Study Protocol with SAP

Title: Evaluating the Feasibility of the Individual Managing Fatigue Program (IMFP) for People with Parkinson`s Disease: A Randomised Pilot Feasibility Study

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Background/Significance

Fatigue in Parkinson's Disease (PD): Prevalence, Impact, and Etiology

Fatigue is a frequent and extremely troublesome experience for people living with PD. Individuals with PD identify fatigue among their three most disabling symptoms (Friedman, 2009). People with PD fatigue describe it as an ever-present symptom that is a "whole body experience" which differs in severity from the tiredness experienced before being diagnosed with PD. They also explain their fatigue as having an unpredictable pattern, which varies in intensity during the day (Olsson, Stafström, & Söderberg, 2013).

Fatigue may arise both physically and cognitively (Beiske & Svensson, 2010; Lou, 2009). People with PD describe cognitive fatigue as slow thoughts, increased sensitivity to stressful situations, impaired memory and decision making, and decreased social interaction, concentration, and organizational skills. Physical fatigue is described as feeling paralyzed, inertia, gluey, unable to move, weak, lack of energy, and/or inability to keep the body straight (JauShin Lou, 2009; Olsson et al., 2013).

Fatigue in PD is associated with poor quality of life (Elbers, van Wegen, Verhoef, & Kwakkel, 2014; Havlikova et al., 2008; Herlofson & Larsen, 2003; Siciliano et al., 2018; Solla et al., 2014). Multiple aspects of daily life can be affected including performance of activities of daily living (ADL), leisure, hobbies, and employment. It also affects family relationships and social participation (Friedman, 2009; Kluger & Herlofson, 2017). Fatigue may reduce social participation which result in increased social isolation (Kluger & Herlofson, 2017; Olsson et al., 2013). Fatigue also correlates

with early retirement, and reduced working hours, which results in financial distress and a diminished sense of productivity (Friedman et al., 2007; Zesiewicz, Patel-Larson, Hauser, & Sullivan, 2007).

Despite the huge impact of fatigue in PD populations, the exact etiology remains unknown (Friedman et al., 2017; Kluger et al., 2016). Researchers have proposed different explanations. For example, Chaudhuri et al., (2004) suggested that fatigue can be caused by complex interactions between the disease process, peripheral control systems, the central nervous system, and environmental factors. Imaging studies have demonstrated that fatigue arises more in patients with frontal hypo-metabolism, and reduced serotonin uptake in the ventral striatum and temporal lobe (DeLuca, Genova, Capili, & Wylie, 2009; Genova, Wylie, & Deluca, 2011). It also has been proposed that fatigue in PD is "the result of abnormality in "basal ganglia (BG)-cortical mechanisms, particularly frontal loops, and an imbalance between neurotransmitters (e.g., dopamine and serotonin), along with an altered hypothalamus-pituitary-adrenal axis, neuro inflammation, cardiac sympathetic denervation, etc." (Kostić, 2016, p.323.). Friedman and colleagues (2007) also suggested that physical fatigue in PD could arise as the result of atypical "corticomotor neuron excitability, rather than the fatigue of the muscle fibre itself (Friedman et al., 2007). Therefore, it seems most likely that PD fatigue is the result of interactions among multiple systems (upper motor neurons, the lower motor neurons and the neuromuscular junction) (Gołąb-Janowska et al., 2016).

Non-Pharmacologic Treatments

Existing pharmacological interventions for managing fatigue often have intolerable side-effects, with weak and inconclusive effectiveness (Asano & Finlayson, 2014; Bruno & Sethares, 2015; Fabbrini et al., 2013). Non-pharmacologic interventions, however, have minimal to no side effects and are an attractive alternative to pharmacological management. Among non-pharmacological interventions, the three most common approaches to managing fatigue in neurological conditions are cognitive-behavioural therapy (CBT) (Elbers et al., 2016; van den Akker et al., 2016), exercise (Asano & Finlayson, 2014; Elbers, Berendse, & Kwakkel, 2016), and energy conservation strategies (Blikman et al., 2013; García Jalón, Lennon, Peoples, Murphy, & Lowe-Strong, 2013).

CBT is a common approach to managing fatigue in many conditions other than PD. For example, in the most recent available analytical review, Van den Akker et al (2016) reviewed 18 randomized controlled trials which used CBT approaches to manage fatigue in people living with multiple sclerosis (MS). Fatigue was a primary outcome in all these studies. Although the included studies were heterogeneous in their delivery forms, intensity, and the therapists' levels of experience, collectively CBT techniques resulted in a moderate positive effect, reducing fatigue and fatigue impacts in MS populations (standardized mean difference =-0.47; 95% CI: -0.88, -0.06). Of two most recent review articles that examined fatigue interventions for people with PD (Elbers, Berendse, & Kwakkel, 2016; Franssen, Winward, Collett, Wade, & Dawes, 2014) only one article evaluated the effectiveness of CBT in people living with PD, which did not result in any significant changes in fatigue scores (Rios Romenets et al., 2013).

