THE HEALTHY STAFF INITIATIVE STUDY: EXAMINING EXERCISE, HEALTH COACHING AND MINDFULNESS MEDITATION FOR UNIVERSITY EMPLOYEES: A RANDOMIZED TRIAL

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ABSTRACT

Objective: This study evaluated the effectiveness of workplace interventions for university employees aimed at increasing overall fitness. Investigators examined the benefits of a workplace walking program (WP), health coaching (HC) and a mindfulness meditation program (WPHC+MM) combined vs. a program where subjects solely received the workplace walking program and health coaching (WPHC). **Methods**: Sixty employees from the York University, Keele Campus volunteered for participation. They were randomly assigned to one of the two 24 week programs. The weekly workplace walking program and health coaching (WPHC) was provided to both groups for the first 12 weeks and MM participation was additionally facilitated for the comparison WPHC+MM group 3 times per week for the first 12 weeks. For the remaining 12 weeks, both groups received no further structural support in terms of walking schedule or HC sessions. Participants were assessed at baseline, 3 months and 6 months on fitness measures, psychological questionnaires, and heart rate variability. **Results:** The study sample included 93% women and 80% of participants were 40 years of age or older. At baseline the mean waist circumference (WC) was 88.0 cm, mean BMI was 26.74 kg/m^2, mean weight was 71.9 kg and the mean pulse/blood pressure were 73 bpm and 122/76 mmHg respectively. Forty-seven participants were analyzed: n=22 in the WPHC+MM and n=25 for WPHC. Repeated measures ANOVA were conducted. A main effect of time analysis indicated: significant increases in VO_2 peak: $F_{(2,80)}$= 9.138, p=0.001, partial η^2= 0.186; significant increases in Five Facet Mindfulness Questionnaire (FFMQ): $F_{(2,90)}$=5.997, p=0.004, partial η^2=0.118; a significant decrease over time on the perceived stress scale (PSS) ($F_{(2,90)}$=3.857 units, p=0.033, partial η^2=0.079) and a significant decrease over time in perceptions of overall job commitment: $F_{(2,90)}$=6.158, p=0.004, partial η^2=0.120. **Conclusion:** This study found that a workplace walking

(WP), health coaching (HC) and a mindfulness meditation program (WPHC+MM) was not superior to solely walking and health coaching (WPHC) program. By study completion, employees overall, demonstrated improvements in their cardiovascular fitness/ aerobic endurance, in overall mindfulness, in perceived stress (decreases) and in perceptions of job over-commitment (decreases) when compared to the baseline assessments.

DEDICATION

I dedicate this dissertation to my wonderful husband Wilk Persaud, and my amazing children Weslyn and Wesley Persaud.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

A reduction in the prevalence of physical inactivity by adoptions of regular healthy physical activity is an important disease prevention goal (1). Increased health benefits can be best derived by motivating inactive individuals to adopt active lifestyles, as well as in appropriately increasing the activities of those already active (1). For many individuals, psychosocial stressors and negative exercise reactions (such as muscle soreness, slowly evolving exercise benefits, time constraints, etc.) derail efforts at increasing physical activity (PA) (2) and, in workplace settings, psychosocial and physical stressors are often linked to psychologically and/or physiologically demanding jobs (e.g. repetitive movement and task jobs) (3). When workplace wellness programs can increase and sustain PA adoption, they can improve the psychophysiological well-being of employees (4). Ultimately, exercise and related lifestyle effects are often aimed at reducing stressful experiences as employees learn to counteract unavoidable stressors with stress reducing activities (e.g. exercise) (4-6). Workplaces therefore can be nearly ideal settings for promoting healthy lifestyles, as employees constitute a target sample for health promotion undertaken precisely *where* multiple stressors are confronted (ie. in the workplace)(7, 8).

Exercise promotion interventions have trended towards a focus on fitness improvements and health benefits (e.g. smoking cessation, obesity), as well as reductions in disease (e,g diabetes, cardiovascular disorders). Individuals who are inactive appear less likely to become active because movement-related benefits are not readily observed and/or because they are affected by the negative side effects of exercise such as injuries or immediate bouts of reactive fatigue (9-11). In such cases, complementary stress reduction practices can assist PA adoption via multiple pathways that may include anti-inflammatory and anti-fatigue effects as well as

contemplative activities that results in in-depth considerations of exercise value and lifestyle enhancement (12).

An increasing body of research suggests mindfulness-based interventions (MBI) are associated with *physical* and *mental health* benefits (13) and, since these methods can be autonomously used, benefits can be obtained in a cost-effective manner. With mindfulness techniques, participants are encouraged to self-monitor internal states in ways that may be linked to adopting positive (lifestyle) changes (14). MBIs have been associated with anti-inflammatory effects (15-19), improvements of physical performance (20), and immediate reductions of pain (21). MBIs also appear to be effective interventions for reducing mood/anxiety difficulties and chronic stress (22, 23). Moreover, MBIs can be conducted via remote telemedicine-conveyed methods (24) and face-to-face formats (25).

2.0 BACKGROUND

A systematic search of PubMed, Scopus and Google Scholar databases was undertaken using the following terms: worksite/workplace health-promotion intervention, healthcare, employees, health coaching, exercise, physical activity, fitness, mental health, mindfulness, meditation, health coaching, VO_2 max/peak, health and wellness. N=52 trials published between 1978 and 2018 were identified and reviewed according to the aims, outcomes and design quality. Reviews of these trials informed the background data for this research study.

2.1 Workplace Exercise Program/Wellness Program Interventions

Despite the acceptance of the benefits of workplace wellness programs, implementations of workplace exercise interventions have been impeded by perceptions of insurmountable barriers to exercise adoption, excess cost and impatience with the time intervals between lifestyle changes and detectable benefits (9). Nonetheless, in the last twenty years, a movement has

emerged in many corporations to promote worksite PA to increase productivity and reduce health-related costs (4, 8). In the existing literature, workplace exercise interventions have been particularly developed to help alleviate job-associated pain (e.g. neck/shoulder and lower back pain) and to address stress-related mood problems (like depression and anxiety) (26-28). Multi-component workplace programs that combine physical activity and stress relief interventions have been designed to promote health-related behaviours using various motivational and educational approaches (4, 8).

2.2 Workplace Health and Wellness Promotion in Canada

In Canada, existing evidence indicates that 44% of Canadian employees have experienced mental health issues observed in the workplace, while only 22% have received interventions of any type from employers; this discrepancy suggests that many employers do not realize or acknowledge or act on the prevalence of mental health issues observable in the workplace (29). Nonetheless, some Canadian companies have implemented workplace health and wellness programs for employees, motivated by an accumulation of poor lifestyle habits, notably excess dietary consumptions and sedentariness, with each contributing to multiple risk elevating conditions (e.g. obesity, type 2 diabetes, cardiovascular disease and related mental health issues) (30). These partly preventable conditions cost the Canadian economy ~ $4.6 billion dollars in 2008 (30), a figure that has likely stabilized or increased since this 2008-based estimate. The workplace interventions implemented typically aim to prevent cardiovascular disorders and increase healthy life expectancy by targeting PA *and* healthier eating (30). For example, a Canadian-based Physical Activity Workplace Study (PAWS) used a 12 week intervention to increase PA in 3 governmental organizations and 2 private companies that resulted in small, but statistically significant, improvements in PA, healthy eating and self-

efficacy (30). A similar 18 month intervention at Daimler Chrysler Corporation resulted in improvements in physical activity and diet, and reductions in smoking, cumulatively reducing cardiovascular risk factors; subsequent cost-benefit analyses suggested there were substantial financial savings associated with positive program outcomes (30). Altogether, available evidence indicates that successful programs can be mounted with outcomes that reduce adverse health-related events.

2.3 Workplace Health and Wellness Interventions

Workplace interventions have generally addressed disabilities, work-related injuries, and stressors that affect employee performance, such as neck and back injuries (9, 31-33). Amongst office workers, many of the targeted health problems revolve around musculoskeletal symptoms with related interventions involving ergonomic and stress management training, workstation adjustment and strategic use of rest breaks (31). Strength (resistance) training physical activity interventions (32) have been effective in some studies in reducing neck/shoulder pain (especially in industrial and office workers) (9, 34), when a specifically-localized resistance training of the neck/shoulder regions was used (9, 31, 34).

Mental health has emerged as a particular workplace concern resulting in companies using multifaceted approaches to address mental health concerns among employees (7, 28, 35, 36). The aim of reducing psychological stress through use of health promotion interventions (physical activity, behaviour modification, cognitive behavioural therapy, meditation, emotional refocusing, addiction counselling and motivational interviewing) has shown small but significant effect sizes (28). In a 2014 systematic review of interventions designed to prevent depression in employees, nine workplace-based randomized controlled trials (RCT) were identified, with the majority utilizing cognitive behavioural therapy (CBT) techniques (35). Results showed small,

positive effects favouring the intervention group compared to the control group (Standardized Mean Difference (SMD) = 0.16, 95% CI: 0.07-0.24, p = 0.0002) (35) providing evidence that universally delivered workplace mental health interventions can reduce the level of depression symptoms in workers (19). An earlier meta-analysis of seventeen articles on health promotion workplace interventions targeting depression and anxiety also indicated small but positive intervention effects re: symptoms of depression (SMD 0.28, 95% CI 0.12–0.44) and anxiety (SMD 0.29, 95% CI 0.06–0.51) (28).

With respect to exercise training studies, results from a single RCT indicated that a 24 week aerobic and weight training exercise intervention coupled with behaviour modification (consisting of 5 exercise/healthy living seminars, scheduled in monthly hour-long health coaching meetings) with casino workers significantly improved mental health (p= 0.005), vitality (p< 0.001), general health (p = 0.009), bodily pain (p = 0.005), physical functioning (p = 0.004), depression (p = 0.048), and stress (p = 0.036) for the treatment group vs. the wait-list controls, as assessed with the Medical Outcome-Short Form-36 (SF 36) and the Depression Anxiety Stress Scale (DASS) (28, 37). Despite the positive links seen in a few studies between workplace physical activity and stress relief interventions, there has been a slow uptake of these interventions in workplace health promotion programs (27, 38, 39).

The need for these interventions is highlighted in results from the Canadian Health Measures Survey (CHMS) for 2007-2009, which indicated that only 17% men and 14% women fulfill the weekly recommendations for physical activity (40). With these statistics, it is reasonable to focus on exercise interventions at worksites as a method of addressing the low rates of adult physical activity levels (34). However, many worksite physical interventions have had difficulties showing significant increases in physical activity or fitness for employees (8, 41),

resulting in the inability of companies to attract enough employees to see benefits (41). However, a study with home care workers showed positive outcomes linked to a workplace mixed-modality aerobic/resistance intervention (of 9 months duration). The results demonstrated improvements in physical fitness, perceived health status and the prevention of declining work ability, combined with significant increases in peak VO_2 at follow-ups of one year and five years (41). In a systematic review of fifty-eight studies (2014), thirteen studies involved counselling/support interventions, while thirty-nine additional studies involved health promotion messaging interventions and six involved specific PA and exercise training, where participants engaged in walking, aerobics, muscle training and stretching programs (with the choice of medium-to-high intensity exercises) (39). These findings suggest that workplace physical activity interventions can be adopted (39). Of the six physical activity and exercise training studies, four showed post-intervention increases in PA behaviour and two involved university employees (39, 42-46). Gilson et al. evaluated workplace walking interventions (in comparison with a control group) among white-collar university employees from the UK, Spain and Australia (n = 179, age 41.3 +/- 10.1 years; 141 women) in a ten week study (42). Significant interaction effects were observed ($F= 3.5$; $p<.003$) such that route walking (968 steps/day; $t=3.9$, $p<.000$) and incidental walking (699 steps/day; $t=2.5$, $p<.014$) groups had significantly increased step numbers vs. controls, who had a decrease in steps per day (-391 step/day) (42). Lee et al. randomized 37 women aged 40-61 years to an exercise intervention (low-impact aerobic fitness combined with weekly activity and education sessions) or a wait-list control condition for a 12 week intervention, with 24 week and 48 week follow-ups (46). While significant arterial pressure and body composition benefits were observed at 12 and 24 weeks, they were not maintained at 48 week follow up (46). In general, wellness interventions have been shown to be

successful when conducted at the workplace, especially when they are fitness oriented, indicating potential benefits if such programs were instituted more widely.

2.4 Health Coaching for Workplace Exercise Uptake

In efforts to improve outcomes in workplace-employee interventions, health coaching (HC) has emphasized chronic disease management and prevention through health-behaviour change. Mobile technologies complement HC in enabling multiple channel contact via remote monitoring, voice and text communications (47). In proportion to employee/participant and employer decisions on the intensity/frequency/duration of contacts with a health coach (HC), the HC can detect lapses in adherence and initiate supportive-corrective responses while the non-adherence pattern is still unfolding. Reminder and reinforcement messages of different kinds can be sent to participants at any hour of day/evening, enabling interactions strategically blended with the participant's daily lifestyle. The results from a three month motivational interviewing health coaching intervention (two-arm, non-randomized design, as part of an employee wellness program (EWP)) showed that the treatment group (n=145) had improvements on the SF-12 with significant findings on both the physical and mental health composite score (1.69 points, $p=0.035$; and 4.40 points, $p< .0001$, respectively) when compared to the (non-randomized) controls (n=131) (48). Pro-active awareness, motivational enhancement and skill building in combination are key elements in the HC process (49).

Telephone based health coaching has also been found to result in significant improvements in various behaviour change activities such as: a) self-reported medication adherence; b) physical activity behaviour which foster reductions in stress and health risks in combination with increases in perceived and actual health status (39, 50-54). With these

findings, implementing an HC component in a workplace physical activity program could result in a more consistent and effective guidance of employees.

2.5 Heart Rate Variability

Stressful situations in workplace environments can result in the body releasing stress-related responses that negatively affect the functioning of the endocrine, immune and cardiovascular systems (55). Heart Rate Variability (HRV), which is the beat-to-beat variation in the R-R wave interval, can reflect heart health and personal adaptation to different stress exposures and ongoing stress loads (56, 57). HRV has been commonly used as a non-invasive technique for examining sympathetic/parasympathetic nervous system effects on the heart, while assessing changes in autonomic cardiac regulation aimed at identifying the health/disease status and exercise effects on individuals (56-59). As an indicator of autonomic cardiac activity, HRV is used as an index of changes in sympathovagal function, at rest and under specified conditions (60, 61). In contrast to stressful states, more self-regulated states are typically associated with: increased HRV largely attributed to respiration-based (parasympathetic) HR control, in turn, attributable to respiratory stimulation of vagus nerve activity (62, 63). Reduced HRV under resting conditions is associated with increased mortality, cardiovascular disease and anxiety/depressive conditions (57, 64-66).

A growing literature reflects associations between increased HRV and enhanced attention/self-regulation (67-69) and use of meditation techniques (70, 71). In a study that compared the responses of maladaptive perfectionists, with the responses of normal controls after exposures to an artificial stressor, significant increases in HRV (in controls) and significant between group differences in HRV (perfectionists vs. controls) were observed after exposure to 10 minutes of mindfulness meditation instruction, with the main focus on exhalation-based

stimulation of vagus nerve, increases on vagal tone and reduced heart rate (beat to beat) through parasympathetic dominance (72). Another study that examined meditation, learned within a MBSR course, and HRV, indicated that participants who engaged in the MBSR approach had improved sympatho-vagal balance when compared to controlled respiration alone, as measured by HRV (73). For patients with poor health prognosis (e.g. chronic heart failure, myocardial infarction, coronary artery disease, diabetes), a review of nineteen studies analyzing exercise therapy effects indicated that supervised and unsupervised exercise programs of variable intensities were associated with increases in HRV (74).

On the other side of the spectrum HRV measures have been implemented in fitness studies as beat-to-beat analyses are indicative of overall health, and regulation of autonomic balance, blood pressure and vascular tone (75). In fact, HRV is used as a non-invasive measure for evaluating cardiovascular and autonomic nervous system functioning through tests that involve responding to deep breathing, valsalva manoeuvres, and an orthostatic testing protocol(76). A study of endurance exercise training for young (mean=28 years old) and older (mean= 68 years old) men revealed that the older men had 47% lower HRV than the young men at baseline (rest). But after 6 months of intensive aerobic exercise training (4-5 times per week and bouts of 45 minutes of exercise with 3, 10-minute stretches, warm-up and cool-down practices) both groups demonstrated decreases in heart rate (9 beats/min), increases in HRV at rest (older men had a 68% increase, younger men had a 17% increase), and increases in parasympathetic tone at rest (77). In terms of time domain HRV in relation to age and gender, it was observed that HRV decreases with age, and men younger than 50 are more likely to have higher HRV than age-matched women (78). A review of several supervised and unsupervised exercise therapy programs of varying intensities have increased HRV, especially in individuals

with cardiovascular disease and diabetes; with cumulative data suggesting that exercise increases vagal modulation and decreases sympathetic tone (74). A study from a review, undertaken by Sandercock et al., investigated changes in HRV after an eight week cardiac rehabilitation program for patients and an equivalent control group, and results indicated that, compared to controls, significant increases were seen in SDNN, HF (ln), LF (ln) and R-R interval from pre-to-post assessments (74, 79).

In summary, the above findings support the exploration of stress-regulation practices that may be associated with increases in HRV. Given the importance of attention regulation and mindfulness in current psychotherapeutic approaches, more evidence is needed to support the hypothesis that mindfulness training can assist individuals in regulating cardiovascular stress responses, especially in combination with moderate-to vigorous exercise effects that also appear to be associated with increases in HRV.

2.6 Benefits of Workplace Wellness Programs

Health promotion is related to disease prevention in that it elicits better present and future health through behaviour change (80). Employee benefits, along these lines, can be obtained through programs sponsored by employers directly, or through group health plans that are often labeled 'workplace wellness' programs whether multi-component programs or single component interventions (80). It is suggested that participating in wellness programs for over five years is associated with trends towards lower health care costs and health care with a return on investment of $3.27 for every dollar invested (in the wellness programming) (80, 81). Hence, several studies have indicated that employers are willing to offer incentives to their employees as a means of reducing the costs to the health insurance they subsidize (80-84). In a study focused on the offering of health benefits to employees, 77% of all firms (large and small) indicated that

they would offer at least one wellness program (a weight loss program, gym membership discount or on-site exercise facility, smoking cessation program, personal HC, classes in nutrition or healthy living, biometric screening, web-based resources for healthy living, a wellness newsletter, flu shots or vaccinations, or an employee assistance program) to employees, while 10% of all firms would offer financial incentives for health benefits, wellness programs and or wellness incentives; larger firms indicated larger percent offerings for wellness programs and health benefits (82).

Wellness programs appear to function best when employers adopt health promotional programs that suit their goals as a company and fit the organizational climate of the company (85). Organizations have been the most concerned with employee stress as it is the most impactful on work performance, productivity, turnover, job satisfaction and absenteeism; therefore organizational wellness programs targeting reductions in stress have received the most attention (86, 87).

2.7 Benefits of Mindfulness and Interaction with Exercise

An increasing body of research shows that MBIs are generally associated with physical and mental health benefits (13, 88). Through mindfulness techniques, participants are encouraged to generate and maintain an 'open, peaceful mind' that is relatively free of conflicting thoughts, leading to greater abilities to foster self-acceptance and positive change (14). Although mindfulness training has been embedded in religious, cultural and philosophical traditions, the training is now conveyed and practiced independently of religious, philosophical or cultural affiliations (89). Mindfulness, as a secular practice, as popularized by Kabat-Zinn, emphasizes the cultivation of non-judgmental awareness and 'being in the present moment' using practical, scalable methods (89, 90).

MBIs are linked to improved attention, memory and executive functions in neuropsychological and neurophysiological studies (22). MBIs have also been demonstrated to be effective interventions for mood/anxiety difficulties along with the achievement of significant reductions in sub-clinical levels of stress reduction (22, 23). MBIs are associated with significant improvements in psychological functioning in a range of populations (13, 89, 91).

