Creating a Physical Activity Screening Tool for Primary Care

by

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A thesis

presented to the University of Waterloo

in fulfilment of the

thesis requirement for the degree of

Master of Science

in

Kinesiology

Waterloo, Ontario, Canada

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Background: Only 20% of the population meets the aerobic Canadian Physical Activity Guidelines despite the many benefits of regular activity. Healthcare providers (HCP) in primary care are well positioned to discuss physical activity, since a majority of the population visits a physician at least once a year. Unfortunately, many HCPs face barriers that prevent them from routinely screening for physical activity. **Objectives:** The Knowledge-to-Action cycle guides the study objectives, which aim to determine the needs, preferences and barriers healthcare providers, patients and other stakeholders have to the implementation and adoption of a physical activity screening and counselling tool in primary care. This study also aims to validate a brief physical activity questionnaire against a criterion measure, an accelerometer. **Methods:** A qualitative study design using semi-structured interviews with healthcare providers, patients and other stakeholders was used for the tool development and revision process. Thematic and content analysis on all the transcripts identified emerging themes and design elements for the screening tool, and informed the creation of the Physical Activity Screening (PAS) tool. To validate the PAS tool participants wore an accelerometer for seven days. Bland Altman plots were used to determine the agreement between the two measures. **Results**: 38 physicians, nurses, patients and other stakeholders (mean age 40.8 years, 71% from primary care) participated in the tool development study, and 60 participants completed the validation study (mean age 75.3, 75% female and 61.7% community dwelling). Two themes were evident; there is a willingness and interest for physical activity screening in primary care, but healthcare providers have limited opportunities and capabilities to complete the process. Many physicians already

screen for and counsel on physical activity, but their efforts are not consistent or standardized. HCPs face many barriers in primary care such as limited time per patient, and a lack of knowledge regarding physical activity guidelines or about tailoring information to patients with chronic diseases. The PAS was designed to be time efficient, uses simple language and contains non-confrontational questions to allow HCPs to have a conversation with patients about physical activity. From the Bland-Altman plots, the mean difference between the PAS and accelerometer moderate vigorous physical activity (MVPA) was -12 minutes (unbouted), and -58.5 minutes (bouted). The intra-rater reliability for aerobic and strength training is 0.584 and 0.589 respectively. The sensitivity of the PAS to determine patients not meeting guidelines is 71.4%. **Conclusion:** There is a tension between the capacity of primary care and the ideal process for physical activity screening and counselling. The PAS was developed with input from multiple user groups to create a desirable screening tool for primary care in Ontario. The PAS is a valid physical activity screening tool that is able to identify patients that are not meeting the aerobic physical activity guidelines. The PAS can facilitate physical activity screening, and provide opportunities to discuss physical activity, hopefully leading to behaviour change in patients.

Acknowledgements

My time as a student at the University of Waterloo is coming to an end and it's bittersweet. I'm excited as I move to the next chapter of my life, but sad because I am leaving the place that has been my second home for seven years. I certainly would not have completed my thesis without the encouragement, guidance and friendship from so many amazing people.

I would like to extend my deepest gratitude to my supervisor, Dr. Lora Giangregorio for all her support and guidance over the past four years. From my first meeting with her as an undergraduate student wanting to volunteer, until the end of my Master's she has helped me grow into a better researcher and person. She provided me so many opportunities I never dreamt of, and I am very appreciative of that.

I want to thank my parents, Kim and Dave Clark. I do not know where I would be without their continued love and encouragement. I thank them for supporting me throughout my entire educational journey, not thinking I was crazy for staying in school for another degree, and always providing a listening ear even when they did not know what I was talking about.

I would like to thank my committee members Dr. Paul Stolee and Dr. Laura Middleton for their guidance and support during my thesis. I would also like to thank the many members of the Bones lab for helping me with all my projects and for all the great laughs we shared. In particular, I want to thank Dr. Jenna Gibbs for being second mentor and friend to me. The patience and kindness she showed towards me will not be forgotten.

Lastly, I would like to thank Matt for always believing in me. I cannot even begin to describe what he has done for me over the past few years and how much he means to me. His love is unconditional and for that I am forever grateful.

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List of Abbreviations

BCW: Behaviour Change Wheel

EIMC: Exercise is Medicine

EMR: Electronic medical records

EVS: Exercise Vital Sign

GPPAQ: General Practice Physical Activity Questionnaire

HCP: Healthcare provider

IPAQ: International Physical Activity Questionnaire

KTA: Knowledge-to-Action

MET: Metabolic equivalent of task

MVPA: Moderate-vigorous physical activity

PAS: Physical Activity Screen

PAR: Participatory Action Research

PAVS: Physical Activity Vital Sign

SNAP: Speedy Nutrition and Physical Activity Assessment

1.0 Chapter 1: Introduction

1.1 *Rationale*

Only 20% of Canadian men and women are estimated to meet the Canadian Physical Activity Guidelines for aerobic activity (1,2). The guidelines recommend adults achieve 150 minutes of moderate to vigorous aerobic activity per week as well as two days of strength training (3). Regular physical activity can improve an individual's health by acting as both a preventative measure and treatment option for a variety of diseases and can improve overall wellbeing. For instance, physical activity can be a primary strategy for the prevention of over 20 diseases such as diabetes, coronary heart disease and depression (4,5). Issues such as fall and fracture risk can also be prevented with regular physical activity (5). One study found exercise inclusive of challenging balance training can reduce fall rates in community dwelling older adults by 39% (6). Currently, in addition to the physical activity guidelines, there are many organizations that promote physical activity such as ParticipACTION (8) or Osteoporosis Canada's Too Fit To Fracture initiative (9). These organizations use television advertisements, use fitness challenges, and have online and paper based resources to encourage individuals of all ages and abilities to become more physically active. Unfortunately, current promotion efforts, existence of guidelines, and the knowledge that physical activity is beneficial does not necessarily equate to more individuals being active as many other factors influence rates of physical activity. Therefore, more effective interventions are needed to improve the physical activity rates of Canadians.