Another common non-pharmacologic therapy to manage fatigue is exercise. Exercise improves health-related quality of life and physical functioning and decreases disease progression in people with PD (Goodwin, Richards, Taylor, Taylor, & Campbell, 2008). Research in other conditions has shown that exercise reduces fatigue (Miller & Soundy, 2017). In combination, these results suggest that exercise may also reduce fatigue in people living with PD. However, to date, there have been no high-quality trials specifically testing the effect of exercise on fatigue in people living with PD (Elbers et al., 2016; Franssen et al., 2014; Lou, 2015). As Lou (2015) described in a review study, most existing studies for exercise therapy in PD are pilot studies with small sample sizes and without fatigue as a primary outcome. Furthermore, the effectiveness of available evidence so far is heterogeneous as different types of exercise programs were used, ranging from unsupervised voluntary exercise sessions to highly structured high-intensity exercise. Therefore, even though exercise may be effective to reduce fatigue impacts in PD, more research is needed to confirm this (Amara & Memon, 2018; Jaushin Lou, 2015).

Energy conservation strategies are another non-pharmacologic alternative to manage fatigue. Energy conservation techniques educate individuals to use their energy efficiently to complete their daily activities (Blikman et al., 2013). Three structured energy conservation programs have been introduced in the literature, including the *Multidisciplinary Fatigue Management Program* (Kos, Duportail, D 'hooghe, Nagels, & Kerckhofs, 2007), *the Fatigue Take Control* (Hugos et al., 2010), and the Managing Fatigue Program (MFP): A Six-Week Energy Conservation Course (Packer, Brink & Sauriol, 1995). Among these, the MFP has the most evidence of effectiveness in

reducing the impact of fatigue (Beckerman et al., 2013; Mathiowetz, Finlayson, Matuska, Chen, & Luo, 2005; Mathiowetz, Matuska, & Murphy, 2001; Sauter, Zebenholzer, Hisakawa, Zeitlhofer, & Vass, 2008; Vanage, Gilbertson, & Mathiowetz, 2003), depression (Ghahari, Packer, & Passmore, 2010; Sauter, Zebenholzer, Hisakawa, Zeitlhofer, & Vass, 2008), and sleeping problems (Sauter et al., 2008), and improving quality of life (Finlayson, Preissner, Cho, & Plow, 2011; Ghahari, Packer, & Passmore, 2009; Ghahari et al., 2010; Mathiowetz, Finlayson, Matuska, Chen, & Luo, 2005; Mathiowetz, Matuska, & Murphy, 2001; Van Heest, Mogush, & Mathiowetz, 2017) and self-efficacy (Finlayson et al., 2011; Ghahari et al., 2010; Mathiowetz et al., 2005; Van Heest et al., 2017).

Managing Fatigue Program (MFP): An Energy Conservation Solution. The Managing Fatigue Program (MFP) is a six-week, self-management energy conservation course. It was developed in 1995 by three occupational therapists (OTs) for patients with fatigue secondary to chronic conditions. The MFP focuses on strategies to make active occupational decisions to determine and prioritize desired activities and to save and spend energy wisely. The strategies introduced in the MFP are resting, communicating, using proper body mechanics, following ergonomic principles, analyzing activities, and modifying environment. As a result, people with fatigue make changes to save and use their energy to accomplish their daily activities. The original MFP consists of six 2-hour sessions of highly structured discussion with 7–10 participants per group. During each session, an OT uses mini-lectures, facilitated discussions, activities, and homework to convey principles of energy management and to encourage participants to trial, evaluate and adopt strategies relevant to their own everyday life (Packer,., Brink, N., & Sauriol, 1995).

Several studies have adapted and evaluated different forms of the MFP for people with MS. Six studies evaluated the face-to-face group version in the US, Austria, and the Netherlands (Beckerman et al., 2013; Mathiowetz et al., 2005, 2001; Sauter et al., 2008; Vanage, Gilbertson, & Mathiowetz, 2003). The teleconference version of the group MFP was adapted and evaluated by Finlayson et al (2011) in the US. Ghahari et al. (2010), developed an online version of the MFP in Australia and evaluated its effectiveness in patients with chronic conditions (Ghahari et al., 2010). While the MFP has been tested in different formats in people living with chronic conditions, other than PD, it is yet to be evaluated in people with PD in any form. Participants with PD were included in one study (n=8) (Ghahari et al., 2010), however, results were not independently reported for participants with PD (Ghahari et al., 2009).

Outcomes related to MFP. The outcomes measured by previous studies evaluating the MFP included fatigue impact, participation, depression, stress and anxiety, self-efficacy, sleep quality, and quality of life. In the following these outcomes and their measurement tools in people with PD will be reviewed.

Fatigue Impact/Severity. There are a number of generic fatigue measures, however, the Movement Disorders Society of PD recommended only two scales, the Fatigue Severity Scale (FSS) and the Multidimensional Fatigue Inventory (MFI). These were the only two scales to meet all three criteria used to assess scales: (1) is used in PD, (2) assess only fatigue, and (3) has been used by groups other than the developers of measures.

The FSS, developed by Krupp et al (1989) assesses the functional impact of fatigue. The scale consists of nine items measuring physical, mental and social aspects of fatigue, although the items are not divided into explicit domains. The items are brief and easily understandable statements rated on a seven-point Likert scale from completely disagree (1) to completely agree (7). The total FSS score, which ranges between 1 and 7, represents the mean of the nine items, with higher scores indicating greater fatigue. The FSS developers report that a score of four or above is indicative of fatigue severe enough to warrant further evaluation and/or intervention (Krupp, NG, Muir-Nash, & AD, 1989).

