutes / session
Type	

STRENGTH / RESISTANCE ACTIVITY

2 3 4 5 6 7 days / week

Example

CANADIAN PHYSICAL ACTIVITY GUIDELINES FOR ADULTS 18 YEARS AND OLDER

To achieve health benefits, adults aged 18 years and older should accumulate at least 150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of 10 minutes or more. It is also beneficial to add muscle and bone strengthening activities using major muscle groups, at least 2 days per week. More physical activity provides greater health benefits.

REFERRAL FOR ADDITIONAL EXERCISE ASSESSMENT AND COUNSELING

Name / Contact _____

Follow-up / Other _____

YOUR HEALTH PROFESSIONAL

Name Signature Licence #

WHAT DO WE KNOW ABOUT EXERCISE?

- **Exercise will make you feel good and can be fun!**
- **Exercise is effective.** If exercise was a drug, it would be one of the most effective and safe ways to prevent and treat many chronic diseases such as heart disease, hypertension, diabetes, osteoporosis, anxiety disorders and depression!
- **Exercise is safe for your joints.** Regular low impact exercise and gradual muscle strengthening can stabilise and protect your joints from osteoarthritis and reduce the risk of falls and injuries that is associated with poor physical fitness.
- **Improving fitness is more important than losing weight.** Low cardiovascular fitness is associated with a much higher risk of disease and death than being overweight.
- **Walking is free anywhere and any day of the year!**

WHAT ABOUT AEROBIC INTENSITY AND MUSCLE STRENGTHENING?

How can I assess intensity?

- **Light exercise will usually not cause adults to sweat and breathe harder.** It is easy to have a conversation at this intensity. Walking is the typical example of light exercise.
- **Moderate-intensity exercise will cause adults to sweat a little and breathe harder.** It is possible to have a conversation in short sentences. Examples are brisk walking (as if you are late for the bus!) and bike riding.
- **Vigorous-intensity exercise will cause adults to sweat and be "out of breath".** It is difficult to have a conversation. Examples are jogging, swimming laps, cross-country skiing and hiking on hills.

What is strength and resistance exercise?

- Strength and resistance exercises make your muscles work harder by adding weight or resistance to the movement.

For more information

You can consult your health professional, an exercise professional or visit the Resources page on **exerciseismedicine.ca**.

CASEM ACMSE

THE COLLEGE OF FAMILY PHYSICIANS OF CANADA / LE COLLÈGE DES MÉDECINS DE FAMILLE DU CANADA

CSEP | SCPE
THE GOLD STANDARD IN EXERCISE SCIENCE AND PERSONAL TRAINING

Canadian Physiotherapy Association / Association canadienne de physiothérapie

RCCSS (CANADA)
ROYAL COLLEGE OF CHIROPRACTIC SPORTS SCIENCES (CANADA)
COLLEGE ROYAL DES SCIENCES SPORTS CHIROPRACTIQUE (CANADA)

Appendix G- Recruitment Posters

Do you sometimes want to be more physically active but feel like you lack the time, motivation and/or skills to go through with it?

Physical Activity Counselling can help you overcome these barriers and achieve your physical activity goals!

If you are a female, between the ages of 18-24, a full time undergraduate student, are inactive/slightly active and are experiencing symptoms of depression:

Book an Appointment by E-mail With Taylor McFadden: pac-cap@uottawa.ca

BOOK NOW as spaces are limited and participants will be selected on a first come/first served basis!

Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca Pac-cap@uottawa.ca

Est-ce que vous songez parfois à devenir plus actif physiquement? Est-ce qu'un manque de temps, de motivation et/ou d'habiletés vous empêche d'aller de l'avant?

Le counselling en activité physique peut vous aider à surmonter ces barrières et à atteindre vos objectifs de mise en forme!

Si vous êtes une femme âgée de 18 à 24 ans ET;
Que vous êtes une étudiante universitaire au premier cycle inscrite à temps plein, que vous êtes inactive ou peu active physiquement et que vous éprouvez des symptômes liés à la dépression:

Réservez un rendez-vous par courriel à:
Taylor McFadden: pac-cap@uottawa.ca
Premier arrivé, premier servi! RÉSERVEZ DÈS AUJOURD'HUI car les places sont limitées!
Le counselling en activité physique est offert en Anglais seulement.

Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca | Pac-cap@uottawa.ca

Appendix H- The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+)

Regular physical activity is fun and healthy, and more people should become more physically active every day of the week. Being more physically active is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

Section 1: General Health

Please read the 7 questions below and carefully answer each one honestly: check YES or NO.		**YES**	**NO**
1.	Has your Doctor ever said that you have a heart condition OR high blood pressure?		
2.	Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?		
3.	Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Please answer NO if your dizziness was associated with over-breathing (including during vigorous activity).		
4.	Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)?		
5.	Are you currently taking prescribed medications for a chronic medical condition?		
6.	Do you have a bone or joint problem that could be made worse by becoming more physically active? Please answer NO is you had a joint problem in the past, but it does not limit your current ability to be physically active. For example, knee, ankle, shoulder or other.		
7.	Has your doctor ever said that you should only do medically supervised physical activity?		

If you answered NO to all of the questions above, you are cleared for physical activity.

- Go to Section 3 to sign the form. You do not need to complete Section 2.
- Start becoming much more physically active- start slowly and build up gradually.
- Follow the Canadian Physical Activity Guidelines for your age (www.csep.ca/guidelines).
- You may take part in a health and fitness appraisal.

- If you have any further questions, contact a qualified exercise professional such as a CSEP Certified Exercise Physiologist (CSEP-CEP) or CSEP Certified Personal Trainer (CSEP-CPT).

If you answered YES to one or more of the questions above, please go to Section 2.

Delay becoming active if:

- You are not feeling well because of a temporary illness such as a cold or fever—wait until you feel better
- You are pregnant – talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the PARmed-X for Pregnancy before becoming more physically active OR
- Your health changes—please answer the questions on Section 2 of this document and/pr talk to your doctor or qualified exercise professional (CSEP-CEP or CSEP-CPT) before continuing with any physical activity programme.

Section2: Chronic Medical Conditions

Please read the questions below carefully and answer each one honestly: check YES or NO			YES	NO
1.	Do you have Arthritis, Osteoporosis, or Back Problems?		If yes, answer questions 1a-1c	If no, go to question 2
	1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)		
	1b.	DO you have joint problems causing pain, a recent fracture, or fracture caused by osteoporosis or cancer, displaced vertebra (e.g. spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?		
	1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?		
2.	Do you have Cancer of any kind?		If yes, answer questions	If no, go to question 3

			2a-2b	
	2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of the plasma cells), head, and neck?		
	2b.	Are you currently receiving cancer therapy (such as chemotherapy or radiotherapy)?		
3.	Do you have Heart Disease or Cardiovascular Disease? This includes Coronary Artery Disease, High Blood Pressure, Heart Failure, and Diagnosed Abnormality of Heart Rhythm.		If yes, answer questions 3a-3e	If no, go to question 4
	3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)		
	3b.	Do you have an irregular heart beat that requires medical management? (e.g. atrial fibrillation, premature ventricular contraction)		
	3c.	Do you have chronic heart failure?		
	3d.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer YEWS if you do not know your resting blood pressure)		
	3e.	DO you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?		
4.	Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes		If yes, answer questions 4a-4c	If no, go to question 5
	4a.	Is your blood sugar often above 13.0 mmol/L? (Answer YES if you are not sure)		
	4b.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease		

		and/or complications affecting your eyes, kidneys, and the sensation in your toes and feet?		
	4c.	Do you have other metabolic conditions (such as thyroid disorders, pregnancy-related diabetes, chronic kidney disease, liver problems)?		
5.	Do you have any Mental Health Problems or Learning Difficulties? This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome)		If yes, answer questions 5a-5b	If no, go to question 6
	5a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)		
	5b.	Do you also have back problems affecting nerves or muscles?		
6.	Do you have a Respiratory Disease? This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure		If yes, answer questions 6a-6d	If no, go to question 7
	6a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)		
	6b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?		
	6c.	If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week?		
	6d.	Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?		