Previous interventions have proposed the use of healthcare providers (HCP) to screen for and counsel individuals on physical activity. In particular, physicians in primary care are

well positioned to discuss physical activity for a number of reasons. Physicians have access to a large majority of the population since almost 80% of Canadians see a physician yearly (10). Physicians are already accustomed to screening for and counselling on other health behaviours and diseases such as smoking cessation and diabetes on a regular basis. Using primary care to promote physical activity can also help mitigate barriers that prevent patients from being activity such as lack of information and financial constrains (11–13). For example, if a patient wants more information about physical activity from a trained person, common sources would be a personal trainer at a gym, or fitness instructor through a community program, both of which often require payment. People with limited finances are unable to access this information. On the contrary, seeing a physician in Canada has no direct costs, and provides individuals opportunities to get beneficial information or receive suggestions where to find information that would be appropriate to them. Lastly, the preventative benefits and use of physical activity as a treatment option make it clinically relevant to discuss during consultations.

While the prevalence of physical activity screening in primary care has increased over the past few decades in Canada, the high rates of inactivity suggest current methods are ineffective at changing patient behaviour (1,5,14,15). A national survey in 2001 found that 85.2% of primary care physicians in Canada screen patients for physical activity while previous studies found only 50 -70% were screening (14,16). While recent rates are promising, the survey is subject to biases such as self-report bias. Little is known about the consistency of screening, or the quality of the information provided by physicians since health risk factors, such as alcohol, diet and exercise, are rarely recorded into the electronic medical record (EMR) system (14,17). There is a need for more transparent and standardized

screening practices in primary care to ensure that individuals who would benefit from increased levels of activity are being helped.

Despite knowing the benefits of physical activity, HCP face multiple barriers that prevent the routine screening for physical activity. Physicians report time as a major barrier (18–20). Other common barriers include lack of incentives, poor self-efficacy, and insufficient knowledge regarding physical activity prescriptions and tailoring information to patients with chronic diseases (18–20). Some barriers may be easier to overcome than others, but all are important to address to increase the frequency of screening and counselling.

In order to increase the current rates of physical activity screening and counselling, and eventually improve the physical activity levels of Canadians, a number of factors need to be considered and planned for accordingly. The Knowledge-to-Action (KTA) framework is a process that can assist with the successful translation and adoption of a behaviour; or screening for and counselling on physical activity (21). Briefly, the framework advises once a problem and relevant knowledge has been identified, the barriers to and facilitators of using that knowledge in a specific context must be evaluated (21). Then the selection, tailoring and implementation of interventions can occur (21). Using this framework will encourage the selection of effective, and data driven interventions that will change behaviour.

One specific intervention function that can facilitate behaviour change in the presence of barriers is environmental restructuring, which involves changing the physical or social context a person is interacting with (18,22). The electronic medical record system is an example of an environmental restructuring intervention that has changed the workflow of primary care and the management of patient health over the past decade. HCPs across

Ontario use the EMR daily. One feature of the EMR is its ability to remind HCPs or flag important information. An EMR intervention using reminders was successful at improving adherence by a median of 4.2% to established care processes by physicians (23). The availability of the EMR and potential effectiveness makes it a potential avenue for implementing a physical activity screening and counselling tool.

More specific to physical activity, Exercise is Medicine Canada, as well as others within North America promote the concept of 'exercise as a vital sign' (EVS) or physical activity vital sign (PAVS) to address low physical activity screening and counselling rates in primary care using the EMR system (24). The concept entails physical activity screening in every consultation (25). Two simple questions are used to determine if patients meet physical activity guidelines and it provides counselling opportunities; "How many days a week do you engage in moderate to strenuous exercise (like a brisk walk)?" and "On average, how many minutes do you engage in exercise at this level?" (26). The EVS is time efficient taking less than one minute to administer, and has face and discriminant validity (26). The EVS was successfully implemented by Kaiser Permanente healthcare system in the United States in at least four clinics. As a result of implementation, physicians were more likely to document exercise in consultation notes by 12% (adjusted odds ratio, aOR), and increased the number of lifestyle related referrals per visit by 14% (aOR) compared to clinics that did not implement the EVS (27). In addition some overweight and obese patients exposed to the EVS questions reported clinically significant weight loss, as well as patients with diabetes had improved HbAIc levels (27).