Employers who provide education-based, stress reduction programs may financially benefit from reductions in workplace stress-related illness (92). Work-related stress appears to account for approximately 40% of all work-related illness, with 69% of American employees reporting that their work experiences are a main source of stress and 41% reporting 'feeling stressed out' during workdays (93). In a workplace randomized study investigating work-related wellbeing and job performance, using meditation awareness training coupled with mindfulness practices (among office-based middle-hierarchy managers), researchers found sustained and significant improvements in work-related stress, job satisfaction, psychological distress and employer-related job performance (93). With MBIs advocated by American Psychiatric Association (APA) and National Institute for Health and Clinical Excellence as a beneficial treatment for specific forms of depression in adults, its administration in relation to workplace stress is being recognized as a viable option (93).

While the general benefits of MBIs have focused on mood, anxiety and stress reduction (94, 95), the specific benefits of MBI in promoting exercise have been relatively understudied. In combination with a series of reported mindfulness anti-inflammatory effects (15-19) and immediate pain reduction effects (that differ in mechanism from placebo effects) (21), mindfulness seems to qualify as a promising adjunctive intervention in exercise promotion. As aerobic activity has a reliable anti-inflammatory effect, over the long term, its combination with

mindfulness can create a healthy reduction of inflammation that appears protective of neurodegenerative disease and cardiovascular and diabetes related disease (96). MBIs are also effective interventions for mood/anxiety difficulties that could impede exercise adoption at subclinical levels as linked to addictive tendencies and inabilities to adapt to chronic stress (22, 23).

There is a paucity of research identifying the independent effect of mindfulness on fitness and only recently have there been specific findings that suggest a synergistic effect when meditation is combined with exercise (97). Essentially, increasing aerobic activity and increasing mindfulness can be separately beneficial but there may also be an interactive physiological and psychological change that can help increase physical activity. Studies show that additive benefits emerge when participants learn to modify cognitions and affective responses to internal sensations during physical activity (98, 99); and in doing so, learn to reduce the impact of negative thoughts and body sensations associated with behaviour change (adopting physical activity) and not attaining goals (98-100). A study that examined the impact of a ten week mindfulness and walking program on cardiorespiratory fitness (as measured by VO_2 max) on twenty-four sedentary adults indicated that the incorporation of mindfulness based therapy to a fitness walking program resulted in a significant decrease in time when completing the Rockport 1-mile ($t(18)=4.61$, $p=.0002$, $d=.64$) and a significant increase in estimated VO_2 max ($t(18)=-4.05$, $p=.0007$, $d=-.43$)(101). Another study that focused on the direct effects of a weekly two hour MBI program over eight weeks on various physiological measures (including submaximal exercise testing) on eighteen randomized female heart disease patients, indicated no significant differences between the intervention and the control group, although the intervention group had lower ventilation and breathing frequency and increased tidal volume when compared

to the controls (102). Still another study that examined therapeutic approaches to facilitate movement for six female arthritic participants indicated that a daily series of mindfulness, resistance, massage, Tai Chi and various whole body interactive programs were not significant in improving VO_2 amongst the women assessed. However, the six minute walk test speed and distance covered were significantly increased (103). The diversity and modest sample sizes in these studies (with clinical and non-clinical populations) aimed at examining the effects of increases in mindfulness states and their impact on physical fitness (as measured by peak VO_2 testing) is associated with varying results, contributing to the inconsistencies observed in a sparse literature. Mindfulness has its separate physiological benefits to decreasing blood pressure, inflammation, stress and cardiovascular disease; while increasing HRV and parasympathetic tone (97). However, in conjunction with physical activity, mindfulness, which is the awareness of the present moment in a non-judgmental way, can be an effective motivator and moderator to increasing physical fitness (VO_2) by decreasing negative cognitions, cognitive distortions and perceived stress associated with behaviour change (99, 100).

While the independent benefits of fitness/exercise based programs and mindfulness programs in workplaces have been explored, there are inconclusive results when these types of programs are combined. Therefore, addressing the combination of mindfulness and fitness programming is a strategic next step in better understanding the impacts that mindfulness can have on fitness and that fitness can have on mindfulness.

3.0 RATIONALE AND OBJECTIVES

There is great potential in implementing workplace health and wellness programs, but more randomized trials are needed to determine which interventions are worksite-effective in decreasing inactive behaviours and increasing healthy lifestyle engagement (104). For

employers, effective interventions could improve the health and productivity of employees (105). For workers, especially those in physically and/or psychologically demanding positions, it could mean developing strength, endurance and agility to reduce musculoskeletal pain while developing the stress reduction skills that reduce long-term sickness and absenteeism (3). While changing behaviour in a complex workplace can be difficult due to the potential needs to change workplace and organizational culture between employers and employees (105), the study goal was to identify the effectiveness of workplace interventions (WPHC and WPHC+MM) that minimally impact workplace culture but aim to increase overall work fitness.

Given the limited research in mindfulness meditation used in combination with a cardiorespiratory fitness intervention, especially as a workplace intervention, the aim was to contribute to a developing research literature. With the lack of studies targeting the mind-body interactions reflected in mindfulness and fitness training, the goal was to determine whether the addition of mindfulness and supportive health coaching improves the benefits of a walking program for employees, who were interested in positive behaviour change.

3.1 Specific Objectives and Hypothesis

Given preliminary evidence that walking, health coaching and mindfulness are independently effective health intervention components, the aim was to better understand their potential combined benefits. We hypothesize that a synergistic effect between mindfulness and physical activity will emerge, with mindfulness providing an additive benefit to physical activity, With the initiation of mindfulness and VO_2 peak testing outside of workplace environments, the goal was to identify to what extent mindfulness impacts the effects of a walking promotion intervention when participants are monitored by a coach in a workplace setting. The effects of Workplace Health Coaching + Mindfulness (WPHC + MM) were compared to Workplace

Health Coaching (WPHC) alone on VO2 peak, HRV, anthropometric measures, and self-report questionnaires

Objective 1- VO_2 Peak Program Benefits: The primary objective was to determine if the combined WPHC+MM program was more effective than the WPHC program in terms of positive changes in cardiovascular fitness (peak VO_2). Secondary cardiovascular fitness objectives included positive changes to BMI, WC, weight, resting pulse, and blood pressure.

Hypothesis1A: As engagement in physical activity and mindfulness have independently and collectively been associated with physical and psychological health improvements, it was hypothesized that the WPHC+MM program would be superior to the WPHC program alone as manifested in significant between-group differences in VO_2 peak. Additional significant changes in BMI, WC, weight, resting pulse, and blood pressure were also hypothesized to be associated with WPHC+MM when compared to WPHC alone.

Objective 2- HRV Program-Related Benefits: The secondary objective was to determine if the combined (WPHC+MM) program was more effective than the WPHC program alone as indicated by more positive changes in heart rate variability in response to WPHC+MM vs. the WPHC program alone.

Hypothesis 2A: Engagements in physical activity and mindfulness have been independently associated with improvements in HRV outcomes. It was hypothesized that the combined WPHC+MM intervention would be associated with significantly greater benefits in HRV outcomes, (e.g. increases in the vagal tone, and R-R interval measures) when compared to the benefits derived from WPHC alone.

Objective 3- Psychological Program Benefits: The tertiary objective was to determine if the combined (WPHC+MM) program was more effective than the WPHC program alone in terms of

positive changes in self-reported stress, depression, anxiety, leisure time physical activity, mindfulness, and job over-commitment (effort-reward imbalance/over-commitment to the job).

Hypothesis 3A: It was hypothesized that the combination of WPHC+MM would result in greater increases in overall mindfulness and leisure time physical activity and decreases in anxiety, depression, perceived stress and effort/over-commitment to the job when compared to the effects of WPHC alone.

4.0 METHODS

4.1 Ethics and Consent Form

A guideline for this study was approved by the Research and Ethics Board at York University. The Consent Form for the intervention is in **Appendix A**. Notification of our study is registered with clinical trials (NCT02936726), a service of the U.S. National Institutes of Health.

4.2 Study Setting

Participants were recruited from York University Keele Campus, Toronto Ontario. Study testing occurred on campus.

4.3 Participants

Subjects were employees of York University who volunteered for research participation. After assessment on specific eligibility criteria, participants were randomly allocated (WPHC = 30, WPHC+MM = 30). Subjects were randomized through use of a randomized sequence generator (106). The sequence was determined prior to recruitment of all 60 participants.

Inclusion/ Exclusion Criteria

Inclusion Criteria: i) Employees at York University; ii) fluency in English; iii) provision of informed consent

Exclusion Criteria: i) engaged in regular exercise programs or routines that exceed the Canadian Physical Activity Guidelines of 150 minutes of moderate to vigorous physical activity per week, ii) musculoskeletal co-morbidities inhibiting participation in exercise program; iii) > 65 years old; iv) medical history of cardiovascular diseases such as Coronary Artery Disease – Congestive Heart Failure and uncontrolled hypertension v) currently engaged in a mindfulness meditation program or meditative practice at advanced levels (i.e. greater than 45 minutes daily); vi) not in possession of a smartphone equipped to download and deploy appropriate applications (JawBone Up and YouTube).

4.4 Recruitment

Recruitment was undertaken through HPRC approved notices and advertisements posted in the hallways of York University's Keele Campus and in the online Journal of Record called Y-File. Interested candidates made contact via email where their eligibility was determined through a series of email conversations. Eligible participants were sent an informed consent package that addressed study details, including data on expectations, benefits and risks, and they completed a Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) to determine physical activity readiness. All participants were given the opportunity to carefully review study participation requirements and address concerns and questions. With the provision of consent and medical clearance, participants were provided intake assessments based on an agreed-upon date/time and were then randomized.

5.0 PROCEDURES FOR PROGRAM IMPLEMENTATION

In this study, a workplace walking program in combination with mindfulness meditation training was compared with the workplace walking program alone. Both groups received equivalent one-on-one health coach counselling. This randomized trial (RT), followed the

Consort statement (**Figure 1**), and participants were randomly allocated to one of 2 groups: WPHC or the WPHC+MM.

Consent, refusal and drop-out rates were documented to assess subject representativeness. Reasons for refusal were recorded. Participants completed a baseline demographic profile (**Appendix A**), a physical activity questionnaire (**Appendix A**) and multiple self-report instruments on psychological function and mood (e.g. anxiety and depression) (**Appendix A**). They were fitness tested (VO_2 peak) and received various musculoskeletal measurements (**Appendix A).** Additional information collected pertained to tobacco use, and previous fitness behaviour and a PAR-Q+ (Physical Activity Readiness Questionnaire) undertaken prior to baseline fitness testing. Participants also underwent HRV testing, following an orthostatic protocol. These assessments were conducted at three different time points for participants: baseline, end of intervention {12 weeks or 3 months} and at 3 month follow-up {24 weeks or 6 months}. All participants completed questionnaires, physiological assessments and HRV testing at all three time points.

Participants followed the following testing protocol order. Upon arrival, they completed the questionnaire package, followed by the anthropometric measures (these assessments typically require 40 minutes), and cardiovascular screening measures (blood pressure and pulse). Participants then engaged in treadmill exercise in order to complete the peak VO_2 testing. When volitional maximums were reached, participants engaged in an active recovery cool down period (peak VO_2 testing duration ranged from 1-20 minutes and the active recovery cool down period extended for a standard 5 minutes). After the cool down period, participants prepared for the HRV testing. Participants were asked to expose the required regions on both wrists and the right ankle. Those areas were pat dry before the electrodes were placed [on wrists/right ankle] and the

yoga mat was set on the floor for the lying down test component. The preparation time for HRV testing required approximately 10 minutes following completion of the modified Bruce protocol treadmill test. After the 10 minute interval, participants were instructed to lie down on the yoga mat for the HRV testing (for duration of 5 minutes). After the lying down component was completed, the transition to standing upright was allocated 2 minutes; and the HRV standing test was allocated another 5 minutes in duration.

5.1 Walking Exercise Program

Participants randomized to either group underwent the same walking exercise protocol program (**Appendix B**), carried out by themselves, designed to guide and track each participant's progress in the exercise intervention over 12 weeks. Participants were asked to engage in walking on campus during work hours (time on campus) according to the requirements designated at each week. Following the 3 month assessment, participants were expected to maintain their walking for additional 12 weeks. Participants had access to the Jawbone Up application which records distance, steps and or calories covered at each walking session. The CEP (Certified Exercise Physiologist) guided and explained what appropriate exertion and intensity was safe and appropriate for each individual, according to their fitness levels, determined by the exercise testing at baseline. The aerobic walking exercise program consists of a moderate-to-vigorous intensity, aiming to achieve 60-80% of the participant's estimated heart rate maximum (from baseline assessment) or 4-8 on the Ratings of Perceived Exertion (RPE) on a 10 point scale, with intensity increasing according to their calculated target heart rate range. The walking schedule gave participants the duration and frequency of their weekly walks.

5.2 Health Coaching

Health coaches were undergraduate students in a health related discipline (Kinesiology), who attended weekly health coaching seminars. The study involved 10 health coaches who were assigned no more than 6 participants per coach on a rolling recruitment basis. A health coaching manual, training techniques and guide, developed specifically for coaches were provided to assist and motivate counselling discussions with participants **(Appendix C).** Coaches were informed of participants' health/medical condition and what group they were allocated to. They addressed various topics, but the key areas that the participant and the health coach discussed on a weekly (12 sessions) basis were difficulties getting sufficient time to walk, time management, work, stress, and healthy physical activity. Information gathered by the health coaches, was recorded on a sheet (**Appendix C**). The health coaches provided participants with the guidance and support to achieve their desired goals of the study.

5.3 Mindfulness Meditation

Participants randomized to the WPHC+MM attended sessions in person, via ADOBE CONNECT (online login), or listened to audio recordings. The sessions were led and the audio recordings were produced by Dr. Paul Ritvo. Participants were asked to engage in mindfulness training of varying durations 3 times per week for 12 weeks. Following the 3 month assessment, participants in the mindfulness group were expected to maintain their mindfulness meditation for an additional 12 weeks. The in-person sessions followed a schedule that was determined by Dr. Paul Ritvo and colleagues (**Appendix B)**. Six audio recordings varying in length were provided. (**Appendix B)**. Subjects were encouraged to select the combination of either audio, in person or online participation that were most helpful to them.

6.0 ASSESSMENT TESTING MEASURES

6.1 Demographics

Demographic data collected included: age, ethnicity, marital status, household income, education, current job position, and years at job. Additionally, sick days were asked to be reported. (**Appendix A**).

6.2 Physiological and Anthropometric Assessment Measures

Tests included primary cardiovascular screening (resting heart rate and blood pressure) (done before treadmill testing), body composition measurements (height, weight, waist circumference, and BMI), and aerobic capacity. The aerobic fitness test was a volitional maximal test and used to determine participants' aerobic capacity. Participants were expected to work to their max on the treadmill with a Canadian Society for Exercise Physiology (CSEP) Certified Exercise Physiologist (CEP). The test abides by the modified Bruce Protocol. This protocol is accompanied in a full assessment package (**Appendix A**).

6.2.1 Modified Bruce Protocol Treadmill Test

Cardiorespiratory fitness determined by VO_2 peak was assessed using the modified Bruce treadmill protocol (107, 108) during which subjects walk at 1.7-5.0 mph at elevations from 0-18% grade, with speed/grade increased every 3 minutes up to subjectively described 'maximal' effort. After attaining max, participants had an active recovery cool down period for five minutes. VO_2 max is estimated using standard American College of Sports Medicine (ACSM) metabolic equations. Standard termination criteria for graded exercise testing were applied: chest discomfort, drop in or fluctuations in heart rate despite increase in workload, nervous system symptoms (ataxia, dizziness, near syncope), cyanosis/pallor, or participant's desire to stop, indicating their peak/max (109). This protocol follows ACSM recommendations for exercise

testing for untrained populations, such as with elderly and sedentary participants (110-112). Participants' achieved speed and grade were used and converted into a VO_2 peak score using an equation; [VO_2 = ((SPEED * 26.8) * 0.1) + ((SPEED * 26.8) * (GRADE / 100) * 1.8)](111). This protocol has been validated amongst older sedentary women aged 51-68 years old and was found to have test-retest good reliability of r^2=.70 -.89 (112). Participants were tested 3 times (baseline, 12 weeks and at 24 weeks).

6.2.2 Body Composition Measurements

BMI was used to translate height and weight into an overall health marker score. Height (m) and weight (kg) are converted into BMI score (kg/m^2). It is widely used and has been noted to have extremely high reliability (R^2= 0.99)(113). A Stadiometer and scale were used to measure height and weight, respectively. An inelastic measuring tape was used to measure waist circumference in centimeters. Following the National Institute of Health (NIH) method, measurements were taken at the superior boarder of the iliac crest (suprailiac) in midaxillary line (114-116).

6.3 Heart Rate Variability

Participants in each group had heart rate variability measurements at baseline, 12 weeks and at 3-month follow up. An orthostatic protocol was applied to assess heart rate and heart rate variability in response to the fitness training undertaken while examining the induced (position) changes in the autonomic nervous system (64, 117). Participants were asked to lay supine and breathe normally for five minutes with three electrocardiogram (ECG) electrodes attached (one to each wrist and one to the right ankle). After this 5 minute period of lying down was completed, the transition to standing upright was allocated 2 minutes. Then the HRV standing test was allocated another 5 minutes in duration. Exposure to stress symptoms and/or exercise

overtraining are associated with lower HRV scores (regardless of age or gender) during the orthostatic testing protocol (117). Previous findings indicate those subjects for whom the change from lying to standing positions is stressful will have greater decreases in HRV and lower levels of parasympathetic activity (117-119).

Electrocardiogram (ECG) recordings were collected using ADInstruments' (ADI) PowerLab 4-channel data acquisition system (Colorado Springs, United States), which utilizes the ECG unit and is used to obtain a computer digitized ECG signal from the PowerLab console while sampling at a rate of 250 Hz. ECG data was collected and prepared for analyses in accordance with the standards established by the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (120). HRV 2.0 Add-on for LabChart Pro (integrated with the PowerLab unit) was used to calculate the time and frequency domain measures (60, 121). LabChart Pro used automated ECG interpretation to indicate which beats were ectopic vs. normal beats. Data was visually inspected to ensure each RR interval had clear PQRST formation. The "beat classifier view" feature in LabChart 8 Pro was utilized to inspect ectopic beats. The data was also inspected to confirm the absence of artifacts and cardiac arrhythmias. All normal beats were included.

The four parameters used to assess HRV were: Average RR (milliseconds (ms)) (average time between R-R intervals during 5 minute time period), SDNN(ms) (standard deviation of normal R-R intervals,) and RMSSD(ms) (root mean square of successive R-R interval differences) from the time domain and HF power (milliseconds squared (ms^2)) (absolute power of the high frequency band) from the frequency domain (75, 117, 120). The SDNN assesses cyclic components responsible for heart rate variability, RMSSD assesses cardiac vagal tone and its contribution to cardiac regulation, and HF is similarly useful in assessing vagal tone (122,

123). HF is associated with parasympathetic dominance (124). The frequency range used for HF was 0.15-0.45 Hz. These parameters were examined to assess each participant's ability to cope with stressors.

Time domain measures of SDNN and RMSSD are used to examine variations in heart rate, while the frequency methods are typically more associated with physiological regulations (120).

6.4 Beck Anxiety Inventory (BAI)

This 21 item scale assessed participant's self-perceived experience of anxiety. Responses were placed on a 4-response scale and took approximately 5 minutes to complete. The internal consistency for the BAI is Cronbach's α=0.92 with a test-retest reliability (1 week) of Cronbach's α 0.75 (125). The BAI has been shown to be moderately correlated with the revised Hamilton Anxiety Rating Scale (Cronbach's α= 0.51), and mildly correlated with the Hamilton Depression Rating Scale (Cronbach's α=0 .25) (125).