The MFI was also recommended by the Movement Disorders Society of PD as capable of measuring multiple dimensions of fatigue in PD. Fatigue in PD seems has multiple aspects (ex. mental, physical), which need to be measured independently (Lou, Kearns, Oken, Sexton, & Nutt, 2001). The MFI is a self-report fatigue tool with 20 items measuring five dimensions: General Fatigue, Physical Fatigue, Mental Fatigue, Reduced Motion, and Reduced Activity. Elbers and colleagues (2012) evaluated the MFI in the PD population (N=153). After combining General Fatigue and Physical Fatigue dimensions they reported the reliability and validity of the four-domain scale (Physical Fatigue, Mental Fatigue, Reduced Motivation, and reduced activity) as higher than the original five-domain scale. Testing of the MFI shows good internal consistency (Cronbach's alpha >0.80) and construct validity compared to a Visual Analogue Scale measuring fatigue ($0.22<r<0.78$) (Smets et al., 1995).

Quality of Life. Previous studies have evaluated the effect of the MFP on quality of life using the SF-36 (Finlayson et al., 2011; Mathiowetz et al., 2005), SF-12 (Plow, Finlayson, Motl, & Bethoux, 2012), and Personal Wellbeing Index (Ghahari et al., 2009, 2010) in people with multiple sclerosis. However, the most common measures used to evaluate quality of life in PD populations are the 39-item Parkinson's Disease Questionnaire (PDQ-39) (Peto, Jenkinson, Fitzpatrick, & Greenhall, 1995), the 8-item Parkinson's Disease Questionnaire (PDQ-8)(Jenkinson, Fitzpatrick, Peto, Greenhall, & Hyman, 1997; Solla et al., 2014) the SF 36) (Mchorney, Ware, & Raczek, 1993), and the Parkinson's Disease Quality of Life Scale (Welsh et al., 2003).

The PDQ-8 is a short-form version of the Parkinson Disease Questionaire-39 which assesses the impact of PD on HRQoL over the past month. The PDQ-8 is a summary index with eight items, each representing one dimension of the PDQ-39 (Mobility, Activities of Daily Living, Emotional Well-being, Stigma, Social Support, Cognition, Communication, and Bodily Discomfort). It uses a 0-4 response scale. Scores are summed, then converted into a percentage. Lower scores indicate better quality of life (Peto et al., 1995). The PDQ-8 psychometric properties have been confirmed in several studies (Franchignoni, Giordano, & Ferriero, 2008; Katsarou et al., 2004; Luo et al., 2009; Tan, Luo, Nazri, Li, & Thumboo, 2004). Franchignon et al (2008) and Tan et al (2004) demonstrated good internal consistency (Cronbach's alpha 0.72, 0.81) and construct validity between PDQ-8 and a measure of autonomy and participation (IPA-I) ($rs>0.50$); and PDQ-8 with clinical PD-specific measures (UPDRS-ADL, UPDRS-ME, HY, and SE), ($rs = 0.30–0.50$).

Participation in Daily Activities. The literature has defined participation in many ways. For example, Nagi (1991) defined it as the ability to perform socially defined roles (Nagi, 1991). However, others believe that participation goes beyond social roles, describing it as a more complex concept with physical, social, emotional, and environmental aspects (Cardol, De Jong, & Ward, 2002; Jette, Haley, & Kooyoomjian, 2003). Wood (1990) referred to participation as the fulfillment of any role that one completes in their daily life. Others have defined it as being able to have control or be autonomous in life situations, even if they are not able to accomplish the tasks independently (Perenboom & Chorus, 2003). The ICF provides a common language to describe participation (World Health Organization, 2001). They describe participation as involvement in multiple life situations in relation to health conditions, activities, and contextual factors. ICF provided a series of categories for Activity/Participation: learning and applying knowledge; general tasks and demands; communication; mobility; self-care; domestic life; interpersonal relationships, major life areas (education, work, economic); and community, civic, and social life (World Health Organization, 2001).

In PD, participation has not been described nor measured extensively. The Activity Card Sort (ACS) (Foster, Golden, Duncan, & Earhart, 2013; Ghahari et al., 2010; I. Sturkenboom et al., 2013), and the Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-Participation) (Sturkenboom et al., 2013) have been used to measure participation. However, the ACS does not cover all domains of activity/participation based on the ICF. The USER-Participation

measures approximately all domains of activity/participation based on ICF, but its responsiveness has not been evaluated in the PD Population (I. Sturkenboom et al., 2013).