Although the EVS and PAVS concept has been implemented in clinics within the United States, and tested in Canada, there are gaps and weaknesses in the implementation

strategies that impact the adoption and success of the tools. First the healthcare systems within Canada differ significantly from the United States, eliciting different barriers and facilitators to changing provider behaviour and for the successful implementation of the EVS. For instance, during the study conducted within Kaiser Permanente, only medical assistants asked the questions whereas in Canada, the questions may be asked by a physician, nurse or another HCP or completed as a self-report questionnaire (27). The diversity in HCPs completing the screening or the implementation of the tool may influence the tool design or uptake. Therefore, the thoughts and opinions of each type of healthcare provider in primary care need to be considered during implementation. Grant et al. also suggested the success of the EVS implementation may have been influenced by the organization choosing to adopt the tool, rather than provider-level adoption, which would be more likely within Canada (27). This emphasizes the need for a bottom up, or participatory action research (PAR) approach during the development and implementation of a screening and counselling tool. This process necessitates the active involvement of HCPs as well as patients in the design and implementation of the screening and counselling tool, and its associated resources. Lastly, upon completion of the study, due to the small absolute improvement of clinical outcomes such as weight loss, the Grant et al. suggest the EVS questions alone may not be effective enough to change patient behaviour, highlighting the need for a more comprehensive intervention (27). This finding aligns with existing literature indicating brief physical activity interventions may be less effective at increasing physical activity rates than more comprehensive ones (28). Collectively, these points emphasize the need to design a screening and counselling tool that is pragmatic, more comprehensive than

the existing EVS, and appeals to HCPs working in a variety of contexts while effectively improving screening rates and ultimately patient outcomes.

Once developed, the tool will need to be validated. The questions within the tool need to accurately assess a patient's habitual physical activity for the responses to valuable. Physicians report evidence based research is a facilitator to behaviour change (18). Regardless of how pragmatic or comprehensive the tool is designed, if the questions do not accurately reflect a patient's physical activity, asking the questions will not provide useful information and it is unlikely HCPs will adopt it.

The KTA framework guides the objectives of this study, with the over-arching aim of selecting, tailoring and validating a physical activity EMR tool for primary care. In order to develop an effective and pragmatic physical activity screening and counselling tool for primary care in Canada we aim to: (a) determine the needs and preferences of healthcare providers and patients regarding the implementation of a physical activity EMR tool in primary care; (b) assess barriers to and facilitators of using an EMR based physical activity screening tool, (c) understand the benefits and challenges that exist with physical activity screening from the perspectives of physical activity related community organizations, and (d) evaluate the criterion validity for the EMR screening tool.

2.0 Chapter 2: Background Information

2.1 *Benefits of Physical Activity*

Physical activity can benefit an individual's health by lowering the rate of all-cause mortality, reduce the risk of developing chronic diseases such as cardiovascular disease, and can be utilized as a treatment option for conditions such as osteoarthritis (4,5,29). Studies have also found a strong dose-response relationship meaning the more physical activity an individual does, the more benefits he or she will experience (5). For treatment purposes, moderate to vigorous physical activity can reduce pain and disability in individuals with chronic back pain and can improve more general outcomes such as overall well-being for individuals with fibromyalgia (30,31). The risk of chronic diseases such as cardiovascular disease, stroke, colon cancer, depression and numerous others can all be reduced from regular activity (4,5). For Type 2 diabetes, physical activity is the suggested primary preventative approach, especially for people with a high risk of developing the disease (5). The benefits also extend past disease specific outcomes to issues such as falls and fractures (6,7). For example, individuals with osteoporosis can reduce their fall and fracture risk with regular physical activity that includes resistance training and balance training (7). While all domains of activity are beneficial (i.e. aerobic, resistance training, and balance training), for specific diseases and outcomes, certain domains and doses of activity yield more benefits than others (5,15). This emphasizes the need to tailor physical activity to the individual to be most effective. Physical activity is beneficial for people of all ages; especially those at higher risk of developing a chronic disease and it should be promoted as preventative and treatment options to improve health.

2.2 *Physical Activity in Canada*

The current rates of inactivity in Canada remain high. A study done through the Canadian Health Measures Survey (2007-2009) investigated the activities levels of Canadians ages 6-79 years old using accelerometers (1). The study reported only 17% of men and 14% of women 20 years and older were meeting the Canadian physical activity guidelines for aerobic activity, and a majority of waking hours were spent in sedentary time (1). In 2012 and 2013, the same study was updated and found approximately 20% of the population met the aerobic guidelines (2). When people are asked to self-report meeting the aerobic guidelines the results are often different than results from objective measures. In 2017, approximately 57% of Canadians report they achieve 150 minutes of physical activity per week (32). Self-reported Canadian rates are comparable to other countries such as the United States (33). Self-report measures are subject to bias and people underestimate what moderate and vigorous intensity physical activity actually is (34). Regardless of whether rates are documented via self-report or objective measures, the physical activity levels of Canadians need improvement.

The Canadian Physical Activity guidelines developed by the Canadian Society for Exercise Physiology state that adults should engage in 150 minutes of moderate to vigorous aerobic activity in bouts of at least 10 minutes, while engaging in strength training two times per week (3). For older adults (65 years and older), in addition to the adult guidelines, they recommend balance training for individuals with poor mobility (35). Adhering to the guidelines can reduce the risk for multiple chronic diseases such as hypertension and type 2 diabetes (5). The guidelines are similar to many other countries (33). Despite the existence

of physical activity guidelines, the rates of inactivity are prevalent emphasizing the need for new, comprehensive interventions to address this issue.

2.3 *Physical Activity Screening and Counselling*

While rates of physical activity screening and counselling have increased over the past few years, discrepancies in the rates reported in the literature exist (5, 22). Previous studies using self-report and direct observation found a wide range of screening and counselling rates; 66%-91% (19,37,38). A large Canadian study found that 85.2% of physicians ask about physical activity, but only 69.8% of respondents report providing counselling (14). It is difficult to objectively measure screening and counselling rates in primary care therefore the results of studies using self-reported data should be interpreted with caution as they are susceptible to response and selection bias. When patients were surveyed regarding physical activity screening and counselling by a physician, only 28% reported discussing physical activity (39). This finding indicates that a majority of the population has not received information from a physician about the benefits of physical activity, the recommended guidelines or had opportunities to ask questions, which can be helpful for behaviour change. Regardless of discrepancies in rates, there is a need for physicians to consistently assess physical activity, and discuss the benefits of it with all patients.