6.5 Center for Epidemiologic Studies Depression Scale (CES-D)

This questionnaire is a 20-item scale used to (126) assess depression in the general population (127). Specifically, the scale assessed depressive and distressed feelings and behaviours during the past week (128). This questionnaire took approximately 5 minutes to complete and responses were (126) placed on a 3-point Likert Scale. Higher scores (both item and total scores) indicate more depressive symptoms and a score of 16 or higher has been used as the cut-off point for discriminating high levels of depressive symptoms that warrant clinical attention(128, 129). (126)The CES-D has been shown to be a reliable measure for assessing the levels, types, and duration of depressive symptoms across racial, gender, and age categories

(128, 130, 131). High internal consistency has been reported with Cronbach's alpha coefficients ranging from .85 to .90 across studies (128).

6.6 Perceived Stress Scale-Short Form (PSS)

The Perceived Stress Scale (PSS) is a widely used scale to assess one's perception of stress in their lives. The scale was adapted and validated from the longer version of 14 questions to 10 questions. Questions tap into how unpredictable, uncontrollable and overloaded people may find their lives over the last month (132, 133). Responses were placed on a 5-point Likert scale. The score is out of 40, with higher scores indicating higher levels of perceived stress. It has an internal reliability alpha coefficient of 0.78 and has been reported as a better used measure than the PSS-14 (132).

6.7 Five Facet Mindfulness Questionnaire-Short Form (FFMQ)

The Five Facet Mindfulness Questionnaire (FFMQ) is a reliable and valid comprehensive instrument for assessing different aspects of mindfulness. The 24-item short form of the FFMQ (FFMQ-SF) was developed, assessed and cross-validated in independent samples (134). Responses were placed on a 5-point Likert scale with questions observing five component skills of: describing, acting with awareness, observing, non-judging and non-reactive of inner experiences (135). Factor analyses showed acceptable model fit for a correlated five-factor structure of the FFMQ and good model fit for the structure of the FFMQ-SF (134). The FFMQ demonstrates good internal consistency, with alpha coefficient ranging from 0.75-0.91 (135). This questionnaire took approximately 5 minutes to complete.

6.8 Effort-Reward Imbalance and Over-commitment Questionnaire (ERI and OC)

This questionnaire contains 3 standardized self-report psychometric scales referring to effort, reward and over-commitment an individual experienced in relation to their job (136). It

consists of 22 questions on a 4 point Likert-scale, with 16 questions referring to effort and reward, and 6 questions referring to over-commitment. For the effort and over-commitment components, higher scores represented high-effort and high (i.e. excess) commitment, and for the reward component, higher scores represented lower reward; therefore, for all three components, the highest score represents more adverse psychosocial working responses (137). This questionnaire took approximately 5 minutes to answer and responses range from strongly disagree to strongly agree. The Cronbach's Alpha coefficients for the Effort-Reward Imbalance scale were 0.76, 0.73, and 0.78 for effort, reward and over-commitment, respectively (137).

6.9 Godin Leisure-Time Exercise Questionnaire-Leisure Score Index (GLTEQ-LSI)

Leisure-Time exercise behaviour was assessed by the Leisure Score Index from the Godin Leisure-Time Exercise Questionnaire (138, 139). The LSI contains two questions which assessed the average frequency of mild (minimal effort, no perspiration), moderate (not exhausting, light perspiration), and strenuous intensity (heart beats rapidly, sweating) exercise during free time in a typical week, as well as the frequency of duration at strenuous intensities. An independent evaluation of this measure found its reliability compares favourably to nine other self-report measures of exercise based on various criteria including test-retest scores, objective activity monitors, and fitness indices (140). The LSI demonstrated a 1 month test-retest reliability of 0.62 and concurrent validity coefficients of 0.32 with an objective indicator (CALTRAC accelerometer) (140).

6.10 Statistical Analysis

Statistical analysis was conducted using the IBM Statistical Package for the Social Sciences version 22 (141).

The statistical data analyses conducted included demographic variables (descriptive, t-tests, chi square and frequency) and assessment of between-group baseline differences. Following these analyses, other specific analyses were employed to determine differences relevant to the objectives and stated hypotheses.

Hypothesis 1A: The WPHC+MM group will demonstrate significant increases in cardiovascular fitness (VO_2 peak) when compared to WPHC (between-group differences). Additionally, significant between-group differences (i.e. larger improvements in the WPHC+MM group vs. WPHC group) will be demonstrated in the anthropometric measures: BMI, WC, blood pressure, and resting pulse.

Hypothesis 2A: The WPHC+MM group will demonstrate significant benefits in HRV (increases in vagal tone, and R-R interval measures) when compared to WPHC (between-group differences).

Hypothesis 3A: The WPHC+MM group will demonstrate significantly greater outcomes in the following psychological variables: anxiety (reductions), leisure time physical activity (increases), depression (reductions), effort/reward and over-commitment (reductions), perceived stress (reductions), overall mindfulness (increases) and mindfulness subscales when compared to the WPHC group (between-group differences).

Analyses for Hypothesis 1A, 2A, 3A: General Linear Model (GLM) repeated measures ANOVA with Greenhouse-Geisser correction was used to assess between-group differences and group-by-time interactions (across time from baseline to month 3, from baseline to month 6, and from month 3 to month 6 for each evaluated measure). Baseline differences were controlled for within the repeated measures ANOVA analyses and post hoc analyses included the use of Bonferroni correction for significant main effects of group and group by time interaction.

Secondarily, a General Linear Model (GLM) repeated measures ANOVA with Greenhouse-Geisser was also used to examine any main effect of time significance. Post hoc analyses included the use of Bonferroni correction for significant main effects of group.

7.0 POWER ANALYSIS

Power calculations were based on a clinically significant mean difference from baseline to post intervention of VO_2 peak (primary outcome) (142). Analysis was based on values that would elicit an observed power of 80% at p=0.05, from a significant within group analysis. Accordingly, based on previous research utilizing a similar intervention protocol (assessments at 3 different time points), for a medium effect size (*Cohen's d*=0.50) (142, 143), mean change in primary outcome variable of VO_2 peak over time at p=.05 and 80% power (142, 143) a sample size of 18 participants per group was determined. Therefore, our projected sample size was 36 participants (18 per group), to observe 80% power with the primary outcome variable. To account for an anticipated attrition rate unique to exercise interventions of approximately 25% to 50%, it was determined that a total sample size of 60 participants (30 per group) was required (144).

In the secondary analysis of HRV measures, a study by Azam et. al determined that with an α=.05 and the employment of multivariate statistical tests for HRV changes associated with meditation, it was estimated that a total sample size of 40 participants would provide acceptable power (80% power) for detecting a medium effect size (72).

8.0 RESULTS

Following descriptive analysis, 3 (time) by 2 (group) repeated measures ANOVA analyses were conducted in SPSS v.22. A per protocol analytic approach was employed where consented subjects who completed each section of the assessments were included in the final

analyses. Participants with missing data were not dropped from the overall study but through pairwise deletions they were dropped from repeated measures ANOVA outcome analysis. At study completion, a total of 42 subjects completed the VO_2 peak testing, while more (N = 43) and less (N = 35) subjects completed the lying and standing measures of HRV respectively, and 47 participants completed the questionnaire package. Some of these fluctuations (e.g. for the VO_2 peak testing) were due to 5 participants being unable to complete treadmill testing because of medical/health concerns. Missing data in the HRV analysis (N = 4 had missing data from the lying down data and N = 12 participants had missing data from the standing measures) was related to subject's medical concerns and/or equipment malfunction. The progress through the various phases of this parallel randomized trial is shown in the Consort Diagram in Figure 1.

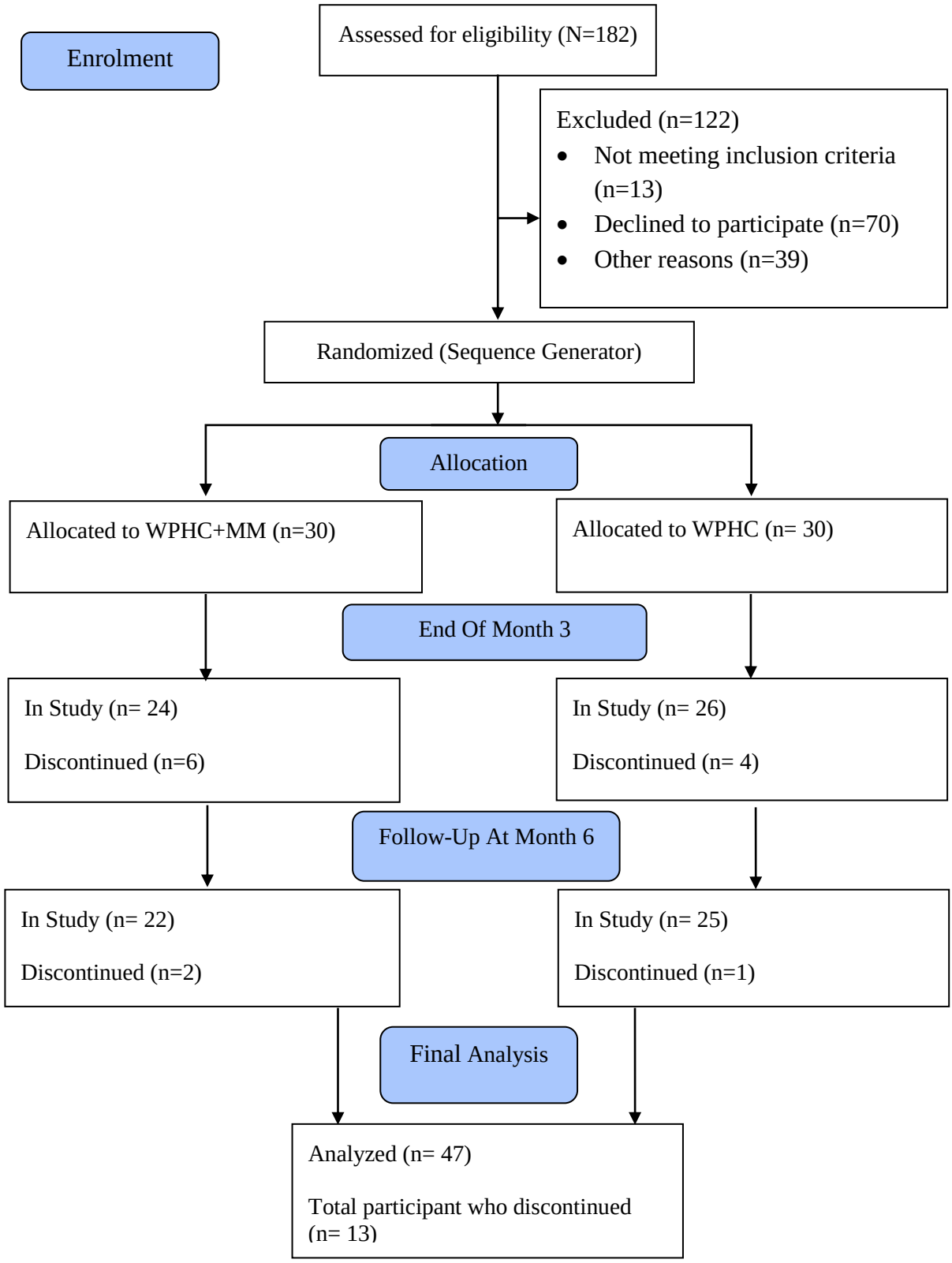
8.1 Recruitment Analysis

Participants were recruited via email. Of the 182 participants who contacted the principal investigator re: study interest, 60 were accepted into the study. Reasons for non-participation in the study were: 1) declined to follow-up with initial assessment (n=70); 2) too much meditation activity (greater than inclusion criteria) (n=8); insufficient communication (recruitment ended before coordinator could discuss participation) (n=8), time constraints (n=16), personal constraints (n=15), employee contract and location/travel issues (involving employees on a remote campus) (n=5).

Participants were randomized to two groups: 30 participants to the WPHC+MM and 30 participants to the WPHC program only. By the month 3 assessment, 24 participants remained in the WPHC+MM group and 26 participants remained in the WPHC group. At study completion, there were 22 participants in the WPHC+MM group and 25 participants in the WPHC group. Drop-outs were due to time constraints, unfulfilled study expectations, feeling guilty for

participating in the study on work hours, health implications, family responsibilities, termination of university employment. Analyses were conducted with 47 participants with total of 13 dropouts. Total study completion rate was 78%. Per group, the total completion rate was: 83% for the WPHC and 73% for the WPHC+MM groups.

Figure 1: Consort Diagram for York Walking and Mindfulness Study 2016-2017



8.2 Demographic Analysis

Table 1 displays the demographic variables for the participants for each study group at baseline. Between the two groups, minimal differences were found with regards to descriptive variables (marital status, income, ethnicity and age). Chi squared tests were conducted on the categorical variables.

Table 1: Demographical Data for WPHC versus WPHC+MM at Baseline

Characteristics	WPHC	WPHC+MM	pValue
Total Study Participants (n)	30	30	
Mean Age (years)	49.5±10.2	47.7±10.9	0.518
Sex [n(%) of women in study]	28(93.3)	28(93.3)	1.000
Union [n(%)]			
CPM	9(30.0)	13(43.3)	
YUSA	11(36.7)	5(16.7)	0.362
YUTA/YUFA/Faculty Exchange	2(6.7)	2(6.7)	
Undisclosed	8(26.7)	10(33.3)	
Current Occupation [n(%)]			
Administration	19(63.3)	20(66.7)	0.787
Management/ Coordinator/ Director/ Supervisor	11(36.7)	10(33.3)	
Marital Status [n(%)]			
Married	18(60.0)	18(60.0)	
Divorced/Separated/Widowed	8(26.7)	5(16.7)	0.470
Never Married	4(13.3)	7(23.3)	
Education [n(%)]			
Some Post-Secondary or Less	7(23.3)	3(10.0)	
Post-Secondary	17(23.3)	13(43.3)	0.069
Graduate School	6(20.0)	14(46.7)	
Ethnicity [n(%)]			
Caucasian	18(60.0)	16(53.3)	
African/Caribbean Canadian	4(13.3)	2(6.7)	0.599
Asian	5(16.7)	6(20.0)	
Other	3(10.0)	6(20.0)	
Household Income ($)[n(%)]			
Less than 89000	12(40.0)	12(40.0)	
90000-169000	14(46.7)	12(40.0)	0.758
170000+	4(13.3)	6(20.0)	

Years At Current Occupation [n(%)]			
5 or Less Years	13(43.3)	11(36.7)	
6-10 Years	7(23.3)	7(23.3)	0.951
11-20 Years	5(16.7)	6(20.0)	
21+ Years	5(16.7)	6(20.0)	
Days Absent At Work [n(%)]			
Baseline(T1)			
None	9(30.0)	10(33.3)	
1-4 Days	17(56.7)	17(56.7)	0.907
5+ Days	4(13.3)	3(10.0)	
3 Months(T2)			
None	9(34.6)	12(50)	
1-4 Days	17(65.4)	9(37.5)	0.054
5+ Days	0(0.0)	3(12.5)	
6 Months(T3)			
None	11(45.8)	11(50)	
1-4 Days	11(45.8)	8(36.4)	0.745
5+ Days	2(8.4)	3(8.7)	

*Asymp Sig (2-sided); $p<0.05$

It is noteworthy that both groups had unequal numbers of men and women at the start of the study, with n=28 women and n=2 men per group, summating to n=30 participants per group. WPHC group had more employees reporting sick days at 3 months than the WPHC+MM group (17 versus 9 days respectively).

8.3 WPHC and WPHC+MM Analysis

Variables from the VO_2 peak, anthropometric, HRV and questionnaire data were analyzed to test the following hypotheses.

8.3.1 Hypothesis 1A: there will be greater increases (improvements) in primary outcome VO_2 peak, the anthropometric variables and the secondary physiological variables in those subjects who received the WPHC+MM intervention versus the WPHC intervention.

Table 2 shows a comparison of mean differences for physiological and anthropometric measures at baseline, month 3 and month 6.

Table 2: Comparing mean values for physiological and anthropometric measures at each time point

Variable	Group	N	Time			pValue*		
			Baseline Mean (SD)	Month 3 Mean (SD)	Month 6 Mean (SD)	Group by Time	Main Effect of Time	Main Effect of Group
VO_2 Peak (ml/min/kg)	WPHC	23	32.86(8.62)	34.63(7.05)	34.03(7.16)	0.157	**0.001**	0.698
	WPHC +MM	19	31.90(7.98)	36.44(5.55)	35.61(6.84)			
Waist Circumference (cm)	WPHC	25	88.0(19.0)	86.5(17.5)	87.0(18.0)	0.547	**0.005**	0.996
	WPHC +MM	22	88.5(11.0)	86.5(11.0)	87.0(12.5)			
BMI (kg/m^2)	WPHC	25	28.1(6.1)	28.0(6.0)	28.3(6.1)	0.830	0.364	0.163
	WPHC +MM	22	25.8(4.9)	25.7(5.1)	25.9(5.4)			
Weight (kg)	WPHC	25	75.9(21.8)	75.5(21.3)	75.9(21.8)	0.670	0.522	0.357
	WPHC +MM	22	70.6(12.9)	70.7(14.0)	71.0(14.6)			
Systolic (mmHg)	WPHC	24	126(14)	124(14)	126(16)	0.169	0.069	**0.031**
	WPHC +MM	22	120(16)	114(18)	116(16)			
Diastolic (mmHg)	WPHC	24	80(6)	78(8)	78(8)	0.468	0.725	**0.001**
	WPHC +MM	22	74(8)	70(10)	72(10)			
Resting Pulse (bpm)	WPHC	25	75(8)	72(8)	68(15)	0.532	<**0.001**	0.461
	WPHC +MM	22	74(9)	69(7)	68(6)			

*Significance at p=0.05

The analyses undertaken did not reveal a significant main effect of group, time or a group x time interaction for final treadmill-based HR, weight, and BMI. Height was assessed at baseline and no significant between group differences were found: $t_{(58)}$=-1.391, p=0.170. There were significant between group differences in blood pressure from baseline to study completion, with WPHC having higher blood pressure than WPHC+MM group.

8.3.1.1 VO_2 Peak

There was neither a group x time interaction nor a main effect of group that was significant. There was a significant main effect of time: $F_{(2,80)}$= 9.138, p=0.001, partial η^2= 0.186 for VO_2 peak. Post-hoc analyses (Bonferroni) indicated that increases in VO_2 peak scores were

significant from baseline to month 3 (MD=3.160 ml/kg/min, p=0.043) and from baseline to month 6 (MD=2.441 ml/kg/min, p=0.037).

8.3.1.2 Waist Circumference (WC)

There was neither a group x time interaction nor a main effect of group that was significant. There was a significant main effect of time: $F_{(2,90)}$= 5.975, p=0.005, partial η^2= 0.117 for WC. Post-hoc analyses (Bonferroni) indicated a decrease in WC from baseline to month 3 (MD=2.0 cm, p=0.002).

8.3.1.3 Blood Pressure

Blood pressure (BP) was divided into systolic and diastolic measures. There was no group x time interaction that was significant. The main effects of group for both systolic and diastolic BP were significant.

In systolic blood pressure a significant between group effect was found: $F_{(1,44)}$= 4.941, p=0.031, partial η^2= 0.101. Post-hoc analyses (Bonferroni) indicated that the WPHC group demonstrated higher systolic values compared to WPHC+MM: M= 126mmHg versus M=116 mmHg respectively. With a MD=9.511 mmHg, p=0.031. The main effect of time was not significant.