One`s ability to engage in daily life activities can also be defined as participation. For example, the level of the independence in performing daily life activities has been evaluated using the Barthel scale (Rios Romenets et al., 2013) and Modified Schwab and England Activities of Daily Living Scale (Schifitto et al., 2008). Another used the occupational performance using the the Canadian Occupational Performance Measure (COPM). The COPM was selected since it has proven to be sensitive to change and was able to detect significant differences between study groups at three months (mean difference =1.2 (95% CI 0.8-1.6) and after 6 months follow-up(mean differences= 0.9 (95%CI 0.5-1.3) (I. Sturkenboom et al., 2013). The COPM is a client-centred, standardized, cost-effective, occupation-focused measure used in occupational therapy. IT is an individualized outcome measure administered using a semi-structured interview. It measures occupational performance and occupational satisfaction (Law, M. Baptiste, S., Carswell, A. McColl, M. A., Polatajko, H. & Pollock, 1998). Three to five self-selected occupational performance issues are identified by respondents each is then rated based on a 10-point Likert scale. The average performance and satisfaction scores are calculated by summing individual occupational issue scores and dividing by the number of problems (Law et al., 1990). The psychometric properties of the COPM have been confirmed in many chronic conditions (Cup, Scholte op Reimer, Thijssen, & van Kuyk-Minis, 2003; Dedding & Beelen, n.d.; Eyssen, Beelen, Dedding, Cardol, & Dekker, 2005). It has good responsiveness to change in patients with chronic conditions (N=150) (Eyssen et al., 2011). is sensitive to change (Law et

al., (1998) and has acceptable test-retest reliability for both the performance and satisfaction scores (ICC=.63 and .84 respectively).

The COPM has not been validated in PD, however, it can be used for any population with disability since it was based on a generic theory, the Canadian Model of Occupational Performance (Law, M. Baptiste, S., Carswell, A. McColl, M. A., Polatajko, H. & Pollock, 1998). Sturkenboom and colleagues (Sturkenboom et al., 2013) used the COPM as a primary outcome to evaluate changes in occupational performance for individuals with PD after an occupational therapy-based intervention.

Occupational balance is another concept to define individuals` involvement in daily activities (Wagman & Håkansson, 2014). The OBQ is a 11-item measure developed by Wagman et al., (2014), which assesses individuals' satisfaction and perception with the amount and variation of meaningful occupations. The OBQ measures satisfaction with the amount of time that one spends to accomplish tasks. It uses a 4-level ordinal response scale for each item ranging from 0 "completely disagree" to 3"completely agree". The OBQ total score ranges from 0 (no occupational balance) to 35 (maximum occupational balance). The psychometric properties of the OBQ have not been explored in PD. However, in the general population, it has shown good internal consistency (Cronbach's alpha= 0.936) and test, re-test reliability (Spearman's Rho= 0.926) for its total score (N=67). Neither ceiling nor floor effects were reported (Håkansson, Wagman, & Hagell, 2019).

Sleep Quality. Fatigue and sleep are inseparable complications of PD (Siciliano et al., 2017, 2018). The PSQI is the most common assessment tool used to evaluate sleep quality (Mollayeva et al., 2016). It is a 19-item self-report assessment that measures seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Component scores range from 0 (no difficulty) to 3 (severe difficulty and are summed to produce a global score (range 0 to 21). Higher scores indicate worse sleep quality. A meta-analysis by Mollayeva et al. (2016) evaluated the measurement properties of the PSQI. This meta-analysis (N=37) demonstrated that the PSQI has good internal consistency based on Cronbach's alpha, strong reliability and validity, and moderate structural validity in a variety of samples. The PSQI has been used as an outcome measure to test the effectiveness of the MFP in the MS population which was able to detect a significant change in sleep quality (Sauter et al., 2008).

Self-efficacy. Self-efficacy is defined as the confidence an individual has to accomplish a task and to reach their determined goals (Bandura, 1977). It can be improved through performance success, communicating with others in the same situations, verbal persuasion and psychological feedback (Bandura, 1977). Self-efficacy is an essential skill to make long-term behavioural changes (Shortus, Rose, Comino, & Zwar, 2005). Studies suggest that self-efficacy may improve in PD if (1) patients receive knowledge, techniques, and psychosocial support to

increase confidence in their ability to manage their condition, and (2) patients attend in group programs to meet people in similar situations and see their strategies and success to attain a positive attitude (Mulligan, Arps, Bancroft, Mountfort, & Polkinghorne, 2011).

Previous studies evaluating the MFP, assessed self-efficacy using the Self-Efficacy for Performing Energy Conservation Strategies Assessment (SEPECSA) (Finlayson et al., 2011; Mathiowetz et al., 2005; Van Heest et al., 2017), and the generalized self-efficacy scale (GSE) (Ghahari et al., 2009, 2010). All studies measured self-efficacy as an outcome of MFP resulted in significantly improved changes The SEPECSA was developed based on the Managing Fatigue Program (Liepold & Mathiowetz, 2005) and measures the individual's self-confidence to perform the strategies they learned in the program. The item response scale of the SEPECSA ranges from 1 (not at all confident) to 10 (completely confident). The final score is mean of the item scores. In a study on people with MS (N=36), Liepold & Mathiowetz (2005) demonstrated that the SEPECSA has high test and retest reliability (r = .776, ICC = .771), good validity, and very high internal consistency (Cronbach's alpha = .953). The SPECSA has not been used with the PD population, however, it has been used in previous similar studies (Ghahari et al., 2010; Matuska, Mathiowetz, & Finlayson, 2007).

Methods

Purpose

The purpose of this study is to evaluate the feasibility of the Individual Managing Fatigue Program (IMFP) from the perspectives of individuals with PD, and to prepare for a full-scale randomized controlled trial (RCT).