The likelihood of a patient being screened, counseled and receiving referrals for physical activity is based on a variety of characteristics such as BMI, sex, age and health status of the patient (14,36,40). For example, one study found that patients with a chronic disease such as heart disease and diabetes are more likely to be counseled than patients who

do not have any chronic diseases (36,40). Characteristics of the provider such as years of practice, and whether the provider works in an urban or rural setting also influenced physical activity screening and counselling rates (14,37). One study found that primary care physicians that were 35 years of age or older, working an urban teaching clinic were more likely to refer patients, and female physicians who were at least 35 years of age, worked for less than 6 years and working in a private clinic were more likely to provide verbal counselling to patients (14). Another study reported that female primary care physician were more likely than males to ask abut physical activity ($p<0.001$) or provide informational materials ($p<0.05$)(37). These findings indicate HCPs' characteristics are related to inconsistent physical activity screening and counselling practices within primary care.

The quality of screening and counselling for physical activity is largely unknown, but available information suggests high variability between providers. A majority of counselling is done verbally, with only 15.8% of physicians providing patients with written prescriptions (14). Interestingly, recent surveys suggest that a majority of providers understand the value of physical activity and the promotion of it in primary care, but these beliefs are not consistently influencing behaviour (37,41). In addition, few HCPs are providing comprehensive care to facilitate behaviour change of a patient. For instance more physicians screen for physical activity than provide counselling, and both those rates are higher than the HCPs who refer patients (14).

2.3.1 *Barriers to Physical Activity Counselling*

There are many barriers to physical activity screening and counselling in primary care. Lack of time is the most commonly reported barrier by providers (18–20,41,42). Even if HCPs felt they did have the time, there are many other barriers influencing their behaviours. The knowledge that physicians have regarding physical activity guidelines and prescriptions is inadequate, which stems from a lack of education (20,41,42). Physicians also report low self-efficacy, a concept closely related to knowledge, when prescribing or tailoring physical activity recommendations, especially for patients with chronic diseases (18,42). The characteristics of the patients such as interest, financial status and other health concerns are also barriers (18,42). Many studies do not report if these barriers are perceptions of the physician or based on evidence (42). While primary care providers may report the same barriers, the impact of those barriers can differ depending on profession. For example exercise professionals and allied health professionals (e.g., physiotherapist) often report greater self-efficacy than physicians when providing physical activity information (42). It is important to address the internal and external barriers that influence providers' behaviours when designing and implementation a physical activity screening and counselling tool.

2.3.2 *Physical Activity Questionnaires*

There are numerous physical activity questionnaires designed to measure physical activity levels in adults that are valid and reliable such as the International Physical Activity Questionnaire (IPAQ). Some questionnaires work well in research settings and can used by allied health and exercise professionals, but are not realistic for primary care due to time-constrained consultations (43). For example, the IPAQ-long form contains 31 questions (44). This assessment is too long to complete in addition to addressing the main purpose of the consultation. One study in the United Kingdom concluded the General Practice Physical Activity Questionnaire (GPPAQ) was feasible for primary care and rated positively for usability by the primary care providers who implemented it, but the study reported only 8.9% of the consultations during the study period had a completed GPPAQ (45). Additionally, not all physical activity questionnaires produce a quantitative value for an individual's physical activity. The EVS and PAVS produce a total number of active minutes per week, whereas the Speedy Nutrition and Physical Activity Assessment (SNAP) and GPPAQ produce categorical outputs (46,47). In addition, the categories used in the SNAP does not specifically assess the if a patient meets guidelines, instead addressing a combination of readiness and activity minutes (47). These results indicate that despite the existence of well-designed and validated tools, not all tools may be realistic for use and adoption by HCPs in primary care.

2.3.2.1 *Accelerometers*

Currently, accelerometers are considered the best method to objectively measure free-living physical activity. There is a variety of both research grade and commercially available monitors. While the final outputs are often the same (e.g., number of steps, minutes of moderate activity, energy expenditure), different models often collect and process the data differently. Some of these characteristics can be limitations depending on the research objectives. First, some monitors measure physical activity in multiple axes (tri-axial) while others only measure in one direction (uni-axial). Second, accelerometers can be worn on multiple points of the body including the wrist, hip, and ankle. The location of the accelerometer can impact the results, and may require different processing protocols (48). Depending on the location of the monitor certain activities are not well captured. For example, a hip worn accelerometer does not capture strength activities very well, particularly arm movements. Lastly, how the information from an accelerometer is processed may have the biggest impact on the results. In general, an algorithm is used within the monitor or within software that converts the raw data into meaningful information. There are many processing decisions that influence the outputs such as manipulating the epoch length (length of time the activity is averaged over), determining wear time versus non-wear time, and the categorization limits that will determine the four levels of physical activity intensities; sedentary, light, moderate and vigorous (49,50). The categories or cut off points are based on metabolic equivalents or oxygen consumption (METs) (51,52). Multiple cut off points exist for different populations (e.g. children, adults, older adults) to account for variances in age, physical fitness and energy expenditure, and improve the accuracy of the accelerometer

outputs (52–54). The validity of the different cut off points are variable (48,55). Literature exists to guide researchers through all these decisions, but ultimately, every decision will impact the results.