In diastolic blood pressure there was no group x time interaction that was significant. There was a significant between group effect found: $F_{(1,44)}$= 11.770, p=0.001, partial η^2= 0.211. Post-hoc analyses (Bonferroni) indicated that the WPHC group demonstrated higher diastolic values when compared to WPHC+MM: M= 80 mmHg versus 72 mmHg, respectively. At baseline, there was a significant difference between the two groups for the diastolic measure: $t_{(57)}$=2.301, p=0.025. After controlling for baseline differences, a significant between group difference at follow-up remained: $F_{(1,43)}$= 6.875, p=0.012, partial η^2= 0.138. Post-hoc analyses

(Bonferroni) indicated significantly higher diastolic values in WPHC when compared to WPHC+MM: M= 78 mmHg versus M= 74 mmHg, respectively. With a MD=6.657 mmHg,p=0.001. The main effect of time was not significant.

8.3.1.4 Resting Pulse

Following analysis, no interaction, or between group significance was found. There was a significant main effect of time for resting pulse: $F_{(2,90)}= 8.913$, $p<0.001$, partial $\eta^2= 0.165$. Post-hoc analyses (Bonferroni) indicated observed differences in resting pulse rate were significant from baseline to month 3 (MD=4 bpm, p=0.018) and from baseline to month 6 (MD=6 bmp, p=0.001).

8.3.2 Hypothesis 2A: Greater increases in HRV measures with WPHC+MM versus WPHC

Following analysis, no interaction, between-group, or main effect of time significance was found for Average R-R, SDNN (standard deviation of R-R wave analysis), RMSSD (Vagal Tone of Parasympathetic Activity), and HF power measure of parasympathetic activity (Table 3).

Table 3: Comparing Mean Values for HRV at each time point

Variable	Group	N	Time			pValue		
			Baseline Mean (SD)	Month 3 Mean (SD)	Month 6 Mean (SD)	Group by Time	Main Effect of Time	Main Effect of Group
Lying Average RR (ms)	WPHC	24	741.71 (93.58)	744.67 (81.91)	760.43 (103.11)	0.914	0.232	0.958
	WPHC+MM	20	736.35 (93.34)	749.34 (108.79)	765.05 (106.36)			
Standing Average RR (ms)	WPHC	24	644.68 (68.65)	645.27 (66.88)	671.25 (81.59)	0.972	0.117	0.429
	WPHC+MM	19	628.72 (82.86)	632.86 (91.92)	652.56 (96.79)			
Lying SDNN (ms)	WPHC	24	31.24 (21.24)	36.53 (25.00)	32.66 (20.12)	0.594	0.350	0.874
	WPHC+MM	20	30.46 (14.79)	34.60 (16.87)	37.46 (17.87)			
Standing SDNN (ms)	WPHC	24	68.39 (108.74)	35.71 (25.25)	43.90 (53.53)	0.141	0.456	0.195
	WPHC+MM	19	30.12 (14.52)	44.79 (42.36)	28.73 (10.38)			
Lying RMSSD (ms)	WPHC	24	22.88 (23.37)	29.43 (39.00)	22.87 (26.61)	0.370	0.508	0.819
	WPHC+MM	20	19.21 (20.84)	22.30 (25.75)	28.98 (27.41)			
Standing RMSSD (ms)	WPHC	24	36.72 (68.33)	27.75 (38.78)	36.23 (92.17)	0.327	0.810	0.443
	WPHC+MM	19	17.13 (14.11)	37.22 (67.31)	17.02 (9.39)			
Lying HF (ms^2)	WPHC	24	395.40 (1364.94)	344.81 (650.30)	393.52 (1040.54)	0.597	0.558	0.985
	WPHC+MM	20	227.78 (661.93)	318.46 (679.03)	576.24 (1213.00)			
Standing HF (ms^2)	WPHC	24	495.76 (1100.86)	536.68 (1181.29)	1628.77 (7346.39)	0.323	0.617	0.561
	WPHC+MM	19	125.35 (157.35)	1211.97 (4113.68)	97.91 (120.07)			

*Significance at p=0.05

8.3.3Hypothesis 3A: Improvements in secondary psychological variables with WPHC+MM versus WPHC

Data is provided in Table 4 for all questionnaire variables.

Table 4: Comparing mean values for psychological measures at each time point

Variable	Group	N	Time			pValue*		
			Baseline Mean (SD)	Month 3 Mean (SD)	Month 6 Mean (SD)	Group by Time	Main Effect of Time	Main Effect of Group
Anxiety	WPHC	25	7.56(7.02)	5.44(5.30)	5.40(5.66)	0.619	0.064	0.655
	WPHC +MM	22	6.18(3.72)	5.32(5.02)	5.14(4.29)			
Godin Leisure Question 1	WPHC	25	21.88(20.96)	36.44(19.04)	30.48(21.57)	0.302	**0.002**	0.621
	WPHC +MM	22	21.43(16.53)	28.59(20.72)	31.77(22.06)			
Depression	WPHC	25	8.88(6.72)	7.40 (4.01)	9.28(8.48)	0.072	0.212	0.680
	WPHC +MM	22	10.86(7.43)	9.45(6.87)	7.23(5.76)			
Effort	WPHC	24	15.38(3.82)	16.33(4.11)	15.08(4.28)	0.336	0.256	0.993
	WPHC +MM	22	15.86(3.93)	15.59(3.98)	15.36(3.63)			
Reward	WPHC	24	30.83(4.82)	30.46(5.48)	30.08(6.00)	0.177	0.255	0.598
	WPHC +MM	22	29.27(3.30)	30.59(3.67)	29.50(3.49)			
Over Commitment	WPHC	25	13(3.32)	12.52(3.27)	12.48(3.66)	0.076	**0.004**	0.103
	WPHC +MM	22	15.45(2.92)	12.86(3.18)	13.64(3.05)			
Perceived Stress	WPHC	25	15.12(7.03)	13.80(6.27)	13.52(7.04)	0.682	**0.033**	0.790
	WPHC +MM	22	16.36(5.94)	13.82(6.91)	13.59(6.32)			
Five Facet Mindfulness-Observe	WPHC	25	15.96(3.34)	15.36(3.20)	15.68(2.90)	**0.028**	0.417	0.314
	WPHC +MM	22	14.00(2.91)	15.68(3.17)	14.91(3.38)			
Five Facet Mindfulness: Non-Reactive	WPHC	25	16.04(3.96)	16.16(3.20)	15.64(3.75)	0.073	0.264	0.645
	WPHC +MM	22	14.55(2.52)	15.73(2.55)	16.41(4.19)			
Five Facet Mindfulness: Act Aware	WPHC	25	17.92(4.14)	18.48(3.57)	18.96(4.26)	0.405	**0.015**	0.492
	WPHC +MM	22	16.59(3.86)	18.45(3.33)	18.27 (3.97)			
Five Facet Mindfulness: Describe	WPHC	25	17.84(4.22)	19.40(3.57)	19.56(2.92)	0.750	**0.003**	0.876
	WPHC +MM	22	18.09(3.18)	19.14(3.04)	19.18(2.82)			
Five Facet Mindfulness: Non-Judge	WPHC	25	16.56(4.66)	18.20(3.82)	17.84(4.51)	0.118	< **0.001**	0.952
	WPHC +MM	22	16.32(3.39)	17.27(3.43)	18.82(3.83)			
Five Facet Mindfulness Total	WPHC	25	83.60(15.00)	86.84(9.92)	86.24(11.95)	0.375	**0.004**	0.622
	WPHC +MM	22	79.82(10.88)	85.50(11.28)	86.77(13.21)			

*Significance at p=0.05

From baseline to study completion, significant main effect of time changes were indicated for increases in leisure time physical activity and mindfulness; and for decreases in perceived stress and over commitment to job. There were no significant interaction, between-group and main effect of time indications for anxiety, depression, nor perceived job efforts/rewards.

8.3.3.1 Godin Leisure Score Question 1

There was no significant interaction or between-group effect for this measure. A significant main effect of time for the Godin-Question 1 (frequency of exercise > 15 minutes during leisure time/week): $F_{(2,90)}$=7.150, p=0.002, partial η^2=0.137 was found. Bonferroni post hoc analysis indicated an increase from baseline to month 3 and from baseline to month 6: MD=10.86 times per week, p=0.008 and MD=9.47 times per week, p=0.018 respectively were observed.

8.3.3.2 Over-commitment Scale (OC)

There was no significant interaction or between-group effect for this measure. There was a significant main effect of time for OC: $F_{(2,90)}$=6.158, p=0.004, partial η^2=0.120. Post-hoc analyses (Bonferroni) indicated a decrease from baseline to month 3: MD= 1.535 units, p=0.006. There were no statistically significant decreases in self-reported OC from baseline to month 6.

8.3.3.3 Perceived Stress Scale

Results from the analysis indicated that no interaction, or between group effect was found. There was a significant main effect of time for perceived stress: $F_{(2,90)}$=3.857, p=0.033, partial η^2=0.079. Post-hoc analyses (Bonferroni) indicated no significant changes from baseline to month 3 or baseline to month 6.

8.3.3.4 Five Facet Mindfulness Questionnaire

No significant interaction or between-groups effect was found for overall mindfulness. There was a significant main effect of time for overall mindfulness score: $F_{(2,90)}$=5.997, p=0.004, partial η^2=0.118. Post-hoc analyses (Bonferroni) indicated an increase from baseline to month 3 and baseline to month 6: MD=4.461 units, p=0.028 and MD=4.797 units, p=0.017 respectively.

Five component skills of: describe, non-judge, act aware, observe and non-reactive were also assessed. No significant interaction, main effect of neither group nor time was found for non-reactive of inner experiences.

Results from the analysis indicated no significant interaction or main effect of group for the mindfulness component of describing feelings. There was a significant main effect of time for the mindfulness component skill of *describing feelings*: $F_{(2,90)=}$6.146, p=0.003, partial η^2=0.120. Post-hoc analyses (Bonferroni) indicated an increase from baseline to month 3 and baseline to month 6: MD=1.303 units, p=0.025 and MD=1.405 units, p=0.011 respectively.

Results from the analysis indicated no significant interaction or main effect of group for the mindfulness component of non-judgment of inner experiences. There was a significant main effect of time for the mindfulness component skill of *non-judgment of inner experiences*: $F_{(2,90)}$=8.998, p<0.001, partial η^2=0.120. Post-hoc analyses (Bonferroni) indicated an increase from baseline to month 3 and baseline to month 6: MD=1.297 units, p=0.046 and MD=1.890 units, p<0.001 respectively.

Results from the analysis indicated no significant interaction or main effect of group for the mindfulness component of acting aware. There was a significant main effect of time for the mindfulness component skill of *acting aware*: $F_{(2,90)}$=4.663, p=0.015, partial η^2=0.094. Post-hoc analyses (Bonferroni) indicated an increase from baseline to month 6: MD=1.361 units, p=0.005.

There was a significant group by time interaction for the mindfulness component skill of *observing surroundings*: $F_{(2,90)}$= 3.828, p=0.028, partial η^2=0.078. Post-hoc analyses (Bonferroni) indicated that *observing surroundings* scores were greater by month 3 compared to baseline for WPHC+MM: MD=1.682 units, p=0.025. In addition, post-hoc analyses (Bonferroni) also indicated that the scores for observing one's surroundings were greater at baseline for WPHC: MD=1.960 units, p=0.038. Results from the analysis indicated no significant main effect of group or main effect of time for the mindfulness component of observing surroundings.

The between-group differences at baseline for the subgroup skill of observing surroundings was significant: $t_{(58)}$=2.588, p=0.012 and when controlled for, there was no significant interaction, main effect of group nor main effect of time.

9.0 DISCUSSION

The purpose of this study was to compare the effectiveness of two intervention programs for non-diagnosed university employees: one program focused on walking and health coaching and one focused on walking, health coaching and mindfulness meditation. The primary outcome was fitness as measured by peak VO_2. Previous studies that focused on the effects of mindfulness on fitness (as measured by VO_2 peak tests) showed conflicting results. While VO_2 peak improvements after mindfulness exposure have been found non-significant in clinical populations (102, 103, 145), associated benefits have been reported with non-diagnosed inactive adults (101). The employee subjects in this study were a population of non-diagnosed inactive adults.

While WPHC+MM was found to be no more effective than WPHC in improving VO_2 peak (fitness), in the WPHC+MM group there were significant overall group increases in VO_2

peak when compared to baseline levels (primary outcome) and significant overall group improvements in secondary outcomes: perceived stress (reductions), job over-commitment (reductions), mindfulness (increases) and leisure time exercise (increases).

Furthermore, participants in *both* the WPHC and WPHC+MM group significantly increased fitness (peak VO_2), indicating walking programs can improve fitness (peak VO_2) which confirms previous literature (146). Indeed, a meta-analysis of RCTs suggest that healthy, sedentary individuals who adopt regular walking can reduce multiple cardiovascular disease risk factors (147). Results from a single RCT that focused on university employees' physical activity and sit times over a 10 week period showed incidental walkers (who increased walking for job-related purposes) *and* route-based walkers (who walked on non-job-related self-selected routes) both increased physical activity according to step counter findings when compared to controls, despite no significant reductions in sit time (42). Increased exercise and fitness in employee interventions have been shown to be associated with reduced stress levels, which, in turn, are associated with increased well-being and job satisfaction (87). In line with this previous research, our findings confirm reductions in perceived stress and job over-commitment in both groups and increases in mindfulness. Altogether, there is support for implementing walking programs in workplace contexts (148).

Only a few studies have examined the benefits of a walking and mindfulness program using both VO_2 peak *and* mindfulness measures. Mindfulness meditation (MM), i.e. behavioural practices supporting a non-judgmental, present moment focus (149), can apparently impact physical fitness (VO_2 peak) while reducing cardiovascular responses to stress-related triggers (97, 150). MM can also reduce stress and blood pressure in healthy populations (97, 150, 151), providing a preventive cardiovascular treatment that complements increased fitness (149, 152,

153). Meditative movement-related practices, such as yoga and tai chi, increase oxygen uptake (154-156) with the meditative practice of Tai Chi was found to specifically improve strength, flexibility, lower extremity balance and peak VO_2 (155). In this study increased physical activity was associated with increased mindfulness, and decreased perceived stress and job over-commitment. Increases in walking may thus assist participants in becoming more internally focused or aware (of their own behaviours and environments) such that walking may, in effect, comprise a mindfulness practice although not originally or frequently conceived this way (97). Since both employee walking groups (MM + WPHC, WPHC alone) experienced cardiovascular benefits (baseline to month 6) WPHC alone seems sufficient in enabling participants to become more mindful and increasingly fit.

9.1 Heart Rate Variability Measures

There were no statistically significant changes in the HRV findings of participants in terms of their responses to the orthostatic protocol. Examination of the effects of walking versus walking and mindfulness on HRV yielded no significant between group improvements (WPHC + MM vs. WPHC alone). The four parameters used to assess HRV were Average R-R, SDNN and RMSSD (from the time domain) and HF from the frequency domain. These parameters were examined as measures to assess participants' stress tolerance. Decreases in HRV are associated with high levels of vagal withdrawal amidst high stress levels, contributing to quicker R-R intervals (122). Although increases were observed (i.e. towards higher HRV, for each measure assessed), the increases were insufficient to elicit statistical significance.

No significant changes were reported with average R-R, SDNN, RMSSD or HF. However, over time results showed increases in parasympathetic activity. Examining the transition from lying to erect, there were increasing parasympathetic activity levels indicated in

SDNN, RMSSD and HF measures, but decreased parasympathetic activity in the average R-R (during standing). These decreases in average R-R suggest increases in heart rate.

The changes in such outcomes are challenging to interpret with respect to cardiac autonomic modulation during testing. The transition from lying down to standing up is a stressful condition associated with reductions in average R-R. These changes support current understandings concerning how the parasympathetic nervous system acts to modulate stress vulnerability and reactivity; therefore when a stressor is increasingly present it can dampen the effects of the parasympathetic system (117, 157). The increase in parasympathetic activity in the standing position is more difficult to explain. However, because the healthy heart has continually changing oscillations, the cardiovascular system can rapidly adjust to sudden physical and psychological changes to homeostasis (75, 158-160). In addition, although this study had a maximum transition period of 2 minutes, the actual periods of transition varied from participant-to-participant from the minimum of 30 seconds to the maximum of 2 minutes. A standing time > 1 minute and about 5 minutes in duration after postural transition is suggested as muscular contractions, increased heart rate and increased energy expenditures are required for an individual to transition from lying to standing before maintaining standing postural balance (161, 162). Therefore a longer rest period between transitional phases may reduce the rapidly changing states that can affect HRV testing.

Consideration of both electrode placement (and its susceptibility to movement artifact), and the duration of transition from lying to standing, is warranted as both can impact the HRV values collected (75, 158-160). The data can also be affected by the sequence of events before HRV testing. As our testing was done after the treadmill test and predominantly during work hours (lunch to late afternoon), this placement potentially increased participant stress arousal and

might have inadvertently induced fluctuations within the cardiac and autonomic nervous system that affect HRV (163). Changes to the testing time within the protocol, especially to moving testing to earlier in the day, may be preferable, as it is associated with increased vagal modulation. Research has shown that morning exercise does not impact HRV recovery and during the morning, HRV is generally increased, following nocturnal sleep (164, 165). Furthermore, stress/arousal levels may be minimized in the morning (163) such that mornings may be better testing times, contributing to the goal of understanding ECG data in situations more closely approximating resting conditions.

9.1.1 Walking Program and HRV

Ultimately, this study demonstrated that MM + walking had no superior benefits over walking alone as detected with HRV measurement. However, improvements in HRV measures within exercise-based studies have occurred with endurance athletes and within clinical populations (74, 166, 167). In this study, ninety-three percent of participants were women and the mean age of the study population was 49.5 years for WPHC and 47.7 years for WPHC+MM. In line with previous research, women had decreased R-R and higher HR, and less variability in SDNN compared to men (75, 168) and RMSSD has an inverse parabolic pattern with decreased scores from 40 to 60 years old (75); thus explaining the lower scores collected in this sample. A past study that focused on the regulation of the autonomic nervous system (during nocturnal sleep) which compared morning and evening physical exercise indicated that 4 consecutive days of exercising in the morning increased HF indices of HRV following nocturnal sleep (164), suggesting study-related benefits were associated with walking exercise undertaken earlier in the day (e.g. while at work). Thus morning walks can potentially be more beneficial than evening

walks as walking stimulates sympathetic activity and evening walking can affect a reduced quality of nocturnal sleep and consequently a decrease of HF-HRV (164, 165).

Still another study that examined HRV and physically active women indicated greater resting HRV (1 hour after treadmill walking) reflected a positive cardiac autonomic influence in both the time and frequency domains (75, 158). The benefits were seen after a 60 minute bout of walking versus a 20 minute bout of walking, indicating that longer continuous walking periods may be more beneficial than equivalent shorter periods (158). Specifically, women evidenced significant increases in SDNN (51 ms (SD33-69ms) to 65 ms (SD 34-97ms)) (158). Due to the rigidity of participants' job requirements, attaining 60 minutes of continuous walking was difficult and many subjects opted for 20-minute bouts. This indicates a need to investigate what duration-of-walking continuum (e.g. between 20 and 60 minutes of walking) is associated with the most significant cardiac autonomic benefits. Therefore, testing various walking length protocols would better assist understandings of what bouts of walking will contribute to improved (i.e. higher) HRV (166).

9.1.2 Mindfulness Meditation and HRV

Mindfulness meditation research has consistently reflected programmatic effects (e.g. the MBSR program), nonspecific and specific, re: stress reduction (151). Significant improvements in HRV, that might reflect perceived stress reduction, however, were not seen in this study. Once again, this study examined a 12 week exposures to mindfulness, plus 12 weeks in a follow-up phase, to determine whether the WPHC+MM group benefitted more than WPHC-alone participants. Although changes were not seen via HRV, participants gradually became more mindful as represented by scores from the mindfulness questionnaire (73). The participant sample was particularly screened to constitute novice meditators. Therefore prior mindfulness

practice and skill may be needed before a noticeable change in HRV occurs (73). It is also possible that longer duration sessions or more focused trainings in MM might be required for significant HRV changes.