7.	Do you have a Spinal Cord Injury? This includes Tetraplegia and Paraplegia		If yes, answer questions 7a-7c	If no, go to question 8
	7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)		
	7b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?		
	7c.	Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?		
8.	Have you had a stroke? This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event		If yes, answer questions 8a-8c	If no, go to question 9
	8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)		
	8b.	Do you have any impairment in walking or mobility?		
	8c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?		
9.	Do you have any other medical condition not listed above or do you live with two chronic conditions?		If yes, answer questions 9a-9c	If no, read the advice below
	9a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months OR have you had a diagnosed		

		concussion within the last 12 months?		
	9b.	Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?		
	9c.	Do you currently live with two chronic conditions?		

If you answer NO to all of the follow-up questions about your medical condition, you are ready to become more physically active.

- It is advised that you consult a qualified exercise professional (e.g., a CSEP-CEP or CSEP-CPT) to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually – 20-60 min. of low-to-moderate-intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate-intensity physical activity per week.

If you answered YES to one or more of the follow-up questions about your medical condition:

- You should seek further information from a licensed health care professional before becoming more physically active or engaging in a fitness appraisal and/or qualified exercise professional (CSEP-CEP) for further information.

Delay becoming active if:

- You are not feeling well because of a temporary illness such as a cold or fever—wait until you feel better
- You are pregnant – talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the PARmed-X for Pregnancy before becoming more physically active OR
- Your health changes—please answer the questions on Section 2 of this document and/or talk to your doctor or qualified exercise professional (CSEP-CEP or CSEP-CPT) before continuing with any physical activity programme.

Section 3: Declaration

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The Canadian Society for Exercise Physiology, the PAR-Q+ Collaboration, and their agents assume no liability for persons who undertake physical activity. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.
- Please read and sign the declaration below:

  I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that a Trustee (such as my employer, community/fitness centre, health care provider, or other designate) may retain a copy of this form for their records. In these instances, the Trustee will be required to adhere to local, national, and international guidelines regarding the storage of personal health information ensuring that they maintain the privacy of the information and do not misuse or wrongfully disclose such information.

NAME _____ DATE _____

SIGNATURE _____ WITNESS _____

For more information, please contact: Canadian Society for Exercise Physiology www.csep.ca

Appendix I- Patient Health Questionnaire (PHQ-9)

Over the <u>last 2 weeks</u>, how often have you been bothered by any of the following problems?

	Not at all (0)	Several days (1)	More than half the days (2)	Nearly every day (3)
1. Little interest or pleasure doing things				
2. Feeling down, depressed, or hopeless				
3. Trouble falling or staying asleep, or sleeping too much				
4. Feeling tired or having little energy				
5. Poor appetite or overeating				
6. Feeling bad about yourself- or that you are a failure or have let yourself or your family down				
7. Trouble concentrating on things, such as reading the newspaper or watching television				
8. Moving or speaking so slowly that other people could have noticed? Or the opposite- being so fidgety or restless that you have been moving around a lot more than usual				
9. Thoughts that you would be better off dead or of hurting yourself in some way				
Total Score=				

If you checked <u>any</u> problems, how <u>difficult</u> have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult

Appendix J- Godin Leisure-Time Exercise Questionnaire (LTEQ)

1. **During a typical 7-Day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time (write on each line the appropriate number).**
   a. **STRENUOUS EXERCISE (HEART BEATS RAPIDLY)** (e.g. running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

      Times per week _____

   b. **MODERATE EXERCISE (NOT EXHAUSTNG)** (e.g. fast walking, baseball,, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

      Times per week _____

   c. **MILD EXERCISE (MINIMAL EFFORT**) (e.g. yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)

      Times per week _____

2. **During a typical 7-Day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?**

   a. Often ☐

   b. Sometimes ☐

   c. Never/Rarely ☐

Scoring Instructions:

Screening Score= (9 x strenuous) + (5 x moderate)

Tertiary Measure Score= (9 x strenuous) + (5 x moderate) + (3 x mild)

Appendix K- Positive and Negative Affect Scale (PANAS)

Indicate to what extent you feel this way right now, that is, at the present moment.