2.3.3 *Exercise Vital Sign Questionnaires*

There are multiple variations of the EVS or PAVS (Exercise Vital Sign or Physical Activity Vital Sign) that have been tested or implemented within primary care. The most widely known version was created by Exercise is Medicine (56). Kaiser Permanente, a large healthcare system in the United States, implemented the EVS tool in four primary care clinics. The EVS contains two questions; "on average, how many days a week do you engage in moderate to strenuous exercise (like a brisk walk)?" and "on average how many minutes do you engage in exercise at this level?" The questions only address aerobic activity despite the physical activity guidelines including strength as well (57). Upon implementation, a study found that physicians were more likely to document discussing physical activity, refer patients more often, and discuss physical activity in the consultation compared to clinics that did not (27). Additionally, there were small but clinically significant difference in the weight lost by obese and overweight individuals from the clinics using the EVS compared to the same population in the other clinics (27). The authors of the paper suggest that a more comprehensive tool is needed due to minimal changes in patient outcomes (27). For the same implementation period, the EVS tool was determined to have discriminant validity, and face validity (26). It is evident that the EVS tool has the potential to effectively change patient outcomes, and was adopted by HCPs in the United States.

While these studies indicate the effectiveness and validity of the tool, they do not

address feasibility of implementation, which is critical for long-term adoption of the EVS tool. Grant et al. noted that the first two months of implementation were excluded from their statistical analysis since less than 50% of the patient visits had a completed assessment (27). This may be an indicator of poor feasibility or adoption of the tool for a variety of reasons. One reason may be that implementation was decided upon by administration staff of each clinic, not the individual providers themselves (27). Similar PAVS questionnaires have also been studied and determined to be valid assessments of physical activity when compared to other measures, but the long term implementation of the questionnaires are unknown (47,58). The development of numerous PAVS/EVS questionnaires indicates there is support within the healthcare and research field for this concept, but to encourage widespread adoption, and behaviour change; the tool needs to be more than just valid.

2.4 *Validation of Measurement Tools*

For any new measurement tool it is important that the validity of the tool is determined. There are different types of validity. Criterion validity is the objective approach that compares the results of the new measurement tool against the results of a criterion measure, or measure that is already established as being a highly valid measurement of the construct of interest (59). For physical activity, accelerometers are the most frequently used criterion measure, which objectively track a person's physical activity. Generally self report physical activity questionnaires have low to moderate correlation (less than 0.60) with accelerometers (43,47,60–62). One explanation is self-report questionnaires are often influenced by numerous biases such as recall bias. Contrary, the moderate vigorous physical activity (MVPA) from a PAVS questionnaire was found to have a strong correlation with

another self report measure, the modified activity questionnaire (58). Another indicator of validity is the sensitivity and specificity of a questionnaire. In this case, sensitivity is the portion of people that questionnaire correctly identified, or the number of people who report not meeting the physical activity guidelines and do not meet the guidelines according to accelerometry. Specificity is the portion of people who report meeting the guidelines and actually meet the guidelines according to accelerometry. Sensitivity and specificity will indicate the portion of people that the PAS will correctly categorize. By establishing validity of a new tool, it ensures the results of a new tool (i.e. a score or patients' responses) are useful to HCPs in decision making.

2.5 *Primary Care Physical Activity Interventions*

Physical activity interventions in primary care are diverse and there is no consensus on the best methodology within the literature. Many of the interventions are 12 months or less, but can be as short as one contact (28,63). The HCP delivering the intervention is often the physician, but can be a nurse, exercise professional or health educator (28,63). Due to the variations in how primary care clinics are run, certain interventions may not be feasible to implement. For example, not all clinics have a health educator. The intensity of the intervention (i.e. the amount of time each person receives as part of the intervention) appears to vary the most. An intervention can be as minimal as a single discussion with a physician, or can be more intensive involving multiple contacts with HCPs, verbal and written counselling and an exercise program (28,63). Most interventions include two in-person discussions about physical activity, and written materials (28). Follow up phone calls are also common (28,63). The variability of physical activity interventions reported in the

literature is similar to the diverse array of existing physical activity programs in primary healthcare clinics in Ontario. An environmental screen in Ontario found the type of programs offered and the eligibility criteria for them programs differed greatly between clinics (64). An interesting difference is allied health professionals and nurses ran a majority of programs in the environmental scan, whereas many the research studies report involvement from physicians. This suggests different perspectives regarding the personnel who should implement physical activity interventions. Evidently there is no systematic approach to the design or implementation of physical activity interventions in primary care. In order to promote the adoption of physical activity screening and counselling and associated interventions, the diversity in personal and resources within primary care clinics needs to be considered.

2.5.1 *Effectiveness of Physical Activity Interventions*

In general studies targeting the improvement of physical activity levels or other patient outcomes have mixed results (65–67). Of the studies that report positive results, the effects are small to moderate, and results are dependent on intervention components (65,68,69). For example, Calfas et al. (70) reported significant improvements in physical activity levels for sedentary adults as a result of a short counselling session by a physician, and a follow up phone call from a health educator. Another study found improvements in self reported levels of physical activity, and quality of life from a physical activity prescription (67). One meta-analysis reported it would take approximately 12 patients to be counseled for one of those patients to be physical active 12 months later (28). The effectiveness may also depend on the intensity of the intervention. Since time is limited in

primary care, this is an important consideration. One study suggests higher intensity interventions may be more effective than brief ones (e.g. one time counselling session), but more research is needed (28). Collectively the evidence suggests the right intervention can be effective at improving patient outcomes.