9.2 Psychological Variables Measures

There was an overall significant effect of time on several well-being measures. Participants demonstrated positive changes in reported mindfulness and stress levels and reduced over-commitment to their job. These findings indicate that the WPHC and WPHC+MM were effective in helping reduce stress and increase mindfulness, when compared to baseline scores. As job over-commitment is associated with musculoskeletal pain, depression and psychosomatic complaints (169), it would seem that engagement in the walking program was supportive to participants in reducing the risks of experiencing these problems. A study looking at perceived stress, job over-commitment and mindfulness as psychosocial measures is novel. In this study, there were statistically significant, incremental improvements on the self-report questionnaires used. A past study on workplace spirituality (as a moderating variable between job overload and job satisfaction), mindfulness meditation and workplace engagement indicated that employing mindfulness fosters workplace spirituality, which positively impacts engagement and reduces turnover intentions (170-172). These findings suggest that employer organizations who support and treat employees in a holistic manner (addressing emotions, cognitions and emotional well-being) are rewarded as employees become more positively engaged at work (170). More specifically, when employees perceive that the organization *cares* about their happiness, they tend to reciprocate with better performance (170). In regards to this study, we suspect that participants able to engage in the WPHC and WPHC+MM felt in some ways ‘cared or looked

out for', thus potentially contributing to positive changes in perceived stress and job over-commitment and mindfulness observed.

9.3 Health Coaching in Wellness Programs

Workplace wellness programs are not consistently effective in improving employee health. For example, when employees are not held accountable by employers for participation in health programs, fewer than 50% participate (173). Health coaching (HC) has been implemented to improve commitment and adherence to programming and to specific health behaviour changes (173, 174). In this study both groups received HC. Thus the ability to engage employees to think and discuss wellness-related behaviour changes over the course of weeks and months was tested (173), and potential benefits observed at study completion and after (at month 3 additional follow-up). One review of cost-effectiveness for health coaching indicated no short-term savings but projected future savings when HC was paired with disease management goals (175, 176, 177). Peer health coaches (coaches who have experienced or are experiencing similar situations to their clients) have been particularly successful at positively changing the behaviour of participants (177, 178). The health coaches in this study were neither peer to the participants nor financially incentivized for their contribution to the study. The absence of these potentially important elements could have reduced the effectiveness of their assistance although HC-related benefits in this study were observed. However, to better understand the true effects of the health coaches, a 4-arm RCT would be optimal, enabling the WP and WP+MM programs to be compared with and without HC assistance. The focus of this study was on the additive benefit of MM to a walking program. However, with HC being a novel concept in health and wellness promotion, it should be further investigated as a separate intervention component, deliverable in employee health programs.

9.4 Business Case Implications for Universities and Other Companies

Improved business practices may soon involve recognition of the benefits of health and wellness programs to companies in fostering employee well-being. To decrease negative health prognoses such as depression and anxiety, companies can address job related stress, a key indicator of future employee burnout (179). There have been no scientific studies to rigorously examine the impact of wellness programs in Canada, however a 2010 Harvard study suggested that for every dollar a company invests in wellness programs there is a return on investment (ROI) of $3.27, for medical costs and an additional $2.73, for absenteeism (81, 180). In this meta-analysis, the workplace wellness programs typically addressed obesity, smoking cessation, alcohol consumption, back care, prevention of cardiovascular disease and stress management through education materials, counselling, classes and seminars, health risk assessments, healthy diet, weight control and biometric screening (81, 150, 181). In the last three decades, active health and wellness promotion programs have been developed to directly help employees, rather than the more passive exposures to education materials and seminars (85). Results from the current study suggest that wellness programs for employees that include walking, with or without mindfulness meditation, allow employees to be active at work and require minimal equipment (mindfulness audios, time for participants to walk). Many companies that address fitness or physical activity in the workplace often expect to invest in site equipment or health education programs; the success of the intervention studies shows walking programs (WP) are feasible and attainable for companies of all sizes (150).

In this study physical activity in the form of walking benefitted participants, especially with their cardiovascular fitness and reported stress, over-commitment to job, and overall state

of mindfulness, by study completion. Benefits such as these reported can lead to a more positive and healthier employee group.

10.0 LIMITATIONS

One major criticism of this study is the reliance on self-report data. Questionnaire completion, walking reports (on campus versus at home), and reports of relative physical activity and how often the mindfulness meditation group meditated can be inaccurate and skewed depending on the attitudes of participants. Another limitation is that smart phone interactions were not the most reliable means for recording walking for participants. Some phones were successful at recording walking steps while some did not work well (using the Jawbone Up app), due to the various makes and models of smartphones. This made record keeping difficult for most participants. Therefore, the consistency and accuracy of self-record keeping was problematic, affecting the reliability of self-report charting (182).

Another major limitation is that participation in the study was entirely voluntary. This could mean that the most self-motivated employees joined the study. However, although voluntary, many participants who joined the study were not adequately prepared for participation (183).

In addition, the study period extended from October 2016 to September 2017, which required 60 % of participants to walk during 6 of the colder, wintry months in Toronto, Canada. We speculate that poor weather conditions of ice, rain and snow may have impacted the intensity of walking for participants.

Commitment to the walking log schedule or the mindfulness meditation sessions on campus was difficult to maintain for all participants due to their workplace expectations and work load. As a result, participants reported not being able to complete all assigned walks and/or

mindfulness sessions. With the support of management in allocating scheduled time, employees could become more motivated and committed to participate in workplace wellness programs (150). Health coaches were not trained professionals, nor peers of the employees. We suspect that to understand the true benefit of HC, future studies might involve peer health coaching and a wait list control group that receives no intervention.

For the HRV analysis, we suspect that the placement of electrodes may have contributed to the data quality variations and cardiac autonomic modulations observed in HRV data collected in both supine and standing. Research has indicated that electrode placement on the wrist and ankles can elicit artifacts in data collection (160). Factors associated with limb placement include potential muscle movement, tremors, anxiety, and cold extremities which contribute to artifacts/distortions in ECG wave forms (160). Changing the placement to the torso is favoured in the future to provide more accurate and better quality ECGs (160), with limited artifacts/distortions associated with limb placements. Also impacting HRV results would be the timing of HRV testing: (after the physical activity test (treadmill test), time of day participants' stress arousal levels are highest) which can contribute to varying HRV testing values and should be taken into consideration for future HRV studies (75, 163, 164). Another point of consideration is the length of rest between lying to standing. Future studies should focus on more consistent timing and an increased duration during the transitions to allow cardiovascular adjustments (HR, muscular changes and adequate perfusion to the brain) and a steady state to be reached (161, 162, 184). This will allow such transitional effects to subside.

11.0 FUTURE RESEARCH

In many respects, progress towards understanding the implications of walking for employees during the work-day, is optimally assisted with a wearable fitness tracker. It would make recording walking less effortful. We suspect it would allow participants to keep more accurate and consistent records when used correctly. Research has suggested potential benefits for increasing sustained physical activity with fitness trackers; but knowing what incentive it provides to inactive adults is unclear (182). Conducting a randomized trial looking at fitness tracking devices versus self-motivation might give insight into the effectiveness of trackers.

One additional suggestion regarding study findings would involve encouraging employee engagement in activity designed for self-improvement of physical and mental health while *at* the workplace. Future RCT research could enable scientists to better ascertain the benefits to employees and employers, in terms of WP, MM, and HC and its combinations.

Another future study alternative would be having health coaches who are either professionally trained or peer coaches (i.e. age-relatable); either of these alternatives might have been more beneficial than undergraduate students (182). These changes might allow participants to feel more connected to their coach.

12.0 CONCLUSION

The implementations of a workplace WPHC versus WPHC+MM in a randomized trial were tested and this study showed that providing an employee health and wellness programs such as WPHC and WPHC+MM, resulted in physiological and psychological benefits. Employees experienced improvements in cardiovascular fitness/ aerobic endurance, as well as in mindfulness; while reporting decreases in their perceived stress and over-commitment to the job.

Ultimately, in this six month study, participants were able to achieve significant changes compared to baseline, indicating that WPHC is equally beneficial to WPHC+ MM for employees in a health and wellness program. This can facilitate change and bring about new support for employees in the workplace. Hence, supporting employees to engage in healthier behaviours such as walking with or without the addition of mindfulness meditation, results in feelings of being more mindfully present, less stressed, less overly committed to the job as well as more physical activity. All of these changes can potentially translate into and affect improved job performance.

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APPENDIX A: INFORMED CONSENT FORM, QUESSTIONNAIRE, ASSESSMENT FORMS AND MODIFIED BRUCE PROTOCOL

Consent to Participate in a Research Study

Title: The healthy staff initiative study: examining exercise, health coaching and meditation for university employees: A randomized trial

Principal Investigator: S. Moonsammy Persaud, Ph.D. (Candidate)

You are being asked to take part in a research study. Before agreeing to take part in this study, it is important that you read and understand the following explanation of the proposed study procedures. The following information describes the purpose, procedures, benefits, discomforts, risks, and safety measures associated with this study. It also describes your right to refuse participation or withdraw from the study at any time. In order to decide whether you want to participate in this research study, you should understand the risks and benefits before you make a decision. This is known as the informed consent process. Please ask the research coordinator to explain any words you do not understand before signing this consent form. Make sure all your questions have been answered to your satisfaction before signing this document. Ms. Shalini Moonsammy Persaud is the research coordinator and is also a graduate student at York University.

Purpose of the Research

There is evidently great potential in implementing workplace health promotion programs, but more randomized trials are needed to determine which interventions are worksite-effective in helping to decrease inactive behaviours and increase engagement in healthy lifestyle activities. For employers, it could mean improving the health and productivity of employees. For workers, especially those in physically and/or psychologically demanding positions, it could mean developing strength, muscular endurance and agility to reduce musculoskeletal pain while developing the stress reduction skills that reduce long-term sickness and absenteeism risks. While changing behaviour in a complex workplace is, as seen in multiple studies, difficult due to the need to change workplace and organizational culture between employers and employees, this study aims to identify the effectiveness of workplace interventions in relation to counselling for university employees to increase overall work fitness without affecting any hierarchal interactions at the work site. Simply put, the investigators will examine the benefits of a workplace exercise and mindfulness (two-prong) intervention (in combination) vs. a group who just receive a workplace exercise intervention. Both interventions will be guided by health coaches. Given the limited research with health coaching and workplace interventions for university workers, the aim is to contribute to a developing research literature. This study is geared to engage university employees at their workplace over a 3 month period. Participants

will be assessed through pre and post physical and psychological measures and will also undergo semi-structured interviews (SSI).

Study Design

The proposed study implements a workplace physical fitness intervention combined with mindfulness meditation, compared with just a workplace fitness intervention, with one-on-one health coaching in both arms, for employees of York University. This randomized trial will allocate participants to one of 2 groups: the exercise protocol and health coaching, or the same exercise protocol with health coaching and an additional mindfulness meditation intervention component.

Eligible candidates must consent to participation in the study and refusal rates will be documented to assess subject representativeness; participants will be asked for refusal reasons to assist in future workplace-based interventions. Participants will be asked to complete a baseline demographic profile, a physical activity questionnaire and multiple self-report instruments that measure psychological functional and mood variables, along with fitness testing (VO_2 peak and body composition)**.** Additional information collected will include a history of disease, smoking behaviour, previous fitness behaviour along with a PAR-Q+ (Physical Activity Readiness Questionnaire) (conducted prior to baseline fitness testing). Participants will also undergo HRV testing to enable better understands of training effects on the heart and a qualitative interview will be used to assess their intervention experiences. These assessments will be conducted at three different time points for participants: baseline, end of intervention {12 weeks (3 months)} and at 3 month follow-up {24 weeks (6 months)}. All participants will be expected to complete the questionnaire package, physiological assessments, HRV testing and the semi-structured interview at all three time points.

Study Visits

We are recruiting 60 university employees (30 for exercise and health coaching and 30 for exercise, health coaching and mediation) to take part in this study lasting 24 weeks in complete duration (12 weeks for intervention and 12 weeks later at follow-up). Should you agree to participate; weekly health coaching sessions every week, which is telephone based, will be conducted. In addition there are 3 time points that you will need to meet with a research coordinator in order to complete assessments: questionnaires, fitness and body composition assessments, and semi-structured interview (at baseline, at study completion [3months (12weeks) and at 3 month follow-up (24 weeks)].

Participation

Should you decide to participate; you will be randomly assigned to either the exercise and health coaching arm or the exercise, meditation and health coaching arm. The study coordinator will then schedule a time to conduct the baseline assessment. If you choose not to participate, we would ask you for your permission to collect information about your reason(s) for refusal. Refusing to be in the study will not affect your care in anyway.

Procedures

The baseline fitness assessment will be scheduled at the time of your screening visit to review your current levels of fitness and health. You may be excluded from the study if exercise may result in a heightened risk for unhealthy events. Subsequent assessments (3month and 3 month

follow-up), will also follow the same fitness assessment protocol. The fitness assessments will be conducted by a certified exercise physiologist in a study office. The questionnaires will be answered independently. The qualitative interview will be conducted at the time of each assessment. It will be audio recorded and the interviewer will be making additional notes to help facilitate the interview process.
All information gathered during the assessments will be kept strictly confidential.

The measurements included in this study and at each assessment are:
Questionnaires:

- Demographics Questionnaire (~5 min)
- Beck Anxiety Inventory (BAI) (~5 min)
- A Depression Questionnaire (CES-D) (~7min)
- Perceived Stress Scale-Short Form (~2-3 min)
- Five Facet Mindfulness Questionnaire- Short Form (FFMQ-SF) (~5 min)
- Godin Leisure Time Exercise Questionnaire (GLTEQ) (~2-3 min)
- Effort-Reward Imbalance Questionnaire (ERI and OC) (~5 min)

Physical Assessments:

- Body Composition Assessment (height, weight, and waist girth) (~5min)
- VO2 Peak Test (~20 min)
- Heart Rate Variability (HRV) (~10 mins)

Qualitative Interview:

Semi-structured interviews assessing employees' experiences experienced during the study. Guided questions will be utilized to facilitate the interview. (~30 mins)

Each assessment will require you to complete a package of 6 questionnaires assessing various HRQOL factors, a brief demographic profile, followed by fitness assessment and a semi-structured qualitative interview. Each assessment visit will last approximately 90 minutes, for 3 assessment time points (baseline, 3 months and 3 months follow-up).

Exercise Program
Participants in the walking exercise program with a moderate to vigorous intensity, or a Rate of Perceived Exertion of 4-8 on a scale of 10. The walking exercise program will be tailored to meet the current fitness level of participants. You will receive instruction and demonstration of walking pace, intensity monitoring and safety measures during exercise.

Heart Rate Variability
Participants in each group will undergo heart rate variability measurements at baseline, 12 weeks and at 3-month follow up. They will follow an orthostatic protocol, used to assess heart rate and heart rate variability between training and recovery while examining the induced changes on the autonomic nervous system. Participants will be asked, at the baseline measure, to lay on their back breathing normally for five minutes with the electrocardiogram (ECG) attached and then stand still for another five minutes.

Health Coaching Program:
The health coach will guide the coaching sessions on a weekly (12 sessions) basis, focused on key issues related to mood-anxiety management, dietary difficulties, and healthy physical

activity, including the exercise program that is a key intervention component. You will speak with your coach on the phone about issues affecting your psychological, physical well-being. Telephone-Based Counselling (TBC) has been shown to be effective in improving psychosocial functioning.

Information collected by the health coach through your conversations can be added and explored further in your interviews.

Mindfulness Meditation
Participants randomized to the mindfulness meditation and exercise group will attend sessions either in person or via ADOBE CONNECT (online login) led by Dr. Paul Ritvo. They will participate at scheduled times, 3 times per week for 12 weeks, during work hours and/or during their time on campus (after work hours). The Mindfulness Meditation intervention will incorporate varied types of MBI techniques adapted from MBSR, MBCT, and ACT.

Qualitative Interviews
Exercise adherence is critical to the effectiveness of exercise interventions. Open semi-structured interviews represent a rigorous and detailed method for investigating exercise adherence as reports about exercise experience are received in the patient's own words. In this study we will conduct interviews on all participants, pre-intervention, post-intervention and at follow-up. We will examine participants' view on exercise responses and their thoughts, emotions and physical experiences that evolve with participation over time. This will identify key factors relevant to adherence as well as their perspective on their work performance at key points in their experiential trajectory. Using this theoretical formulation as foundation, study results will be used to develop an optimal workplace exercise program.

Follow-up Visits
You will be required to return to the study centre 2 additional times after the baseline visit to complete the same measures as in your baseline visit. Your first follow-up visit will occur at the end of the intervention at 12 weeks and the last visit will occur at follow-up 3 months later.

Reminders:
- You should not conduct heavy physical activity on the day of your assessment
- You should not drink a caffeinated beverage before your visit
- You should not smoke before your visit
- You should not eat within 2 hours of your visit
- It is best to inform your study team about anything that worries you
- It is best to inform your study team if you change your mind about being in the study
- It is best to ask your study team any questions related to the study and/or exercise program

Risks and Discomforts
The risks of experiencing a cardiac incident (heart attack, chest pain, etc.) involved in completing the physical assessments, questionnaires and exercise program are minimal (approximately 1/20000 or 0.00005%). All physical assessments will be conducted by a certified exercise physiologist using standardized protocols and clean equipment.

The fitness programs employed in this study are within the guidelines of recommended exercise frequency, duration and intensity for inactive individuals and have been used in previous studies. You will receive an information and education session on the appropriate exercise technique, intensity monitoring practice, and safety guidelines for your exercise program. You will be contacted by a study staff member to ensure that your program is being successfully maintained and so that any limitations, barriers, or problems may be addressed. Possible side-effects may include muscle soreness and tenderness.
You will also be responding to questionnaires that have been used in numerous studies. There are minimal risks associated with answering these questions. You may refuse to answer any questions that you do not feel comfortable with**.**

In addition, you will be asked to participate in interviews documenting your experiences with the program. There are minimal risks associated with answering these questions. You may refuse to answer any questions that you do not feel comfortable with**.**

Benefits of the Research and Benefits to You:
You may or may not receive medical benefit from your participation in this study, although previous studies suggest that exercise and counselling/coaching programs provide beneficial effects on quality of life and physical fitness. This study will provide you with new information that is learned during the study that might affect your decision to stay in the study. You will have access to the exercise physiologist if you have any questions or concerns about your current physical activity and exercise programs. Additionally, information learned from this study may benefit other university staff employees working mentally and physically demanding jobs.

Voluntary Participation
Your participation in the research is completely voluntary and you may choose to stop participating at any time. If you decide to participate, you can refuse to answer any questionnaire questions you do not want to answer and interview questions by saying "pass".

Withdrawal from the Study
You may stop participating in the study at any time, for any reason, if you so decide. Your decision to stop participating or to refuse to answer particular questions, will not affect your relationship with the researcher, York University or any other group associated with this research project. If you decide not to be a part of the any longer please notify the researcher should you wish to withdraw from the study. In the event that you withdraw from the study, all associated data collected will remain as collected data for the study. No new information will be collected without your permission.

Confidentiality
If you agree to join this study, your personal health information collected will only be for the need of the study. Personal health information is any information that could be used to identify you and includes your:

- name,
- telephone number,
- date of birth,

- new or existing medical information relevant to the study, dates and results of medical tests or procedures.

The information that is collected for the study will be kept in a locked and secure office, in a locked cabinet and password encrypted computer by the study coordinator for 7 years, then shredded by the confidentiality bin disposal Only the study team will be allowed to look at your records. Representatives of the York University Research Ethics Board may look at the study records and at your personal health information to check that the information collected for the study is correct and to make sure the study followed proper laws, ethics and guidelines.