1	2	3	4	5
Very Slightly or Not at All	**A Little**	**Moderately**	**Quite a Bit**	**Extremely**

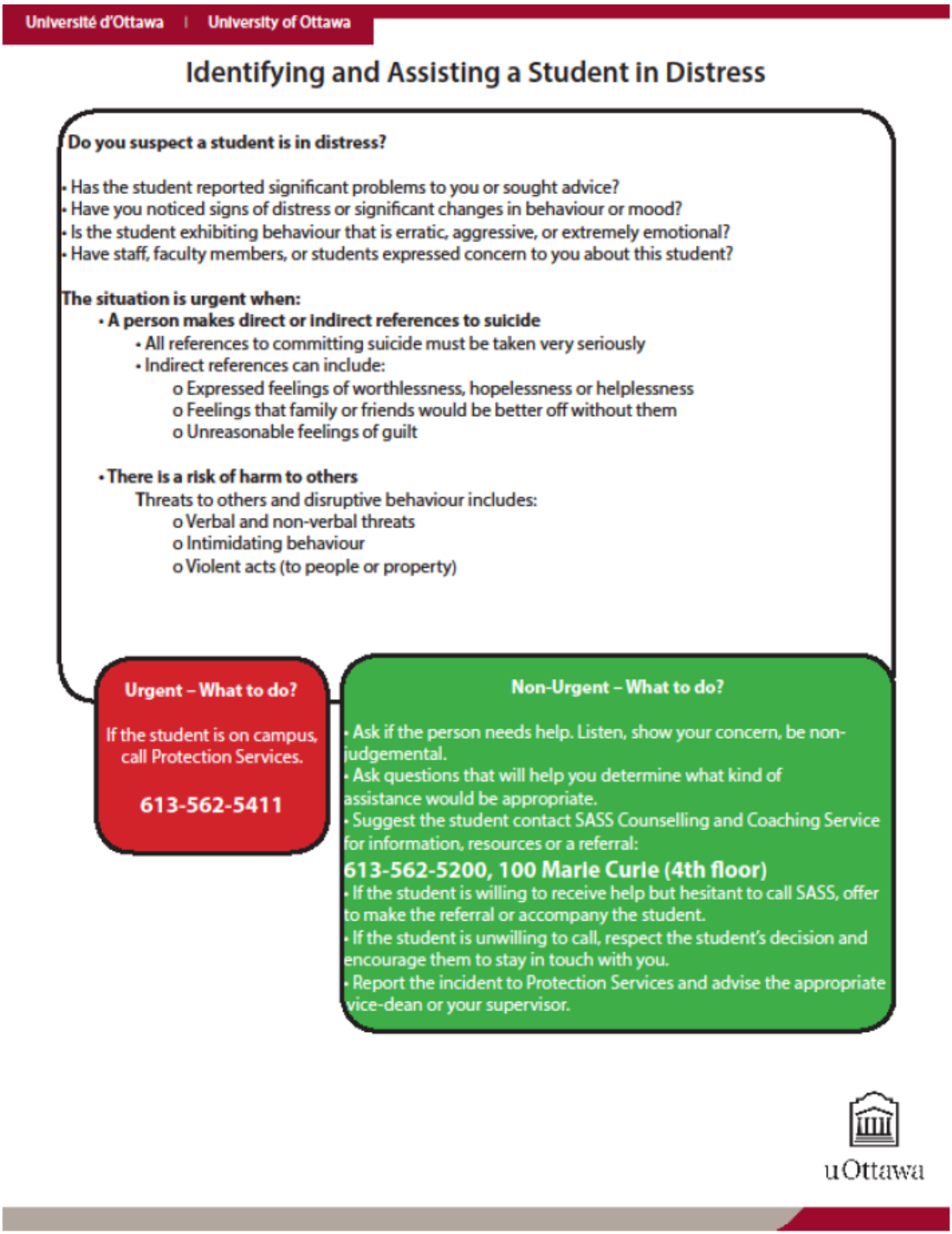
1. Interest _____	11. Irritable _____
2. Distressed _____	12. Alert _____
3. Excited _____	13. Ashamed _____
4. Upset _____	14. Inspired _____
5. Strong _____	15. Nervous _____
6. Guilty _____	16. Determined _____
7. Scared _____	17. Attentive _____
8. Hostile _____	18. Jittery _____
9. Enthusiastic _____	19. Active _____
10. Proud _____	20. Afraid _____

Scoring Instructions:

Positive Affect Score: Add all scores on items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19. Scores can range from 10-50, with higher scores representing higher levels of positive affect.