Specific Aims

Aim 1. To evaluate the feasibility of the IMFP protocol. Using surveys and focus groups, the sub-aims are to evaluate: (1) the relevance, usability, acceptability, and perceived impact of the IMFP from the perspective of individuals with PD; (2) the logistical features (time, location, duration) of the IMFP for individuals with PD

Aim 2. To determine the feasibility of conducting a large-scale RCT of IMFP. By conducting a pilot RCT, the sub-aims are to (1) assess the trial recruitment strategy based on the enrollment, completion and attrition rates, and variation in socio-demographic features of participants; (2) evaluate the responsiveness and sensitivity of potential outcome measures; and (3) use data arising from differences between IMFP and control arm to inform a power calculation for sample size of a definitive RCT.

Design

This feasibility study will use a mixed-methods approach, nested in a pilot randomized control design. Using the triangulation design: convergence model, we will collect qualitative and quantitative data simultaneously (Creswell, 2013).

Participants

Inclusion and Exclusion Criteria. All participants will be adults living in HRM, with self-reported PD, and fatigue severe enough to interfere with daily life (measured by a score of ≥4 on the Fatigue Severity Scale (FSS)). Participants must be able to read and speak in English and provide informed consent prior to participation. Although PD prevalence tends to be higher in men than women (Savica, Grossardt, Bower, Ahlskog, & Rocca, 2013), there will be an attempt to include people of all genders in this study.

In order to minimize bias, participants who have previously completed the MFP and/or who have a comorbidity that causes severe fatigue other than PD (e.g. heart failure, cancer) will be excluded. Finally, as the benefits of self-management programs for people with severe cognitive deficiencies are unknown and participants in self-management programs have an active role, participants with a severe cognitive deficit (Mini-Mental State Examination (MMSE) <13) will be excluded.

Recruitment. In this study, multiple recruitment strategies will ensure sufficient participants: 1) web-based advertisement (International Chronic and Complex Conditions Research Group, Parkinson Society Maritime Region website, and KIJIJI); 2) posters at the

Parkinson Society Maritime Region's office; 3) social media (Twitter, Facebook); and 4) word of mouth. Interested participants will contact the research team by email or phone.

Sample Size Calculation. As a pilot study, a power calculation is not strictly required. However, in preparation for the current study, we conducted both a sample size calculation and consulted previous literature to inform our estimation. To calculate the sample size, type-1 error was set at 5%, type-2 error was set at 20% for a power of 80%. The effect sizes used for the sample size calculation were taken from available previous studies as follows: for the MFI, the effect size of -0.664 I (Bivard et al., 2017) and for the COPM and effect size of 0.37 (Sturkenboom et al., 2013). The results indicated that a total sample size of 42 participants will be required using the minimum effect size for the COPM. Estimating an attrition rate of 20% a convenience sample of 50 participants (25 in each study group) will be recruited from across the Halifax Regional Municipality (HRM), Canada.

This sample size selection aligns with recommendations for pilot studies by other researchers who have suggested that a minimum sample size between 24 to 50 is required for pilot feasibility studies (Julious, 2005; Lancaster, Dodd, & Williamson, 2004; Sim & Lewis, 2012). In another study by Hertzog (2008), a minimum sample of 10-25 per group for feasibility studies was suggested (M., Hertzog, & M., 2008).

Intervention

The IMFP is the individual form of the original, group-based *Managing Fatigue Program: A six-week energy conservation course* developed by Packer et al (1995). A research team at

Dalhousie University, lead by the research supervisor, worked together to identify the main content of the IMFP based the original program. They then structured two manuals, one each for patients and therapists. The session topics are similar to those in the original program; however, two additional topics have been added; sleep hygiene and cognitive fatigue. The IMFP, which will be used in this research, consists of six sessions: (1) the importance of rest and sleep, (2) communication and body mechanics, (3) activity stations, (4) priorities and standards, (5) balancing your schedule, (6) course review and future plans. Each session includes three main parts; 1) pre-session, in which participants are asked to complete activities prior to coming to the session to discuss with their therapist, 2) in-session activities/information in which patients will discuss and learn topics based on their priorities , and 3) homework, in which participants will practice more at home to assure acquiring the skills discusses in sessions. Participants will be expected to complete homework activities following each session. Each weekly session will be approximately 60 minutes, although therapists may adjust the time spent depending on client' needs. OTs licensed by the College of Occupational Therapists of HRM will deliver the IMFP. All will be required to successfully complete an online training session prior to participation. They will learn about the IMFP and the current evidence-based guidelines and research about working with individuals with PD. Therapists will be trained on the following core concepts necessary to facilitate the program: (1)energy management content, (2) building self-efficacy, (3) fatigue concept, (4) self-management and chronic disease management, (5) evidence of effectiveness, (6) history and development of the program, (7) an introduction to fatigue measurements, (8) transtheoretical model, (9) PD specific considerations.

Study Procedure

The principle researcher will contact participants, who expressed their interest to participate, and arrange a screening visit at s time convenient for participants. In the screening appointment, participants will receive the study information. They will be given time to read the study information carefully and will be encouraged to ask questions. Those remaining interested in participating and who provide signed consent will be screened for inclusion in the study. Those who meet the study criteria will then be asked to complete the demographic questionnaire and baseline testing. Those who do not meet the study criteria will be thanked and given a gift card of $20 for their time. Reasons for not being included will be recorded and explained to them. The principal researcher will do all measurements at baseline, post-test, and three months follow up (see Aim 2 below) and will perform the data analysis. This researcher will be masked to group allocation.