All information collected during this study, including your personal health information, will be kept confidential and will not be shared with anyone outside the study unless required by law. You will not be named in any reports, publications, or presentations that may come from this study. Within the study, for assessments and data analysis, participants will be given numerical coded ID's to enhance patient confidentiality. The identifying list to the numerical codes will be store in a separate password encrypted computer file on a password encrypted computer and any identifying forms will be stored separately in a separate file in a locked and secure office, in a locked cabinet.

Questions
If you suffer any side effects or other injuries during the study, or you have general questions about the study, you may contact the Principal Investigator, Shalini Moonsammy Persaud (Ph.D. candidate); the graduate supervisor to the study, Dr. Paul Ritvo, Ph.D.; or the graduate program, Kinesiology and Health Sciences.

This research has been reviewed and approved by the Human Participants Review Sub-Committee, York University's Ethics Review Board and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process, or about your rights as a participant in the study, you may contact the Senior Manager and Policy Advisor for the Office of Research Ethics.

Legal Rights and Signatures:
I _____, consent to participate in Supporting Fitness at the Workplace: Incorporating a workplace exercise intervention and health coaching for York University employees, conducted by Shalini Moonsammy Persaud. I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by signing this form. My signature below indicates my consent.

_____	_____	_____
Participant's Name (print)	Participants Signature	Date
_____	_____	_____
Investigator	Signature	Date

A Study on Suporting Fitness in the Workplace

Questionnaire Package

This package is intended for employees at York University. You will have to complete this survey at three time points during this study: baseline, 12 week, and at a 12 week follow-up meeting (24 weeks).

Thank you for your participation!

SURVEY ID #: _____

DATE DELIVERED:_____

DATE RECEIVED:_____

TRACT ID #: _____

Beck's Anxiety Inventory (BAI)

Below is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by that symptom during the past month, including today, by circling the number in the corresponding space in the column next to each symptom.

	Not At All	Mildly but it didn't bother me much	Moderately – it wasn't pleasant at times	Severely – it bothered me a lot
Numbness or tingling				
Feeling hot				
Wobbliness in legs				
Unable to relax				
Fear of worst happening				
Dizzy or lightheaded				
Heart pounding/racing				
Unsteady				
Terrified or afraid				
Nervous				
Feeling of choking				
Hands trembling				
Shaky / unsteady				
Fear of losing control				
Difficulty in breathing				
Fear of dying				
Scared				
Indigestion				
Faint / lightheaded				
Face flushed				
Hot/cold sweats				

Godin Leisure-Time Exercise Questionnaire

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).

Times Per Week

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)

b) MODERATE EXERCISE _____
(NOT EXHAUSTING)

(e.g., fast walking, baseball, tennis, easy bicycling,
volleyball, badminton, easy swimming, alpine skiing,
popular and folk dancing)

c) MILD EXERCISE _____
(MINIMAL EFFORT)

(e.g., yoga, archery, fishing from river bank, bowling,
horseshoes, golf, snowmobiling, easy walking

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)?

1. Often _____ 2. Sometimes _____ 3. Rarely/Never _____

CES-D

Listed below are statements about some of the ways that you may have felt or behaved during the past week. For each of the statements, please indicate how often you felt this way during the *past week* by circling the number that best applies to you.

During the past week:	**Rarely or none of the time (less than a day)**	**Some or a little of the time (1-2 days)**	**Occasionally or a moderate amount of the time (3-4 days)**	**Most or all of the time (5-7 days)**
1. I was bothered by things that usually don't bother me	0	1	2	3
2. I did not feel like eating; my appetite was poor	0	1	2	3
3. I felt that I could not shake off the blues even with help from my family and friends	0	1	2	3
4. I felt that I was just as good as other people	0	1	2	3
5. I had trouble keeping my mind on what I was doing	0	1	2	3
6. I felt depressed	0	1	2	3
7. I felt that everything I did was an effort	0	1	2	3
8. I felt hopeful about the future	0	1	2	3
9. I thought my life had been a failure	0	1	2	3
10. I felt fearful	0	1	2	3
11. My sleep was restless	0	1	2	3
12. I was happy	0	1	2	3
13. I talked less than usual	0	1	2	3
14. I felt lonely	0	1	2	3
15. People were unfriendly	0	1	2	3
16. I enjoyed life	0	1	2	3
17. I had crying spells	0	1	2	3
18. I felt sad	0	1	2	3
19. I felt that people disliked me	0	1	2	3
20. I could not get "going"	0	1	2	3

ERI-L

The following items refer to your present occupation. For each of the following statements, please indicate whether you strongly agree, agree, disagree or strongly disagree.

		STRONGLY DISAGREE	**DISAGREE**	**AGREE**	**STRONGLY AGREE**
ERI 1	I have constant time pressure due to a heavy work load				
ERI 2	I have many interruptions and disturbances while performing my job				
ERI 3	I have a lot of responsibility in my job				
ERI 4	I am often pressured to work overtime				
ERI 5	My job is physically demanding				
ERI 6	Over the past few years, my job has become more and more demanding				
ERI 7	I receive the respect I deserve from my superior or a respective relevant person				
ERI 8	I experience adequate support in difficult situations				
ERI 9	I am treated unfairly at work				
ERI 10	My job promotion prospects are poor				
ERI 11	I have experienced or I expect to experience an undesirable change in my work situation				
ERI 12	My employment security is poor				

ERI 13	My current occupational position adequately reflects my education and training				
ERI 14	Considering all my efforts and achievements, I receive the respect and prestige I deserve at work				
ERI 15	Considering all my efforts and achievements, my job promotion prospects are adequate				
ERI 16	Considering all my efforts and achievements, my salary / income is adequate.				

OC Scale

The following items refer to your present occupation. For each of the following statements, please indicate whether you strongly agree, agree, disagree or strongly disagree

		STRONGLY DISAGREE	**DISAGREE**	**AGREE**	**STRONGLY AGREE**
OC1	I get easily overwhelmed by time pressures at work				
OC2	As soon as I get up in the morning I start thinking about work problems.				
OC3	When I get home, I can easily relax and ‘switch off' work.				
OC4	People close to me say I sacrifice too much for my job.				
OC5	Work rarely lets me go, it is still on my mind when I go to bed.				
OC6	If I postpone something that I was supposed to do today I'll have trouble sleeping at night.				

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1.	In the last month, how often have you been upset because of something that happened unexpectedly?	**0**	**1**	**2**	**3**	**4**
2.	In the last month, how often have you felt that you were unable to control the important things in your life?	**0**	**1**	**2**	**3**	**4**
3.	In the last month, how often have you felt nervous and "...stressed"?	**0**	**1**	**2**	**3**	**4**
4.	In the last month, how often have you felt confident about your ability to handle your personal problems?	**0**	**1**	**2**	**3**	**4**
5.	In the last month, how often have you felt that things were going your way?	**0**	**1**	**2**	**3**	**4**
6.	In the last month, how often have you found that you could not cope with all the things that you had to do?	**0**	**1**	**2**	**3**	**4**
7.	In the last month, how often have you been able to control irritations in your life?	**0**	**1**	**2**	**3**	**4**
8.	In the last month, how often have you felt that you were on top of things?	**0**	**1**	**2**	**3**	**4**
9.	In the last month, how often have you been angered because of things that were outside of your control?	**0**	**1**	**2**	**3**	**4**
10.	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	**0**	**1**	**2**	**3**	**4**

Five Facet Mindfulness Questionnaire- SF

Below is a collection of statements about your everyday experience. Using the 1–5 scale below, indicate, in the box to the right of each statement, how frequently or infrequently you have had each experience in the last month. Please answer to what reflects your experience, not what you think your experience should be.

never or very rarely true 1	**not often true 2**	**sometimes true sometimes not true 3**	**often true 4**	**very often or always true 5**

1	I'm good at finding the words to describe my feelings	
2	I can easily pit my beliefs, opinions, and expectations into words	
3	I watch my feelings without getting carried away by them	
4	I tell myself that I shouldn't be feeling the way I'm feeling	
5	It's hard for me to find the words to describe what I'm thinking	
6	I pay attention to physical experiences, such as the wind in my hair or sun on my face	
7	I make judgments about whether my thoughts are good of bad	
8	I find it difficult to stay focused on what's happening in the present moment	
9	When I have distressing thought or images, I don't let myself be carried away by them	
10	Generally, I pay attention to sounds, such as clocks ticking, Birds chirping, or cars passing	
11	When I feel something in my body, its hard for me to find the right words to describe it	
12	It seems I am "running on automatic" without much awareness of what I'm doing	
13	When I have distressing thoughts or images, I feel calm soon after	
14	I tell myself I shouldn't be thinking the way I'm thinking	
15	I notice the smells and aromas of things	
16	Even when I'm feeling terribly upset, I can find a way to put it into words	
17	I rush through activities without being really attentive to them	
18	Usually when I have distressing thoughts or images I can just notice them without reacting	
19	I think some of my emotions are bad or inappropriate and I shouldn't feel them	
20	I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow	
21	When I have distressing thoughts or images, I just notice them and let them go	
22	I do jobs or tasks automatically without being aware of what I'm doing	
23	I find myself doing things without paying attention	
24	I disapprove of myself when I have illogical ideas	

Demographics

1. What is your current marital status?
____ Married
____Living as married
____Divorced
____Separated
____Widowed
____Never married

2. What is your sex?
____Male
____Female

3. Which of the following categories best describes your ethnic background? Are you…
____Caucasian
____African Canadian, Caribbean Canadian
____Asian
____Aboriginal
____Hispanic
____Middle Eastern
____Other (Specify)
__ __Don't Know
____Refused

4. What is the highest level of education you have completed?
____ Completed less than High School
____Completed High School or Equivalent Degree (GED)
____Completed some College/University
____Completed College (BS or BA)
____Master's Degree
____PhD or other Doctorate Degree
__ __Don't Know
____Refused

5. What is your yearly household income?
____less than 50,000
____$50,000 - $89,000
____$90,000 - $129,000
____$130,000 - $169,000
____$170,000 - $209,000
____over $210,000
___ _Don't Know
____Refused

6. What is your current occupation?

_____
_____
_____
_____

7. How many years have you worked at your current job?
_____Years

8. Are you scheduled on shift work?
___No
___Yes, with nightshift
___Yes, without nightshift

9. Over the last 4 months, how many days were you absent from work that was not attributed to vacation or holidays, but rather for health purposes (mental health day, fatigue, sick).
_____
_____
_____

Intake Assessment Form

Study ID: _____ On Study: □ Yes □ No Informed Consent □ Yes □ No

PAR-Q □ Yes □ No Questionnaires Completed □ Yes □ No

Assessor Name: _____ Baseline Assessment Date:_____

Sex: □ M □ F Age: _____

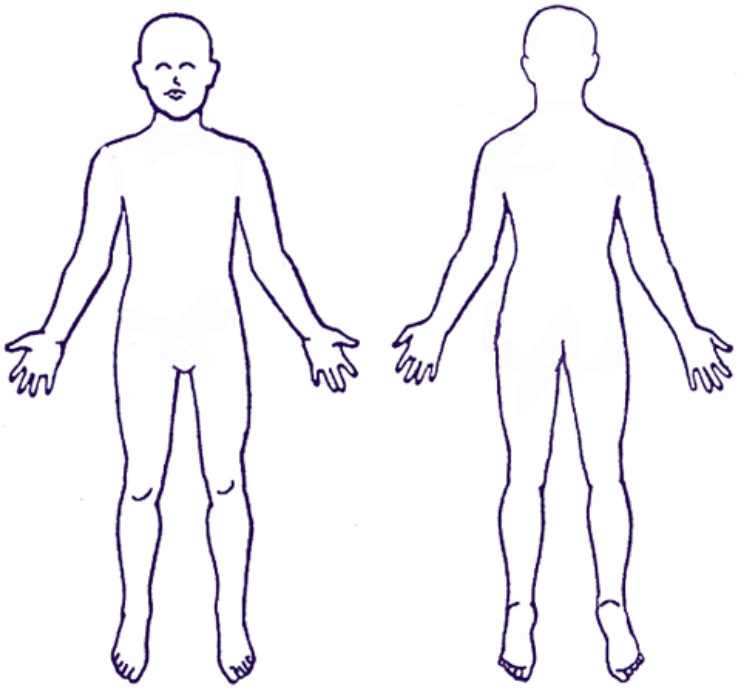
Emergency Contact: Name _____ Telephone: _____

Medical History	Medication	Date Started	Date Completed

Current Functional Limitations:

Personal Care:
Vocational:
Recreation:
Sleep:
Driving:
Social History:
Exercise History: □ Yes □ No Smoker: □ Yes □ No

Location of Pain and Paraesthesias:



Current Symptoms:

1_____ Sharp Dull Throb Burning Superficial Deep Other

_____ Eased By: Ice Heat Meds Rest Nothing

_____ Aggravated By:_____

2

_____ Sharp Dull Throb Burning Superficial Deep Other

_____ Eased By: Ice Heat Meds Rest Nothing

_____ Aggravated By:_____

3_____ Sharp Dull Throb Burning Superficial Deep Other

_____ Eased By: Ice Heat Meds Rest Nothing

_____ Aggravated By:_____

Primary Cardiovascular Screening:

Resting Heart Rate: _____bpm Blood Pressure:_____

Anthropometry:

HEIGHT	Cm	Inches
WEIGHT	Kg	Lbs
WAIST CIRCUMFERENCE	Cm	Inches
BODY MASS INDEX		Kg/m^2

Heart Rate Variability:

Discussion Of Program/Concerns:

_____
_____
_____
_____
_____
_____

Aerobic Fitness Assessment? □ Yes □ No

Follow-up Assessment Form

Study ID: _____ On Study: □ Yes □ No Informed Consent □ Yes □ No

PAR-Q □ Yes □ No Questionnaires Completed □ Yes □ No

Assessor Name: _____ Baseline Assessment Date:_____

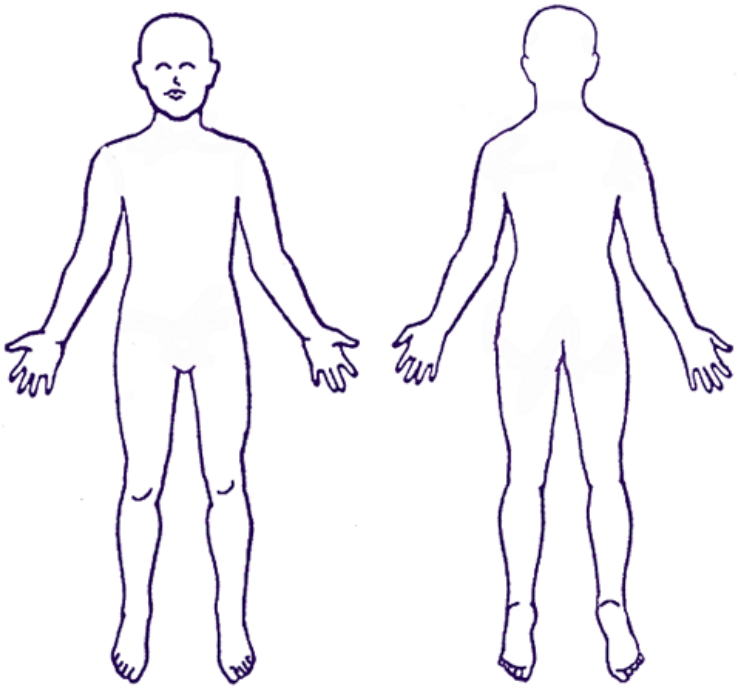
Sex: □ M □ F Age: _____

Medical Status	Medications	Date Started	Date Completed

Current Functional Limitations:

Personal Care:
Vocational:
Recreation:
Sleep:
Driving:
Social History:
Exercise History: □ Yes □ No

Location of Pain and Paraesthesias:



Current Symptoms:

1

_____ Sharp Dull Throb Burning Superficial Deep Other

_____ Eased By: Ice Heat Meds Rest Nothing

_____ Aggravated By:_____

2

_____ Sharp Dull Throb Burning Superficial Deep Other

_____ Eased By: Ice Heat Meds Rest Nothing

_____ Aggravated By:_____

3

_____ Sharp Dull Throb Burning Superficial Deep Other

_____ Eased By: Ice Heat Meds Rest Nothing

_____ Aggravated By:_____

Primary Cardiovascular Screening:

Resting Heart Rate: _____bpm Blood Pressure:_____

Anthropometry:

HEIGHT	Cm	Inches
WEIGHT	Kg	Lbs
WAIST CIRCUMFERENCE	Cm	Inches
BODY MASS INDEX		Kg/m^2

Heart Rate Variability:

Discussion Of Program/Concerns:

_____
_____
_____
_____
_____
_____

Aerobic Fitness Assessment? □ Yes □ No

Aerobic Fitness Test
(modified Bruce Protocol)

RHR_____
Age_____
APMHR_____

Date:_____ Time point_____ Study ID:_____

Min.	Stage	Speed (MPH)	Grade (%)	HR	RPE	BP	METs
1	(1)	(1.7)	(0)				(2.3)
2							
3							
4	(2)	(1.7)	(5)				(3.5)
5							
6							
7	(3)	(1.7)	(10)				(4.6)
8							
9							
10	(4)	(2.5)	(12)				(7.0)
11							
12							
13	(5)	(3.4)	(14)				(10.2)
14							
15							
16	(6)	(3.7)	(15)				
17							
18							
19							
20							
Active Recovery							
1	AR	1.7	0				
2	AR						
3	AR						
4	AR						
5	AR						

Comment (e.g. reason for test termination):

_____

_____

ACSM Walking Equation for VO2 Max Estimation:

$VO_2 = (S \times 0.1) + (S \times G \times 1.8) + 3.5$

S= Speed in m/min (26.8m/min = 1 mph)
G= Grade (% incline) in decimal form

APPENDIX B: WALKING EXERCISE SCHEDULE, MINDFULNESS SCHEDULE AND MINDFULNESS AUDIOS

Walking Exercise Work-out Schedule

Please note that these exercises are meant to be **completed during your work day**. You will be asked to record how many miles/km completed and on what days your exercise was completed on. At the end of the week you will then total the distance completed.

You will also be asked to record your heart rate at the end of each bout of exercise. Count how many beats in 10 seconds either on your radial artery (on wrist, thumb side) or carotid artery (neck), with your index and middle finger, and then multiply by 6.

WEEK	TASK FOR COMPLETION	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	TOTAL FOR WEEK COMPLETED
Ex: WEEK 1 (50 yr old, resting HR of 85)	*15 MINUTES 3X/WK*		*15 MINUTES 1200 steps RPE 3 ~110bpm (80 steps/min & 30% HHR)*	*15 MINUTES 1500 steps RPE 5 ~ 128 bpm (100 steps/min & 50 % HHR)*		*15 MINUTES 1650 steps RPE 6 ~ 136 bmp (110 steps/min & 60% HRR)*	*45 MINUTES 3.2 KM 4350 steps*
WEEK 1	**15 MINTUES 5X/WK**						
WEEK 2	**30 MINUTES 3X/WK**						
WEEK 3	**30 MINUTES 4X/WK**						

WEEK 4	**30 MINUTES 5X/WK**						
WEEK 5	**45 MINUTES 2X/WK & 30 MINUTES 1X/WK**						
WEEK 6	**45 MINUTES 3X/WK**						
WEEK 7	**45 MINUTES 3X/WK & 30 MINUTES 1X/WK**						
WEEK 8	**60 MINUTES 1X/WK & 30 MINUTES 2X/WK**						
WEEK 9	**60 MINUTES 2X/WK & 30 MINUTES 2X/WK**						
WEEK 10	**60 MINUTES 3X/WK & 30 MINUTES 1X/WK**						

WEEK 11	**60 MINUTES 3X/WK & 30 MINUTES 2X/WK**						
WEEK 12	**60 MINUTES 3X/WK & 30 MINUTES 2X/WK**						

Mindfulness Meditation Schedule

Mindfulness Meditation Audios

You are required to attend 3 mindfulness meditation sessions in a week. If you cannot please use the audio files as a supplement to attending. I have attached the mindfulness meditation audios. I hope these audios will assist you in the completion of the mindfulness meditation component assigned to you. You can listen to these recordings at your convenience either during work hours or after work hours. Below are possible links:

https://www.youtube.com/watch?v=pPc7lp62Ohs (5 mins)

https://www.youtube.com/watch?v=OXqM2CCtm0Y (10 mins)

https://www.youtube.com/watch?v=o-Bm3dKfiPA (15 mins)

https://www.youtube.com/watch?v=D7wcU_sELvU (30 min)

https://www.youtube.com/watch?v=QmcSa4bXNU0 (40 min)

https://www.youtube.com/watch?v=jU2uBFqgc2o (41 mins)

APPENDIX C: HEALTH COACHING TRAINING TECHNIQUES, GUIDE, MANUAL AND NOTES FORM

Health Coaching 101

What is the purpose of Health Coaching?