Negative Affect Score: Add the scores on items 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20. Scores can range from 10-50, with lower scores representing lower levels of negative affect.

Appendix L- Identifying and Assisting a Student in Distress



Université d'Ottawa | University of Ottawa

Identifying and Assisting a Student in Distress

Do you suspect a student is in distress?

- Has the student reported significant problems to you or sought advice?
- Have you noticed signs of distress or significant changes in behaviour or mood?
- Is the student exhibiting behaviour that is erratic, aggressive, or extremely emotional?
- Have staff, faculty members, or students expressed concern to you about this student?

The situation is urgent when:

- **A person makes direct or indirect references to suicide**
  - All references to committing suicide must be taken very seriously
  - Indirect references can include:
    - Expressed feelings of worthlessness, hopelessness or helplessness
    - Feelings that family or friends would be better off without them
    - Unreasonable feelings of guilt
- **There is a risk of harm to others**

  Threats to others and disruptive behaviour includes:
  - Verbal and non-verbal threats
  - Intimidating behaviour
  - Violent acts (to people or property)

Urgent – What to do?

If the student is on campus, call Protection Services.

613-562-5411

Non-Urgent – What to do?

- Ask if the person needs help. Listen, show your concern, be non-judgemental.
- Ask questions that will help you determine what kind of assistance would be appropriate.
- Suggest the student contact SASS Counselling and Coaching Service for information, resources or a referral:

613-562-5200, 100 Marie Curie (4th floor)

- If the student is willing to receive help but hesitant to call SASS, offer to make the referral or accompany the student.
- If the student is unwilling to call, respect the student's decision and encourage them to stay in touch with you.
- Report the incident to Protection Services and advise the appropriate vice-dean or your supervisor.

uOttawa

Emergency services

Situation	On campus	Off campus
Suicide – *Threat or attempt*	Protection Services 613-562-5411 (24/7) Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950	Emergency 911
Suicide – *Suicidal thoughts*	Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950	Crisis line (24/7) *Within* Ottawa 613-722-6914 *Outside* Ottawa 1-866-996-0991
Emotional crisis	Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950 Peer Support Phone line (7 p.m. to 1 a.m.) 613-562-5604	Crisis line (24/7) *Within* Ottawa 613-722-6914 *Outside* Ottawa 1-866-996-0991
Sexual assault	Protection Services 613-562- 5411 (24/7) Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950	Emergency 911 Ottawa Hospital Assault Treatment Program 613-738-3762 Ottawa Rape Crisis Centre 613-562-2333 Ottawa Coalition to End Violence Against Women (www.octevaw-cocvff.ca)

Physical assault / Domestic abuse	Protection Services 613-562-5411 (24/7) Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950	Emergency 911 Assaulted Women's Helpline 1-866-863-0511 Ottawa Coalition to End Violence Against Women (www.octevaw-cocvff.ca)
Drug and Alcohol	Protection Services 613-562-5411 (24/7) Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950	Drug & Alcohol Helpline 1-800-565-8603 www.drugandalcoholhelpline.ca
Problem Gambling	Protection Services 613-562-5411 (24/7) Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950	Ontario Problem Gambling 1-800-230-3505 www.problemgamblinghelpline.ca
Mental Health	Protection Services 613-562-5411 (24/7) Counselling and Coaching Service 613-562-5200 Health Services Clinic 613-564-3950	Good2Talk 1-866-925-5454 www.good2talk.ca

IDENTIFYING AND ASSISTING STUDENTS IN DISTRESS

The University of Ottawa is committed to ensuring the health and well-being of its students and understands the importance of promoting good mental health in enabling students to achieve their full academic potential.

Faculty and staff members are often in a position to identify and assist those students who may be experiencing emotional distress. This document is designed to assist the University community in recognizing the signs of emotional distress and to provide its members with guidelines on how to respond appropriately.