After completing baseline testing, a research assistant, independent of all other aspects of the study, will randomly assign participants to group (control, or experimental) using sealed envelopes. After group allocation, this research assistant will inform the participants about their group allocation by mail. This research assistant will also assign ID codes, prepare the feasibility questionnaires (see Aim 1 below) for distribution and the key to the ID codes. The key to participant names and ID codes will be kept separately in a locked storage from other data. The principle investigator, research supervisor, and research assistant will have access.

Participants (in the control as well as in the intervention group) will be instructed not to share any information on group allocation with the researcher during the assessments or with peers in their environment. Masking of the assessor will be monitored by reports of the assessor about receiving any information during the assessments on the allocation of the participant.

Participants in the experimental group will receive the 6-week IMFP in addition to any current healthcare services they are receiving. Those in control group will not receive the IMFP and they will be advised to continue receiving any current healthcare services. Participants will be informed that they may withdraw from the study at any time and for any reasons. All participants who complete measurements at all three time points will receive a gift card of $20 to thank them for their time and to help covering some parts of their traveling cost.

In this study, participants cannot be masked to study group as those in the control group will receive no intervention. All measurements and IMFP sessions will take place in private seminar rooms in the Collaborative Health Education Building, Killam Library, the School of Occupational Therapy, or the School of Health Administration at Dalhousie university. A full consort diagram of subject flow is presented in Figure 1