- Goal is to:
  - Stimulate change in participants' thinking and behaviour
  - Encourage participants' to talk about healthy changes that can be executed in their life
  - Reward healthy changes taken and discussed.

Simple Rules

- Do not provide exercise prescription
- Do not diagnose
- Do not attack, ridicule or belittle participants'
- Do not dismiss concerns that participants' bring up without exploring or bringing to the attention of myself or Dr. Ritvo
  - (ex: feelings of worthlessness, suicidal thoughts, discussions of preforming erratic and harmful behaviours to themselves or others)

Tips to Being a Good Health Coach!

- Remember the Goals and Visions the participant has
- Be a good listener (take notes, stay focused on current discussions, do not "mind read")
- Every participant is different
  - Some may think they don't need help…meet each one at their level
  - Might need to communicate over email or phone
- Your experiences may not always be beneficial to share
- Your goal is not to force change, but encourage.
  - Provide rationales (from literature) for behaviours
    - Ex. Exercise been shown to reduce cardiovascular related disease, stress and diabetes related symptomology amongst individuals
    - Ex. Meditation has been shown to help reduce stress in those who practice.

Health Coaching Guides

Hi,

Below are reminders and guide on how to approach your conversations with participants

You are not a counsellor you are there to motivate the participant. Therefore, your conversations are structured as such. Encourage participants, but be cautious of people who need a counsellor, or friendship. You are guiding them to be active, healthy and on task.

Let them know from your first conversation what the structure is meant to be, so they have an idea on what to expect from the weekly conversations. Let them know you are checking in on them to address any issues that might be affecting their ability to exercise regularly. As well you are to be a positive influence when they feel that they are not committed or executing their goals.

Questions to start of the conversation:

How was your week?

Did you experience challenges or challenging issue to the exercise plan? If yes what where there?

> Possible Response to Participant having difficult time exercising: Sometimes things come up and you can't always stay consistent, but that's alright you can't beat yourself up about it. You just got to be empathetic to yourself and stay motivated. (No judgment on the participant, just be supportive and motivating)
>
> Provide options when possible to help a participant out:
>
> 1. Too cold outside: walking within their building or underground.
> 2. Pains in the knees, legs (let me know): try walking slightly slower and see how that feels. Make sure proper shoes are worn. Avoid inclines/stairs if possible.
> 3. Boss is coming down on them: Let them know that the stress they are feeling is warranted, but they should not allow it to consume them. Still let them take a moment for themselves and go for a walk to clear their head. It doesn't have to be the length of time the study suggests for that week, but they should start small and see how they feel and if they feel they can go longer encourage that. Always let them know it's one day at a time (this can also go for too busy at work and not enough time).

What do you feel you encountered this week that made exercising more challenging?

Is your goal still to achieve your exercise potential?

How important is it to achieve your exercise goals for the next week? Scale 1-10

How confident are you that you will achieve your exercise goals for the next week? Scale 1-10

How motivated are you to achieve your exercise goals for the next week? Scale 1-10

Workplace Study Intervention Health Coaching Manual
Developed by Dr. Paul Ritvo

Electronic connectivity through smartphone technology, bio-monitoring devices and related software establishes a 24 hour per day, 7 day per week communication channel when one aims to improve health. We can reflect on and evaluate nearly everything we do in how it affects health. We all have conditions that can improve with healthy changes of behaviour. The key is to make the changes that are healthiest for you, and those you can continue to do as you optimize your health over the long term.

In this electronic age, we're living with a moment-by-moment consciousness due to increasingly rapid change in economics, employment, the environment and medical science. Change is becoming the norm, with status quo routines the exceptions in a change-dominated world culture. The question arises as to how people get 'stuck' in a status quo which misses or avoids opportunities for positive change. This question is one we will answer, together, as we work with you in improving your health.

It makes sense that when you're getting ready for a 'change', you think and talk about it. Our aim is to stimulate and exchange the thinking and talking about change that serves you best. We'll do this by using the advantages of You Tube and other video tools, combined with printed material, slides, CDs, electronic messaging, verbal messaging, direct phone contacts and face-to-face contacts. All of these forms of connectivity are designed to optimally stimulate and reward healthy changes in the next 3 months.

Which Changes?

We'll focus on: **1) exercise, 2) diet**, **3) stress management, 4) self-monitoring** and, when necessary, **5) medication adherence.** Inevitably you're going to (**1) set goals, (2) monitor how you're doing and (3) when there are differences between goals and behaviour**, **we'll explore ways to reduce them.**
If you choose to use health coaching contact and the Connected Wellness Platform software, you'll be able to readily share all your results and get coaching when you most need it.

Why exercise?

There are health scientists who believe that if you're going to focus on one health behaviour, it should be exercise. We won't just focus on exercise as we're persuaded by the science favouring other changes as well. But we'll start with exercise.

The benefits of regular physical activity supported in high level clinical studies include decreased blood pressure, decreased glucose intolerance, decreased depression and anxiety, weight loss, increased strength, increased sleep quality, increased attention capacity and working memory, and increased brain tissue volume, an overall indicator of brain (tissue) health.

It's recommended that adults do a minimum of 150 minutes of aerobic exercise per week, and engage in resistance training (strength training) on 2-3 days per week. These recommendations

are supported by Public Health Agency of Canada,[1] The Canadian Diabetes Association,[2] The American College of Sports Medicine,[3] the National Comprehensive Cancer Network,[4] the American Cancer Society,[5] and the US Department of Health and Human Services.[6] You may have to **work up** to these numbers because we all have become more sedentary. But in working up to your goals, the research literature shows that bouts of exercise as brief as 10 minutes have healthy effects.[7] Therefore, several 10 minute bouts of exercise at various times in the day (e.g. brisk walks), totalling the recommended 30 minutes, can be an effective way to increase your exercise.

Screening for Exercise

Although many scientists view it as more dangerous *not* to exercise, screening before starting a new exercise program is important to: 1) detect medical conditions which may contra-indicate exercise, and 2) gather health information useful in constructing an optimal exercise program.

In order to screen appropriately, we employ the Physical Activity Readiness Questionnaire (PARQ), published by the Canadian Society of Exercise Physiology (CSEP).[8] This simple tool indicates if there's any need for further screening by a Certified Exercise Physiologist (CEP) who can then assist in completion of a PARQ+ which guides a more detailed discussion. Upon completion of the PARQ+, the CEP then makes a decision on an appropriate exercise prescription, or decides further medical clearance is necessary before an exercise program begins. The PARQ and PARQ+ are both available for download at www.csep.ca.

Starting an Exercise Program

Once screening is complete, you may want to start with a walking program which is a low intensity, excellent physical activity with many health benefits. If you're concerned about starting an exercise program, walking for as little as 10 minutes at a time, 3 times a day, on 5 days a week meets the recommend guidelines for exercise (i.e. 150 minutes/week).

But since there are lots of different ways to exercise, a very important question concerns the type of exercise you enjoy or have enjoyed in the past? Also what equipment do you have or can you obtain? Is there an accessible gym nearby your home? At work? Is there a treadmill? Weights? Resistance Bands? If you've had these kinds of access before, what stopped you from using it to best advantage in the past? Do you have limitations or conditions that stop you from engaging in specific exercises? These are important questions to discuss with your health coach.

Now we'll explore Aerobics and Resistance exercise to see if either or both types will be helpful and healthy for you.

What exactly is Aerobic Exercise ?

Aerobic Exercise is any form of physical activity that increases heart rate and involves muscular contraction in a rhythmic cycle.[9,10] Aerobic exercise may include walking, running, jogging, cycling, playing basketball or squash, swimming and dancing. The intensity (usually measured

via heart rate, or by a rating of perceived exertion) that you should be working at varies depending on your medical and exercise background. You can discuss an optimal range with your health coach.

Resistance Training ?

Resistance training or weight lifting is characterized by lifting or pushing against some form of resistance, such as gravity, resulting in muscular development.[9,10] The increased demand on muscles during resistance training causes the muscle to consume higher levels of glucose, therefore decreasing blood glucose levels.[10] The glucose needs of trained muscles remain higher than baseline for about 24 hours.[10] The stress of resistance training on muscles causes slight degrees of damage, which result in repairs of muscle tissue that increases muscular strength and size.[11] Due to this damaging-repairing cycle, it is important to give muscles 24-48 hours rest before working them again. A well-balanced exercise routine should therefore be comprised of both aerobic and resistance training: while you're undergoing the 24-48 hours of rest required, you can be engaged in your aerobic regimen.[9]

If you're self-sufficient with exercise (and don't need instruction) and have a fitness facility available or, alternatively, access to sufficient equipment, you may only need behavioural support to use exercise healthfully. The first step, in any case, is determining your workout schedule. According to our experiences, the most common reason for people not exercising is the perception of "not having the time". It's worth exploring your current schedule and establishing a weekly routine that helps you identify specific times when you can incorporate exercise. In exploring your schedule, you probably won't find 'free' time, but it's helpful to look through the information needed to help you and your coach rearrange your schedule to incorporate exercise.

Establishing days and times for exercise and arriving at a contract with yourself about when you will do sessions is important. It concretizes a decision, and introduces accountability. If you want your health coach to help, he or she can send smartphone reminders before sessions and encouragement messages after sessions. Your health coach can help you establish a new exercise process that will gradually become more and more self-rewarding once you begin feeling the positive benefits of exercise. Meanwhile it is important to keep asking the question of whether the exercise mode and schedule you have selected is right for you and, if not, what needs to be adjusted. The key questions are:

1) How was your last exercise session, overall ?
2) How did it feel, per unit time, as in the beginning, middle and ending segments of the session? How did it feel later in the day or evening and the next morning or day?

When you feel resistance to exercising

In contrast to what you would like to feel, you'll sometimes experience resistance to following through on a planned exercise session.[12] There will also likely be life events that get in the way, like weddings, transporting kids to outings, and minor illnesses (like a flu or cold). Disruptions will happen and must be accepted. But we know that a relatively quick resumption of your exercise plan is often the best way to sustain your plan. The inevitable disruptions you

experience lead to needs for an overview of your exercise program so you can see improvements and that when you feel better, it is result that is systematically linked to the exercise you're doing. This is where wearing a bio-monitoring device can be especially helpful. We're providing a BodyMedia[13] device free of charge but if you search you'll find similar devices you may want to try. We'll focus on the BodyMedia monitor in this manual because it's the first one you'll likely try.

Why do people lapse in exercise programming

For now, it's best to focus on what we have observed with respect to how and why people lapse into exercise non-adherence. The most frequent statement from subjects, in our experience, pertains to the lack of time to fit in exercise sessions. While that reflects a value question, it also reflects practical considerations. The morning exercise time has advantages in that there are fewer distracting events that can impede a scheduled session. If you're feeling a little low on sleep, it may be difficult to gain momentum in the early morning. But it may help to know that exercise will likely help you sleep better before you awaken to exercise.[14,15,16] The added advantage is that exercise benefits will be perhaps more available to you during the day (while at work).

Another key time is during the noon hour (or around lunch), although you will need to take an hour from the workday which might be difficult. The third key time is right after work during early evening. The problem you may confront as you schedule later in the evening is that you may be exercise sensitive such that you may attain too high arousal level to sleep soundly.[17] Some people have to finish their exercise some 3 to 4 hours before bedtime to get the best night's sleep possible.[18]

Bio-monitoring – Generally

As you're probably aware, we are, technologically, on the threshold of being able to monitor our bodies very precisely while going about everyday life. Furthermore, if we take a few minutes out from routines, an even greater array of tools are applicable. Nonetheless, at the current state of technology, we can accurately monitor how much we move (often quantified in numbers of steps) and how soundly we sleep.[19] These are valuable dimensions to track for several reasons. Basically, we're increasingly aware of how our work styles are becoming more sedentary, regardless of intentions to increase physical activity. Your BodyMedia device is useful for helping you increase smaller bouts of exercise during the day, as in walking more and climbing stairs rather than using elevators.[13] By this point, nearly everyone is aware of the benefits of more movement, but it's hard to put awareness into practice. Wearing your BodyMedia provides measures that go beyond what you'll likely recall at the end of day. There's also something about numbers that makes you want to increase them. So, when you face a choice between taking stairs (or not), or walking extra blocks (or not), you'll more likely 'do' the 'extra' rather than continue with standard patterns. While you can't expect the device to track all the variations of planned exercise bouts (it may pick up some, but miss others), that won't be a major problem as you'll be able to personally track those bouts. What bio-monitoring devices are best for is tracking how active your lifestyle is during daytime and evening, and how well you sleep at night. Once again, you may choose to use your BodyMedia for several days per

week and several consecutive months, rather than consistently for the rest of your life. It's not the whole solution for changing exercise patterns, but a piece to the puzzle that will give you support in the right direction.

Bio-monitoring Your Sleep

There is a sleeplessness epidemic sweeping many nations in today's world, according to indications from multiple studies. We can provide precise data if you're interested, but even a few data sets are revealing. A recently completed sleep study in Sao Paulo (Brazil)[20] revealed 32% of 1042 subjects recruited from the general population had objective insomnia while the New Zealand blood donor study (22,389 subjects) detected a 20% prevalence.[21] In the US, a long term study, the Wisconsin Sleep Study (WSS),[22] assessed sleep-disordered breathing (a good marker of sleep disruption) and found major increases over the past 20 years, from 14% to 55% per subgroup (30-49 year olds and 50 – 70 year olds). A specifically Canadian study (2000 subjects) identified 40% of individuals reporting 1 or more insomnia symptoms on more than 3 times weekly and a low incidence of help-seeking (13%)[23] reflecting an under-treatment of sleep problems. Sleep deprivation has been identified as reducing learning, impairing cognitive performance, and slowing cognitive and motor reaction times.[24,25] Most recently, sleep benefits were further understood when an animal study (mice), based on photon imaging, showed natural sleep associated with a 60% increase in interstitial space in the brain, reflecting fluid exchanges which, in turn, indicated clearance of ***b-amyloid***, a neurotoxic waste product that accumulates in the nervous system during waking hours.[26] It would appear that sleep permits our brains to unload waste that accumulates daily. Another key point is that sleep loss seems to result in dysregulation of key hormones (notably leptin and ghrelin) whose dysregulations are associated with greater intakes of food.[27,28,29] If weight loss and better glucose regulation are goals, better sleep will likely help. While sleep requirements vary per person, current data indicate we should aim for about 7 to 7 ½ hours per night.[30] Using the smartphone software you'll be able to manually enter nightly sleep hours while your Body-Media device will provide an additional source of nightly information about how much and how soundly you slept.

Strength Training

Resistance training, where you increase the strength of selective muscles by using specific movement resistances, has been specifically associated with positive mood[31] changes and improvements in attention functioning, verbal and spatial memory and decision-making.[32] Some scientists believe resistance training affects different brain pathways than aerobics, making the inclusion of both forms an important feature of a planned program.[33,34] Perhaps resistance training was once associated solely with weight training and the need to join a gym or buy expensive equipment but times have changed. We can provide elastic bands that are very easily implemented in mild-to-moderate resistance training at home without any other special equipment. You can find these exercises in our exercise manual and our website (Ontarioonthemove.com) which are supplied free of charge.

SMART Goals Help You Organize

SMART refers to how to organize your exercise program. It is helpful to have goals but it's best to have goals that are:
Specific – What specific exercise will you do on what day?
Measureable – How will you quantify progress (i.e. minutes, steps, frequency)?
Achievable – Is the exercise session possible for you to engage in, at this point?
Realistic – Is the type/frequency/duration appropriate for your fitness level?
Timely – What's the best time frame with which to measure progress and success?

This starts with deciding on an appropriate exercise routine (using SMART goals) and dates at which you will review progress (typically a 1-week time frame works best). Either you will do this with your health coach or a personal trainer (if you employ one) or simply hatch a plan that is self –originated. Once you have your schedule, there's the question of how to cue yourself to remember and get started. Again, this can include your health coach, who will be glad to review how you can use your smartphone and your mutual relationship to optimally prepare for exercise (when it's planned) and conduct an optimal session in terms of SMART goal setting. He or she will also review adherence weekly with you and help you make adjustments according to the optimal tuning of goals, needs and responses.
When you have_unsuccessful or missed sessions, it will be important to explore what the situations or reasons were for missed sessions. Identifying barriers will prepare you to confront similar adherence lapses in subsequent weeks. Barriers that result in missed sessions should be well understood. Some common barriers include unexpected work or familial obligations, tiredness at the end of the day, sleeping in, or just "not feeling like it".[35] Remember that all reasons stem back to motivations and goals. Even the busiest person can *find* some time to exercise.

Positive Inclines of **Exercise Duration** and **Exercise Adherence**

Increases in exercise duration and adherence are highly indicative and important. These inclines merge with the realistic perspective that at some point, increases in duration and adherence 'flatten' or level off. Even if you are an Olympic athlete, you cannot keep on increasing exercise duration and intensity indefinitely. Sooner or later you will reach a 'steady-state' where further increases are not recommended and the focus will switch to refinements of your program such that you enjoy sessions more, find them more conducive to experiences of well-being and fitness, and/or linked to some recreational or celebrative event. While this 'steady-state' can differ for everyone, it deserves important consideration. Even if continued increases are necessary, the steady-state experience may be necessary for weeks or months before you become physically and/or psychologically ready for more. Exercise pacing and increases in exercise per unit time are important issues in sustaining your program. You may find sustained exercise activity is surprisingly vulnerable to minor disruptive factors (e.g. an increased schedule or intensity of activity at work). Once again, the goal of lifelong adherence is emphasized, rather than impressive increases in exercise (and even fitness) that are likely to be short-lived. In this program we will focus on 3 months to help establish stability and resilience in your exercise rather than more impressive (but less sustainable) increases.
There are multiple measures designed to capture the client's experience during and after exercise sessions. At this point, we're not necessarily attempting to assess exercise experience as a 'predictor variable' of intervention success. But we're intent on optimizing your experience of

exercise and the questionnaire below (a composite of several different questionnaires) provides a 'heuristic' for exploring and discovering what you can do sustain enjoyable exercise for the 3 months intervention and beyond.[27]

I feel **relaxed** after exercising	5 4 3 2 1 Very much----------Not at all
I feel **less stressed** after exercising	5 4 3 2 1 Very much----------Not at all
I feel in a **better mood** after exercising	5 4 3 2 1 Very much----------Not at all
I **eat** healthier after exercising	5 4 3 2 1 Very much----------Not at all
I'm more sociable **during** exercising	5 4 3 2 1 Very much----------Not at all
I'm more sociable **after** exercising	5 4 3 2 1 Very much----------Not at all
My body **feels stronger** after exercising	5 4 3 2 1 Very much----------Not at all
My body feels **more vibrant and vital** after exercising	5 4 3 2 1 Very much----------Not at all
My mind feels clearer and sharper/more focused after exercising	
Top score = 45/45 > 27 = beneficial gain < 27 = no benefit or detriment	

Diet

Diet Modification

In working with the next of the five key behaviours, our approach to dietary change aims to achieve nearby goals (e.g. incremental changes of eating behaviour). In the process of building confidence for as much diet change as is good for you, the pacing from modest to bigger changes in eating behaviour is left to your discretion, although several indicators (below) provide reliable guidance.