While physical activity counselling may work at improving activity levels of patients in the short term, long-term adherence is important for maintaining the health benefits of physical activity. A meta-analysis found a small to medium improvement in self-reported physical activity levels twelve months after the intervention (28). Interestingly, the study's findings suggest that some interventions may improve self-reported physical activity levels more than others, but any intervention could lead to an improvement versus no intervention at all (28). Despite interventions showing small improvements in a study scenario, many are not feasible for primary care since they have multiple contacts or are mostly completed by allied health professionals, which not all primary care clinics have.

Most studies addressing physical activity in primary care target improvements in patient outcomes; while very few address the feasibility of implementing interventions or changing provider behaviour. Even if an intervention is found effective, it does not guarantee all HCPs will like or use the intervention materials, rendering it useless. It is important to design and implement an intervention that facilitates the adoption of a physical activity screening tool as well as one that is effective at changing patient outcomes.

2.5.2 *Electronic Medical Records System*

The EMR is an electronic system that is used across Canada to manage patient healthcare information. Over 70% of Ontario physicians use an EMR (71). While there are

different operating systems, all have similar functions designed to improve the organization and flow of health information. One important function of the EMR is its capacity to send reminders. A systematic review found larger improvements in clinical outcomes if providers had to enter a response into the reminder to proceed with the consultation than if they could dismiss it easily (23). The results are promising despite no statistical differences in outcomes found (23). EMR interventions have been successful in other domains such as diabetes (72). The EMR is an existing technology that could facilitate physical activity screening in primary care.

2.6 *Knowledge-to-Action Framework*

The Knowledge-to-Action (KTA) cycle contains two main components: knowledge creation and action (21). It is a dynamic and cyclical process where multiple stages influence other each (21). Completing all stages of the KTA process is not always the quickest method of implementing interventions, but ensures the interventions are effective and the selection process is not done haphazardly. The KTA process is comprehensive yet flexible. It guides the user through the entire process from inquiry of a topic to the continued monitoring of knowledge use while providing the user freedom to achieve each step in his or her own way (21). Therefore, users may utilize other frameworks and theories to supplement the KTA process. For instance, the Participatory Action Research (PAR) process is a framework that encourages the continued collaboration with the target user throughout the development and implementation of an intervention (73,74).

2.7 *Summary of Background*

The current state of physical activity screening and counselling needs improvements. The lack of information regarding what is being provided to patients, and the inconsistency of screening and counselling helps explain the continual high rate of inactivity among Canadians. A number of barriers, such as lack of time and education can explain the inconsistent implementation and the low quality messaging being delivered to patients. There is a need for a valid, standardized screening tool and effective counselling process in primary care. Unfortunately, existing valid physical activity questionnaires are not feasible as they are often too lengthy to complete in consultations. To encourage screening and counselling, the concept of 'exercise as a vital sign' or "physical activity as a vital sign" is promoted by many national organizations. This concept has been implemented in the United States, but needs to be tailored to the Canadian healthcare system, healthcare providers, patients and other relevant stakeholders prior to implementation. The KTA framework can guide the development of a EMR based physical activity screening and counselling tool that is tailored for primary care, healthcare providers and patients within Canada (i.e. the context, the users and the target population).

3.0 Chapter 3: Research Methodology

3.1 Research Questions

3.1.1 *Primary Research Questions*

1. What are the barriers, preferences and implementation considerations of providers, patients and other stakeholders to using an EMR based physical activity screening and counselling tool for primary care in Ontario?

2. What additional resources do providers, patients, and other stakeholders need to overcome the barriers to physical activity screening and counselling?

3. Do the responses on a physical activity screening (PAS) questionnaire have good agreement with the total number of minutes of moderate to vigorous (MVPA) physical activity for seven days assessed by an accelerometer in adults 40 years and older?

3.1.2 *Secondary Research Questions*

1. What is the sensitivity and specificity of the physical activity screening (PAS) tool for determining patients who do not meet the Canadian Physical Activity Guidelines for aerobic activity?

2. What is the agreement between the physical activity screening (PAS) questionnaire responses with the total number of minutes of physical activity assessed by an accelerometer in adults 40 years and older?

3. How strong is the correlation between the physical activity screening (PAS) questionnaire responses and the number of moderate to vigorous (MVPA) physical activity minutes assessed by an accelerometer in adults 40 years and older?

4. Do the PAS questions have intra-rater reliability over a period of seven days?

5. How do participants feel about physical activity screening in primary care and the PAS questions?

3.2 Research Hypotheses

3.2.1 *Primary Research Hypotheses*

1. It is hypothesized that the physical activity screening and counselling tool will need to only contain a couple questions due to time constraints, and be flexible in how it is implemented to accommodate the wide variability in work flow of primary care clinics.

2. Due to limited training in physical activity counselling, providers will need additional resources to assist them with counselling such as handouts or locations to refer patients. Patients will want handouts and specific information regarding physical activity; similar to other information they currently receive from physicians.

3. Similar physical activity questionnaires have been validated (47,58,75). Therefore, it is hypothesized that the PAS will good agreement with the MVPA from the accelerometer.