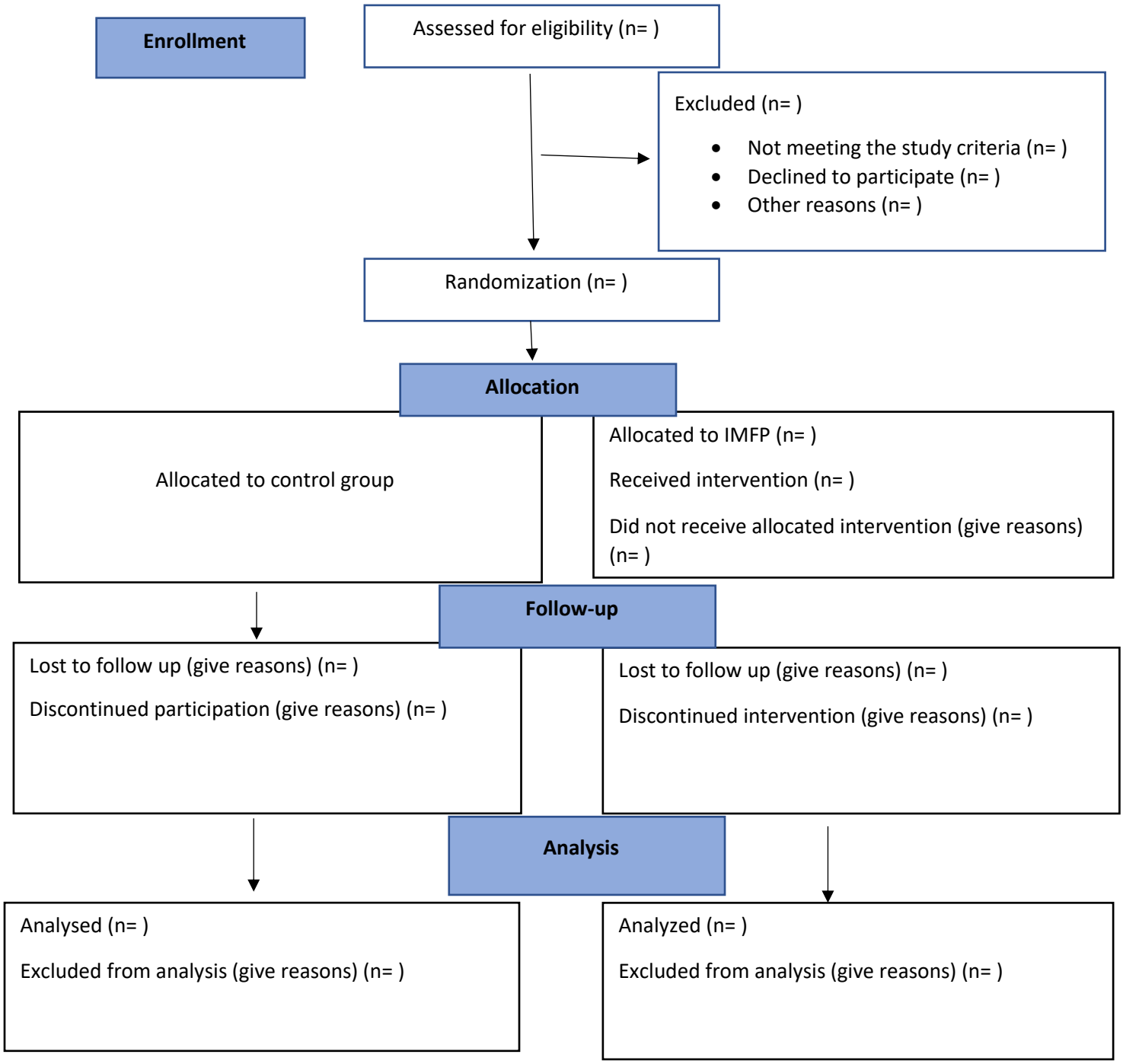

Figure 1 Consort diagram describing the flow of patients through study

Data collection for aim 1. This aim will be achieved using collected data from only the experimental group. Two feasibility questionnaires developed by the research team based on the purposes of the study and the program's intentions will be administered. Questionnaire #1 will evaluate the relevance, acceptability, and usability of each session. Participants in the experimental group will complete Questionnaire #1 weekly, after each session. Questionnaire #2 will evaluate the relevance, acceptability, usability, and logistical aspects of the whole program at the completion of the program. Questionnaire #1, and Questionnaires # 2, will be completed by participants in the experimental group using sealed envelopes. In order to reduce the bias of the measurement, A research assistant, independent of other aspects of the research, will prepare the feasibility questionnaires for each participant. Questionnaires will be coded with participant ID codes; no names will appear on the Questionnaires. The blank, coded questionnaires, along with a second, blank envelop will be placed inside a sealed envelop with participant names for distribution. After each session and at the completion of the program therapists will distribute the questionnaires; completed questionnaires will be returned via the provided sealed and unidentified envelops. Therapists will return these sealed envelopes to the research team. Data collected from Feasibility Questionnaires #1, 2, will be entered to Stata dataset by the researcher following completion of all other data collection to ensure this researcher remains masked to group allocation during all other data collection

After completion of the program, 15 participants will be recruited using maximum variation sampling based on disease duration, fatigue severity, and gender to participate in focus groups (n=5). Participants will be provided additional information about the focus groups and be asked

to provide informed consent prior to participating. Anonymity and confidentially cannot be guaranteed during focus groups, however, participants will be asked to keep the confidentiality of other group participants. Participants will be advised to only disclose the information they are willing to disclose. An experienced research assistant, who is independent from the research, will conduct the focus groups. Participants will be encouraged to discuss the feasibility of the program (relevancy, usability, acceptability, and logistics), barriers to completion of the program, and their perceived impact/changes (improvements/adverse events). The focus groups will be managed using an interview guide, developed by the research team.

Data analysis for Aim 1: Data from the Feasibility Questionnaires #1, 2 will be collected using a five-point Likert scale (Likert, 1932) (0 = 'strongly disagree' to 4 = 'strongly agree). Data from questionnaires will be entered into and analyzed using STATA software (release 15 for Windows). Data will be analysed using descriptive analysis (means, medians and standard deviations).

Focus groups will be audiotaped and transcribed verbatim. Any potentially identifying information will be removed prior to analysis. Data will be evaluated using the six-stage content analysis framework by Braun and Clarke (2014). Data will be managed using the NVivo qualitative data analysis software (QSR International Pty Ltd., Version 11, 2015). The raw data achieved from the group discussions will be coded without any changes in the meaning. Coded material will be categorized semantically until themes emerge. Codes and themes will be reviewed and refined until the final distinctive themes can be created. The final themes and attributes will be compared with literature (Bob-Milliar, 2014).

Data collection for aim 2. The principle researcher who will be masked to group allocation will assess all participants at baseline, post-test, and three months following completion of the program. Outcome variables and measurement tools are described below All the measurements are pen and paper form in this study.

- Fatigue impact will be measured with the Multidimensional Fatigue Inventory (MFI) (Smets et al., 1995). The MFI is the only multi-dimensional measure recommended by the Movement Disorders Society for Parkinson's disease which also assesses the multidimensional aspects of fatigue in patients with PD (Friedman et al, 2016).

- Occupational balance will be measured with the Occupational Balance Questionnaire (OBQ) (Wagman & Håkansson, 2014), which aligns well with the expected outcomes of the IMFP related to scheduling, planning and prioritizing activities.

- Occupational performance will be measured with the Canadian Occupational Performance Measure (COPM) (Law, M. Baptiste, S., Carswell, A. McColl, M. A., Polatajko, H. & Pollock, 1998), which has proven to be sensitive to detect significant differences between study groups in PD, at three months (mean difference =1.2 (95% CI 0.8-1.6) and at 6 months follow up 0.9 (0.5-1.3) (I. H. Sturkenboom et al., 2013).

- Quality of life will be measured with the Parkinson`s Disease Quality of Life-8 (PDQ-8) (Tan et al., 2004), which is a short-form version of the Parkinson's Disease

Questionaire-39. Items are about mobility, activities of daily living, emotional well-being, stigma, social Support, cognition, communication, and bodily discomfort.

- Sleep quality will be measured with the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989), which is the most common assessment tool to evaluate sleep quality (Mollayeva et al., 2016). PSQI measures subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction (Buysse et al., 1989)
- Self-efficacy will be measured by the Self Efficacy for Performing Energy Conservation Strategies Assessment for Persons with Multiple Sclerosis (SEPECSA) (Liepold & Mathiowetz, 2005), which was developed based on the MFP (Liepold & Mathiowetz, 2005). It measures the individual's self-confidence to perform the learned strategies taught in the program.

The efficiency of the recruitment strategies will be examined using data from the number of individuals who contact the research team, the number of participants who meet the study criteria, the number who withdraw from the study or are lost to follow-up (attrition rates), and the variation in sociodemographic characteristics of the participants who enrolled in the study. To collect this data, the main researcher will log all this information throughout the study for each recruitment strategy, separately, and collectively.