1. **Modifying your portion size** – one proximal goal can involve simply changing intake (when too much intake is indicated). This goal follows the observation that most people eat a finite array of differing foods (or meals), resulting in being conditioned to continue eating the same foods. By changing portions, you keep eating some or all your usual foods, you just eat different portions.
2. **Reducing the sugar in your diet –** there's no worthwhile debate amongst physicians or nutritionist-researchers about sugar as it's unhealthy for numerous reasons.[36] The most important one is there's already too much sugar in our processed foods[36]. While it isn't always true, 'dose-level can make any intake poisonous' a point first expressed by the ancient Greek physician, Paracelsus.[37] With too much sugar in our conventional foods, we're overdosing and the result is too much sugar in our blood with many unhealthy effects on our bodies, including our brains.[36] One recent study (Crane et al., 2013) used 35,264 clinical measurements of glucose levels and 10,208 measurements of glycated hemoglobin levels from 2067 participants without dementia to examine the relationship between glucose levels and dementia risks.[38] Participants included 839 men and 1228 women whose average age was 76 years. During a follow-up of 6.8 years, dementia developed in 524 participants and higher average glucose levels within the preceding 5 years were related to significantly increased dementia risks, with blood glucose levels below levels usually associated with diabetes and pre-diabetes associated with increased risks of dementia (> 100 mg per deciliter). These findings can be summed up as indicating it's healthiest to substantially limit sugar intake to the point where blood sugar levels are well below those levels previously considered to elevate risk.[38] Much can be accomplished by just stopping intakes of sugar-laden fluids (e.g. Coca Cola, Pepsi, Iced Tea) as well as deserts and pastries (e.g. muffins).[39,40,41]
3. **Intake of healthy vegetables, fruits, proteins and fats –** onions, corn, peas, kale, broccoli, red bell pepper, spinach, alfalfa sprouts, brussel sprouts, beets, avocado (actually a fruit), apples, bananas, blackberries, blueberries, cantaloupes, cherries, cranberries, figs (dried), grapes, grapefruit, kiwifruit, mango, orange, papaya, peach, pear, pineapple, pomegranate, prune, raspberries, strawberries, tomatoes, watermelons, ground sirloin, eggs, edamame (soybeans), pork chops or lean pork loin, chicken tenderloin, turkey or chicken (at the deli counter), salmon, sole, cod, beans, milk-cheese-yogurt, olive oil, nuts, seeds, and almonds.[42,43,44]
4. **Low Carb and Low Fat**: Once one commits to eating healthy veggies, fruits, proteins and fats with reduced sugar intake and appropriate portion size, the so-called controversy about low carb and low fat diets is reduced considerably.[45] The key issue is **insulin resistance and sensitivity**, a physiological condition where cells variably respond to the normal actions of the hormone insulin[46]. The body produces insulin, but cells in the body respond differently and use it more or less effectively.[46] To the degree your body does

not use insulin effectively, beta cells in the pancreas increase their production, contributing to hyper-insulinemia or an excess of insulin in the blood.[46,47] Your fasting insulin blood test will help determine how well your body is using insulin: if your body is highly effective in insulin use, your diet can involve a higher proportion of carbs; if your body is less effective in using insulin, your diet is optimally adjusted to involve lower a proportion of carbs.[48]

5. **Another key point is salt, which follows closely the issue of too much sugar intake** because there's also too much salt in nearly all processed foods (including those containing high amounts of sugar).[49,50] You can look for 'low-sodium' foods in the grocery or try to eat meals prepared (from scratch) with little or no salt. Salt is a major consideration in heart-health and blood pressure regulation.[50,51,52,53,54]
6. **Increased intake of healthy fats and reduce intake of unhealthy fats – there is quite a difference between healthy fats [4]and those that are less healthy**. For several years nutritionists and physicians advocated a low fat diet for reducing weight, lowering cholesterol and preventing health problems, generally. More recently, the focus has been on differentiating the types of fat you eat. Whereas some fats increase cholesterol and your risk of certain diseases,[55] other fats (e.g. omega -3 fats) protect your heart and overall health.[56] The **less healthy fats** are termed saturated fats and trans fats which, in turn, are linked to weight gain,[57] arterial occlusion[58] and other unhealthy effects.[59] The more healthy fats are monounsaturated fats, polyunsaturated fats and omega-3 fats which seem to help in multiple ways.[60,61,62] Monounsaturated fats include olive oil, canola oil, sunflower oil, peanut oil, sesame oil, avocados, olives and nuts (e.g. almonds, macadamia nuts, hazelnuts, pecans, cashews).[63] Polyunsaturated fats include soybean oil, corn oil, safflower oil, walnuts, flaxseeds, and sunflower, sesame and pumpkin seeds, fatty fish (e.g. salmon, tuna, mackerel, herring, trout, sardines), soymilk and tofu.[63] Saturated fats include high-fat cuts of meat (beef, lamb, pork), chicken with skin, whole-fat dairy products, butter, cheese, ice cream, palm and coconut oil and lard.[63] Trans fats include commercially-baked pastries, cookies, doughnuts, muffins, cakes, pizza dough, packaged snack foods (crackers, microwave popcorn, chips), stick margarine, vegetable shortening, fried foods (e.g. French fries) and candy bars.[63] The American Heart Association's guideline is to reduce trans fats and saturated fats to a minimum and to substitute monounsaturated fats and polyunsaturated fats when possible.[64] For example, this might involve eating less red meat (beef, pork, or lamb) and more fish and chicken. It is better to bake, broil, or grill instead of frying.[63,64] Remove skin from chicken and trim as much fat off meat as possible before cooking.[63,64] When possible, avoid breaded meats and vegetables and deep-fried foods.[63,64] Choose low-fat milk and lower-fat cheeses like whenever possible[63,64]; enjoy full-fat dairy but in moderation.[63,64] Use liquid vegetable oils such as olive oil or canola oil instead of lard, shortening, or butter.[63,64] Avoid cream and cheese sauces, or have them served on the side.[63,64]

The actual American Heart Association 'Know Your Fats' guidelines[64] are printed below and can be reviewed in total in the AHA website:
https://www.heart.org/HEARTORG/Conditions/Cholesterol/PreventionTreatmentofHighCholesterol/Know-Your-Fats_UCM_305628_Article.jsp

The American Heart Association recommends[64]:

- Eating between 25-35 percent of your total daily calories as fats, including fats in oils and fats in foods.
- **Limiting the amount of** saturated fats you eat to less than 7 percent of your total daily calories. That means, for example, if you need about 2,000 calories a day, less than 140 calories (or 16 grams) should come from saturated fats.
- Limiting the amount of *trans* fats to less than 1 percent of your total daily calories. That means, for example, if you need about 2,000 calories a day, less than 20 calories (or 2 grams) should come from *trans* fats.
- Limiting cholesterol intake to less than 300 milligrams a day for people without coronary heart disease (CHD) and to less than 200 milligrams a day for people with CHD.

For good health, the majority of fats you eat should be monounsaturated or polyunsaturated.

Most foods contain combinations of different fats. Eat foods with monounsaturated fats and/or polyunsaturated fats instead of foods with high levels of saturated fats or *trans* fats. Check out the Fats and Sodium Explorer tool to get your personal daily calories and fat and sodium limits.

Choose:

- Vegetable oils and margarines with liquid vegetable oil as the first listed ingredient. Examples are canola, corn, olive, peanut, safflower, sesame, soybean and sunflower oils.
- Soft spreads or liquid or tub margarines low in saturated fats and trans fats.
- Reduced-fat and no-fat salad dressings and mayonnaise.
- Foods including fatty fish (such as salmon, mackerel, herring and trout), avocados, peanut butter, and many nuts and seeds.

Shopping and Preparation Tips

- Use liquid vegetable oils or non-fat cooking sprays instead of butter or solid fats whenever possible.
- Use reduced-fat, low-fat, light or no-fat salad dressings (if you need to limit your calories) on salads, for dips or as marinades.
- Whether cooking or making dressings, use the oils that are lowest in saturated fats, trans fats and cholesterol – such as canola oil, corn oil, olive oil, safflower oil, sesame oil, soybean oil and sunflower oil – but use them sparingly, because they contain 120 calories per tablespoon.
- Use cooking styles that add little or no fat to food (such as grilling, broiling, and steaming), and order foods cooked that way when you eat out.
- Remember to count the "hidden fat" in bakery and snack foods as well as the fats used in cooking and on vegetables and breads. Read food labels carefully.
- Stay away from tropical oils such as coconut oil, palm oil and palm kernel oil. Even though they are vegetable oils and have no cholesterol, they are high in saturated fats.

Photo-journaling Food and How It Can Help

Unfortunately we don't yet have a BodyMedia device for food. Perhaps

in the future, you will put on glasses when you eat and everything eaten will be automatically photographed as it enters your mouth. But for now, you can use your smartphone, in combination with the Connected Wellness Platform (CWP) software to photo-monitor each meal you eat.

The photo-journaling (PJ) function of the CWP Smartphone

Software creates a co-monitoring 'tether' between you and your coach, or with some other selective friends or family members. As you observe your own eating behaviour, the PJ function assists the coach and perhaps others to observe. The coach supports your attempts to change, and your trial-and-error process, while doing so. The additional PJ function inserts a 20 minute (time-adjustable) gap between photographing and additional reminders to answer 3 questions: 1) have you eaten too much, too little or just enough? 2) how healthy is the meal you're eating? [3 hearts vs. 2 hearts vs. 1 heart] 3) whether the meal was made, store-bought (take-in) or eaten in a restaurant or fast-food outlet? These questions, after the 20 minute interval, address the gap between food intake and the sensations of fullness/emptiness in the stomach. When people eat fast, we can't judge intake in terms of fullness-emptiness. Thus strategic placement of the guiding questions encourage you to eat slower and, during the first 20 minutes of eating, to sensitize yourself to what your stomach feels like while you're eating, in contrast to disregarding stomach sensations and eating quickly. This introduces eating modification at the fundamental level of body sensation and intake velocity. Studies have also found that eating slowly may help to maximize satiation and reduce energy intake within meals.[65,66]

The PJ function also generates a cognitive mediation process that intercedes with habitual processing and results in increased intake control.[67,68,69] Building confidence in your dieting ability is often related to some consistent success in minor modifications (that can be built upon with further successes).[67,68,69] One indicator of success is consistent use of the PJ function, particularly when it involves disclosing or 'confessing' to lapses in conscious modification. Along these lines the lapses vary from 1) eating in a way opposite to goals (e.g. eating a portion larger than usual rather than smaller than usual) to 2) eating in a way that's 'status quo' and is neither lapse or progress, 3) eating in a way that's mildly congruent with goals (e.g. portion size minimally but noticeably reduced), 4) eating in a way that's substantively congruent with goals (e.g. portion size significantly and noticeably reduced). You are encouraged to disclose all meals, especially lapsed meals. Your coach can derive a weekly score or metric which combines 1) eating congruent with your goals, 2) consistent use of photo-journaling (if you choose to use it) and 3) meal quality as you assess it.
Your health coach will guide you in making your 'ups' of dietary activity outweigh your 'downs' and, together, you can evaluate each day and week in terms of what can be done to improve.

Healthier Choices of Ingredients and Meals

While we're conditioned to keep consuming similar foods, each of us has dietary selections that range from relatively healthy to relatively unhealthy. This range refers to the ingredients of meals (how much salad vs. how much carbohydrate) and to the overall selection of one meal vs. another (Big Mac vs. large Caesar's salad). You and your coach can rate your meal repertoire from week-to-week to establish a **preferred** sub-list of ingredients and meals, and a **non-**

preferred sub-list. The preferred – non-preferred rating can be mutually established on a 1 – 10 scale (0 – 4 non-preferred, 5 neither preferred nor non-preferred, 6 – 10 preferred). Then a daily metric can be determined based on meal selection from the preferred vs. non-preferred list that ranges from 30/30 (eating the most healthy meals from the established diet) to 0/30 (eating the most unhealthy meals from the established diet). As you begin to make better choices from the established diet, confidence can be built in the capacity for dietary change.

Exercise and Diet Synergize for Your Health

When you reduce intake, your body metabolism may reduce to conserve calories so regular exercise will help maintain a higher metabolism, contributing to your daily resources of energy.[70] Exercise actually creates more mitochondria in muscles which act as "cellular power plants" because they generate most of the cell's supply of adenosine triphosphate (ATP), used as a source of chemical energy.[71] Reciprocally, your diet will help you exercise more healthfully as you will be more energized if insulin is being used more effectively in your body.[72] Lastly, exercise increases your insulin sensitivity as your muscles will naturally absorb more glucose from the blood.[73]

Stress Management and Reduction

The term ***regulation*** becomes more frequently noticed, the more familiar you become with health science. The concept is similarly useful with your automobile, as, for example, you can't drive too fast or make turns too sharply and expect your automobile to optimally function. The same is true for your brain: we all want to work to maximal effectiveness but need to know more about how our brains operate to do that.

First, as mentioned before, our brains need sleep,[74,75] and require our blood glucose to be maintained within a certain healthy range.[76] Furthermore, we must regulate cortisol, a neurochemical produced under stress and high performance demand conditions.[77] Too much cortisol is neurotoxic, meaning it can damage brain tissue.[78,79] Fortunately, the brain is neuro-genetic and neuroplastic, meaning it generates new neurons and can target specific kinds of neurons for new production.[80,81,82] But we don't have to reach the stress levels where neurotoxicity happens. We can regulate stress and by doing so, use our brains effectively while avoiding damage. Now how do we do that?

Aerobic exercise (AE), again, synergistically plays this role. AE produces Brain Derived Neurotropic Factor (BDNF) which contributes so fundamentally to replenishing neurons in the brain that it has been called the 'miracle-gro' (a fertile potting soil for house plants) in the brain.[83,84] AE will also help you release accumulated stress in your body and mind.

Study	Type	Subjects vs. Controls	Morphological Changes	Regions > in meditators than controls
Lazar (2005)	Insight	20 vs. 15	Cortical thickness	Right anterior insula & right middle, superior frontal sulci
Pagnoni & Cekic (2007)	Zen	13 vs. 13	Gray matter volume	Meditators: no age-related declines in the left putamen vs. controls
Hölzel (2008)	Insight	20 vs. 20	Gray matter density	Left inferior temporal lobe, right insula, right hippocampus
Vestergaard-Poulsen (2009)	Tibetan Buddhist	10 vs. 10	Gray matter density - volume	Medulla oblongata, left superior - inferior frontal gyri, anterior lobe – cerebellum left fusiform gyrus

Study	Type	Subjects vs. Controls	Morphological Changes	Regions > in meditators than controls
Luders (2009	Zen, Vipasana Samatha	22 vs. 22	Gray matter volume	Right orbito-frontal cortex, right thalamus, left inferior temporal lobe, right hippocampus
Grant (2010)	Zen	19 vs. 20	Cortical thickness	Right dorsal anterior cingulate cortex, secondary somatosensory cortex
Holzel – Lazar (2010)	MM	16 vs. 17 (randomly allocated)	Gray matter concentration	Left hippocampus posterior cingulate cortex, temporo-parietal junction, cerebellum

On the quieter side of stress management, there is much emphasis on mindfulness meditation which recently registered a shift of recognition when it (as a social and health phenomena) was featured on the cover of Time Magazine.[85] Mindfulness has been shown in seven different studies (below) to result in a thickening of brain tissue which is a healthy effect because it reflects an abundant generation of new neurons.[86,87,88,89,90,91,92,93,94] When brain tissue is thinning, it's invariably a sign of deteriorating tissue due to stress (as in post-traumatic stress disorder) or a disease process,[95] so thickening is welcomed as a sign of brain health.[80] What is noteworthy about mindfulness meditation (MM) is that the last of these seven studies was a randomized controlled trial where the randomly assigned meditating subjects were compared against a wait-list control group.[94] This study, undertaken by Harvard investigators, indicated subjects only meditated an average of 26 minutes per day for 14 weeks.[94] That is not a huge commitment to generate a beneficial effect.

But brain tissue changes are just one finding with respect to MM as it has gradually become a widely adopted and investigated practice in North America and Europe.[96,97] According to current evidence, it has capacities to reduce anxiety, depression,[98,99,100,101,102,103,104] rumination and (perceived) stress[105,106] while increasing positive emotional experiences,[107,108] including compassion.[109,110,107] Neuroscientific evidence links mindfulness practice to improved attention

stability,[111] cortical inhibition[112] improved working memory, and academic test performance (e.g. Graduate Record Exam).[113] Given such positive mental health and attention improvements, mindfulness programs are being applied within educational and corporate environments[114,115] (where Google, for example, offers classes like "Search Inside Yourself"[116] and other corporations (General Mills, Target, Apple, Nike, Proctor and Gamble, AOL, Huffington Post) are conducting mindfulness instruction for employees.[117]

It is important to note that mindfulness instruction can be directly obtained from your health coach in this study and supplemented with use of an online workbook (Overcoming Performance Anxiety While Improving Performance) and a website (OntheMind.ca) which offers specific (audio-taped) instructions as brief as 5 minutes in duration and as long as 45 minutes.[118] The key combination with mindfulness is 1) emphasis on attention to breathing sensations, 2) stimulation of the Vagus Nerve (for relaxation purposes) via emphasis on exhalation, 3) non-avoidance to optimize attention functioning and creative problem solving and 4) focus on experiencing the present moment.

Self -Monitoring and Medication Adherence

Sooner or later, health involves self-monitoring whether it involves your physician, your health coach or just yourself. Knowing, providing it's accurate knowledge, is better than proceeding without adequate knowledge when it comes to cultivating health. Seeing your primary care physician every six months is part of the picture but the self-monitoring we're suggesting in this study is more intensive, personal and sustainable. Entering data into your smartphone and using the bio-monitoring devices that will become increasingly available (e.g. BodyMedia) will motivate you and have a real effect on how you behave in improving and sustaining your health. In all sectors of lifestyle, we're constantly involved in **(1) setting goals, (2) monitoring how you're doing and (3) when differences are detected between goals and behaviour, acting to reduce the difference by making progress.** We're suggesting applying this same monitoring process to your health, as an important and fundamental part of your lifestyle.

Last, but not least, your medication adherence is part of the picture of self-monitoring.[119,120] You probably don't want to remain on any medication you're taking, if you can reduce your dosage by adjusting your behaviour and improving your health. But the first step to reducing dosage and possibly discontinuing medication is taking the prescribed dose; it helps you and your family doctor decide what the next step will be. If you don't take medications as prescribed, it sets up a guessing game between you and your physician that leads to confusion and ultimately unsatisfactory solutions.

In summary, you can clearly improve your health and our job is to provide the right tools and support, especially when you need them most. We will learn from each other, as we work out the best plans for you, and help you make *better health* a reality that can help you in the many facets of your lifestyle.

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Health Coaching Notes on Participants

Health Coaches,

During conversation with your participant I will need you to record a few things:

How often they exercised?
Was there anything of concern?
How many mindfulness sessions they attended (if in that group)?
Did they use the mindfulness meditation recording and how often in a week (if in that group)?

Any additional information that you may feel is relevant (started new medication)

*****KEEP IN MIND THAT EVERY PARTICIPANT HAS 12 SESSIONS (12 WEEKS)*****

Participant ID	**How often they exercised?**	**Was there anything of concern?**	**How many mindfulness sessions they attended (if in that group)?**	**Did they use the mindfulness meditation recording and how often in a week (if in that group)?**	**Any additional information that you may feel is relevant (started new medication)**