3.2.2 *Secondary Research Hypotheses*

Similar self-report physical activity recall questionnaires report moderate reliability if assessed correctly (43). It is hypothesized that the questions will have moderate reliability since the questions do not contain a restriction of time (e.g. within the last seven days). The PAS is estimated to be able to determine the patients not achieving the aerobic physical activity guidelines, similar to other brief physical activity screening questionnaires (46,75,76). The PAS questions are expected to be understood easily by participants since similar iterations of the questions have already been tested and implemented in other settings with no reported issues (27,77). Self-reported physical activity measures historically overestimate an individual's physical activity level, and have low to moderate correlation with accelerometer data (43,78). Therefore, it is hypothesized that the MPVA from the PAS questions will have low correlation with the MVPA from the accelerometers. It is also hypothesized that the PAS MVPA will be stronger correlated with total physical activity assessed by the accelerometer than with MVPA.

3.3 Study Protocol

3.3.1 *Research Process*

The KTA framework was the overarching guide to the methodology of this study. To ensure the development of the physical activity screening and counselling tool was reflective of the KTA process and a grounded bottom up approach, PAR will be used as a secondary guiding methodology. Participatory action research is defined as a "systematic inquiry, with

the collaboration of those affected by the issue being studied for the purposes of education and of taking action or electing change" (79). An interdisciplinary research team composed of researchers, primary care providers and patients continually advised during the development of the methodology and data collection to align with the PAR process. Each team member was encouraged to provide input and participate in all aspects of the study process. Monthly team meetings on the telephone were held to update all members on study progress, share results and provide opportunities for input in the study's progress. During the team meetings, participants were encouraged to provide input, or comment on decisions regarding the study's progress. For example, the team discussed if targeted recruitment was needed during the tool development study, and when recruitment for the study would end. If a team member had additional information they did not wish to share during the meeting, they were invited to contact the lead investigator separately. Input from each team member varied depending on the topic being discussed, but all members actively participated throughout the study (e.g., attended and provided input in most phone meetings). In addition regular emails were sent asking for input or updating members of study progress between monthly meetings. Team members, including patient advocates actively participated in those discussions.

3.3.2 *Sampling and Data Collection*

Purposeful sampling was used to recruit physicians, nurses, and patients from primary care, and relevant stakeholders (e.g., organizations associated with physical activity) in southwestern Ontario. To recruit physicians we shared the project with existing physical activity or healthcare contacts, local family health teams and the Association of Ontario

Health Centres. Interested people responded. Two physicians at a family health team in the Kitchener-Waterloo region recruited patients. We conducted semi-structured interviews and focus groups with participants. As part of the PAR process, the interview guide (Appendix A) was created with input from all team members to ensure the questions were relevant to all groups of participants. The specific questions participants were asked depended on whether the person was a HCP, patient or a stakeholder. The interviews with patients focused on past experiences regarding physical activity in primary care, current physical activity preferences, and desired features of the tool and resources (e.g., language used, information available to patient). Discussions with HCPs addressed current screening and counselling practices, tailoring recommendations to a diverse populations (e.g., chronic conditions, different age groups), and desired resources to aid the delivery and uptake of physical activity screening (i.e., what is needed at an organizational level and individual level to enable screening and counselling on a daily basis). In interviews with stakeholders the feasibility of screening and counselling in primary care, and knowledge translation strategies to facilitate patient and provider uptake of physical activity guidelines and resources were discussed.

Some questions within the interview guide were based on the Diffusion of Innovation theory (80). The theory suggests that innovations are adopted and spread by people at varying rates (80). To facilitate adoption of a physical activity screening tool (i.e., the innovation) in the future, we needed to assess key attributes as perceived by the potential users (80). For example, it is important to determine the compatibility of an innovation to the adoptors' perceived needs, and current values since compatible innovations are more willingly adopted (80). To evaluate compatibility, we asked physicians and stakeholders about their current screening practices or evaluation of physical activity, and then addressed

the need for a physical screening tool within primary care. To address relative advantage we asked, “What are the benefits you see implementing the exercise vital sign tool in primary care?” Users adopt innovations that appear to provide an advantage and have clear effectiveness more easily. Participant responses to the questions regarding the attributes provided helpful information indicating the potential of adoption of a physical activity screening tool.

During the interviews participants who were HCPs were shown three existing physical activity resources designed for primary care, which we asked for their feedback on: Exercise is Medicine Canada Prescription and Referral Tool (56), Canadian Family Medicine Clinical Card (81), and the Exercise is Medicine Canada Exercise Vital Sign Questions (27). All interviews and focus groups were audio-recorded, and transcribed verbatim by the research team.

It is important to note that prior to designing the tool, the research team did have the objective that the screening tool would have the capacity to compare patient responses to the Canadian Physical Activity Guidelines for aerobic activity (i.e. 150 minutes of moderate to vigorous activity per week). Benchmarking is constantly done in primary care for other health factors and indicates whether changes are recommended or not. Therefore, it was desired that all moderate and vigorous activities be quantified in the tool to provide a total number of active minutes per week. The research team also envisioned the tool being implemented within the EMR similar to other screening tools and based on previous research (18). Therefore, when the physical activity screening tool was being presented to participants, the concept of benchmarking and implementation through the EMR was included. These pre-existing objectives may have influenced the discussions and prompts

used in the interviews and focus groups. Using a semi-structured interview guide, and starting the discussions with participants by asking about current practices or experiences and not the tool design or implementation was done to try and minimize potential biases.