Data analysis for Aim 2:

All data for Aim 2 will be first entered into the Stata software (release 15 for Windows). After data entry, data will be cleaned. Data will be examined for skewing, outliers, and systematic missing data. Original data will be double checked to correct errors. Extreme outliers, or erroneous data points that might bias the results of our research will be identified to be double checked. Outliers, defined as greater than ±2SD will be removed from the data if they are less than 5% of all data (Allison, 2001).

Missing data at the item level will be managed based on the protocol with the algorithm of measurement tools. If the scoring algorithm do not provide for missing data, values will be imputed using mean substitution. Missing values at the level of measurement tools will be managed by mean substitution.

Descriptive statistics including frequencies, percentages, means, and standard deviations will be computed for study variables. Frequencies and proportions will be calculated for categorical data (ex. demographic data), while mean and standard deviation will be calculated for continuous data (questionnaires and outcome measures).

Once data will be cleaned, to 1) examine the required sample size for future RCT, 2) evaluate sensitivity, and, 3) evaluate responsiveness the sample size calculation for future RCTs, we will

calculate the effect sizes. Effect sizes will be calculated by dividing the mean differences between study groups by the standard deviation over the duration of the study.

To analyse the sensitivity of the measures we will use the form of ratio of effect size in which, the numerator of the ration is the average change observed in a study population between baseline and follow-up scores (mean differences) The denominators of these ratios is a measure of the variation observed (SD) (Corzillius, Fortin, & Stucki, 1999) .Measurement tools with highest effect size and the smallest significant level are the most sensitive measures to change. In regards to responsiveness of measures, those measurement tools that have higher levels of variability in participants at baseline in relation to mean change scores will have a smaller effect and therefore, are less responsive (Husted, Cook, Farewell, & Gladman, 2000).

Analysis of the effect sizes will adjust for depression measured by the Geriatric Depression Scale-15 (GDS-15) (Yesavage et al., 1982) and PD severity using the modified Hoehn and Yahr (HY). The GDS-15 is a short yes/no self-report measure used to screen for depression in the elderly. Although not extensively tested in PD, it appears to have adequate discriminant validity for a diagnosis of major and minor depressive disorder in PD at a cut-off of 4/5 (Schrag et al., 2007). The modified Hoehn and Yahr scale (HY) is a widely used clinical rating scale which identifies the broad categories of motor function in Parkinson's disease (PD). It includes seven stages of Unilateral involvement only, Unilateral and axial involvement, Bilateral involvement without impairment of balance, Mild bilateral disease with recovery on pull test , Mild to moderate

bilateral disease; some postural instability; Physically independent , Severe disability; Still able to walk or stand unassisted , Wheelchair-bound or bedridden unless aided (Bhidayasiri & Tarsy, 2012).

Qualities of research team:

All research team members that are involved in this research will have completed the Course on Research Ethics (CORE). All research assistants will be trained and supervised the by study supervisor. Additionally, research assistants who will manage the focus groups will have experience doing so. OTs who deliver the program will be registered with the College of Occupational Therapists of HRM and will be required to complete an online training session to be eligible for participation.

Data Storage:

All the data collected from this study will be kept private. Only the research team at Dalhousie University will have access to this information. None of this data will have any identifying information attached to it and there will be only assigned ID codes. In any published report we will never include any information that makes it possible to identify anyone participating in the study.

There are two sets of data in this research which will be kept separately.

1. The key to participant names and ID codes. This data will be saved in locked storage in the office of the research supervisor in the School of Occupational Therapy. The

principle investigator, research supervisor, and the research assistant who prepare the questionnaires will have access to these files.

2. All other data collected from study measures, questionnaires, and focus groups will be de-identified. The hard copies of these data will be kept in locked storage in the Everyday Living Research Lab Collaboration in the School of Occupational Therapy at Dalhousie University. The electronic forms of data will be saved in Dalhousie OneDrive, which both supervisor and main researcher will have access to. This data will be kept at least for five years in the Everyday Living Research Lab Collaboration in the School of Occupational Therapy, Dalhousie University by the research supervisor. All data will be destroyed after this time.

The data from focus groups will be audiotaped and transcribed. No names or identifying information will be in the written transcriptions and once transcribed, the audio tapes will be destroyed. The written text will be stored the same way as other data.

Potential Risks

None of the previous studies evaluating the MFP reported any negative effect as the intervention is an educational one. There is only a minimal chance of discomfort for participants in this study, as they will be undertaking many tasks that may take between approximately three hours for those in control group and eleven hours for those in the experiment group. To minimize this burden, participants will be offered several breaks

between activities. Participants will be informed that they may leave the study at any time or refuse to answer any questions they do not want to. If they wish to resume later, there will be some rescheduling to allow them to participate later.

A small number of participants may face discomfort or distress if the result of the cognitive testing with the MMSE reveals possible cognitive deficits. These participants will be given a list of available resources to seek supports. The research team will advise the participants to visit their family doctor and will offer to provide the participant and/or their health provider with written results of the testing.

Moreover, some participants may find answering some questions difficult or uncomfortable. These participants will be informed that they may skip any questions they are not comfortable with. The research team will be willing to answer any potential questions participants may have. Also, these participants will be given a list of community resources for more help.