HOW TO IDENTIFY A STUDENT IN DISTRESS

Signs to look for include:

- *Stated need for help*

- *Changes in behaviour*
  (Changes in usual behaviour may indicate psychological distress.)
  Examples include:
  - Withdrawal from social interactions or academic work
  - Disruptive behaviour, unexplained outbursts or irritability
  - Noticeably rapid or slow speech

- *Marked changes in mood*
  Examples include:
  - Change in mood from one class to the next
  - Expressed feelings of hopelessness or despair

- *Obvious changes in appearance*
  Examples include:
  - Noticeable weight gain or loss
  - Disheveled appearance, poor hygiene
  - Absence of facial expression

- *Difficulty communicating or apparent distortion of reality*
  (This may indicate a severe psychological problem that requires assessment and treatment of the student by a professional.)
  Examples include:
  - Irrational conversations
  - Disturbing material in academic assignments
  - Suspiciousness, a constant feeling of being watched

- *Significant changes in identity or relationships*
  Examples include:
  - Changes in family circumstances or a break-up
  - Illness or death of a family member or close friend

- *Health concerns*
  (Health issues may impede a student's progress and increase stress levels.)
  Examples include:
  - Long-term illnesses
  - Frequent short-term illnesses
  - Disordered eating

- *Serious academic concerns*
  Examples include:
  - Missed, late or incomplete assignments
  - Disorganized presentation of information
  - Plagiarism or use of unauthorized aids

- *Violence*
  Examples include:
  - Recent experience involving assault or abuse
  - Violence towards self or others

WHAT TO DO WHEN A STUDENT IS IN DISTRESS

If you are concerned about a student and you are unsure, uncomfortable or unable to intervene:

- **Contact** appropriate office before acting (Protection Services or SASS Counselling and Coaching).
- **Notify** your supervisor of your concerns.

If you decide to approach a student you are concerned about or if a student reaches out to you for help:

1. **Listen** carefully as the student describes the situation.
2. **Ask** questions to clarify whether you understand the student's specific needs.
3. **Acknowledge** and express concern.
4. **Offer hope** and reassure the student that things can get better.
5. **Discuss options** and **resources** available and suggest that the student make an appointment with SASS Counselling and Coaching or with Health Services.
6. **Give printed information** from the website or write out the name and phone number of the service(s).
7. **Arrange a follow-up** with the student to show you care and determine whether the referral was effective.

If the student appears hesitant or reluctant to make use of services:

- Offer to contact the service yourself while the student is still in your office.
- Offer to sit with the student during the initial phone call.
- Offer to accompany the student to the appointment, if appropriate, and if you're comfortable doing so.

TAKING CARE OF YOURSELF

Those of us who encounter students in distress can experience a range of emotions based on our own unique experiences and attitudes towards mental health. We can feel a deep sense of satisfaction in trying to help or we can experience frustration and anxiety. We may sometimes even feel threatened by events as they unfold.

If you experience exhaustion, sadness, anxiety, trouble sleeping or irritability, consider seeking support and counselling. Free confidential assistance is available through the University of Ottawa Employee Assistance Program (EAP). Information can be found at:
www.shepellfgiservices.com/app/isite/index.aspx?ipclient=111088&ippwd=Univ1110

CONFIDENTIALITY

When inviting students to discuss their concerns with you, it's important to be clear about the limits of your ability to keep information confidential. Even if a student insists, never promise absolute confidentiality. Rather, let them know that you'll respect their privacy to the best of your ability but that certain situations require you to inform others about the situation.

You should not withhold information about a student if:

- You have concerns about the student's physical safety.
- You have concerns about the safety of others.
- You believe the student is not competent enough to care for himself or herself.
- You have concerns about the neglect or abuse of a minor.
- The student tells you something that involves an academic or criminal offence.
- You are concerned about a situation involving a minor student (under the age of 18).

The University of Ottawa is committed to upholding the principles of the *Freedom of Information and Protection of Privacy Act* (FIPPA).

In situations where a student engages in behaviour that places the student or others at risk, the University is committed to taking steps to protect the student as well as the larger community. If you're concerned about a student, it's important that you communicate your concerns to the appropriate office or service, such as **Protection Services**, so staff can use their expertise and training to evaluate the situation and make recommendations to any other professionals or services.