3.3.3 *Data Analysis*

Two reviewers (RC and LG) independently conducted inductive thematic analysis on each transcript (82). Using an inductive approach or bottom up approach, each sentence was coded with a single word or a phrase that represented the idea(s) within a sentence. Each code was created without the influence of pre-existing theoretical frameworks or preconceptions about the data (82). The codes represent categories of data which is defined as "concepts that pertain to the same phenomenon" (83). Once all transcripts were coded and the reviewers were familiar with the data, each reviewer independently constructed themes by identifying patterned responses or meaning within the categories. Themes were created at the sematic level, which looks at the explicit meaning of the data, and not analyzing the ideologies behind the sematic information. The two reviewers discussed the findings from their individual thematic analyses, and formed main themes that reflected the overall messages within the data set. A peer debriefing session was then conducted with the two reviewers, three patient advocates and one researcher from the research team. Prior to the debriefing session, the patient advocates and researcher received the transcripts and brief instructions explaining how to conduct thematic analysis. Team members read the transcripts to familiarize themselves with the data prior to the debriefing. During the session, the research team reviewers were each given the opportunity to share their findings with the group. There was then discussion with the about the information presented. Everyone was

encouraged to provide his or her input. Some key messages from the study were refined in the debriefing session. Peer debriefing improves the credibility of the results, and attempts to minimize potential biases within the research findings (84). By including the patient advocates in the debriefing session, this affirms the main themes are inclusive of patient messages while allowing the advocates to participate in the entire study process (Table 1).

Table 1. Involvement within the study of the patient advocates on the research team.

Involvement of the Patients on Research Team
- Development and selection of interview questions
- Assisted with participant recruitment
- Assisted with thematic analysis in peer debriefing session
- Continual input regarding study recruitment, timeline, future work
- Provided input on the different iterations of the physical activity screening questionnaire

In addition to thematic analysis, we used content analysis to identify specific attributes about the EMR tool or resources that were desirable or undesirable. For example, if a participant indicated a patient handout is needed to accompany the screening tool, this was recorded. The main attributes of the tool design and features were listed descriptively. The study was approved by the Office of Research ethics at the University of Waterloo and the Hamilton Integrated Research ethics Board.

3.4 Physical Activity Vital Sign Tool Creation

3.4.1 *Development of the Physical Activity Screening (PAS) Tool*

The results of the thematic and content analysis of the qualitative data informed the creation of the PAS tool for the EMR. Researchers (RC and LG) incorporated the main themes and content components mentioned by the participants to create the first draft of the PAS. The first draft contains only screening questions (i.e., no counselling portion or resources) was created during multiple meetings.

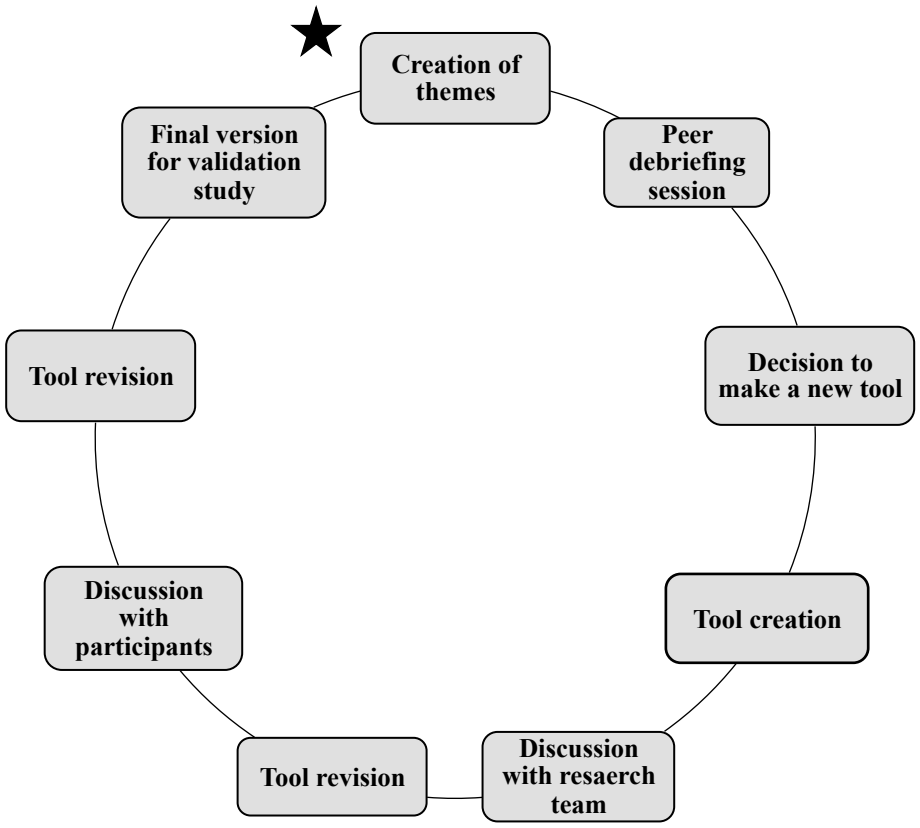
3.4.2 *Data Collection and Analysis*

According to PAR to enable change, a cyclical and iterative process must be used where target users of the research are actively engaged throughout the process (73,74). For this study, the target users were HCPs and patients who are directly affected by the research outcomes (73). Once the first draft of the PAS was completed it was circulated to study team for discussion (Figure 1). Prior to the discussion, the research team was sent an electronic version of the first draft. During the discussion, the main reviewers explain how a HCP would use the tool, the different features, and the rationale behind certain decisions. The research team was then invited to provide input on the different aspects of the tool and on decisions regarding changes to the tool. The main reviewers took notes of the feedback and decisions made during the meeting. Based on initial feedback and discussion from the team, the PAS was revised by the researchers (RC and LG). The PAS proceeded to be circulated to participants from the initial tool development process including primary care providers,

select stakeholders and the patients on our advisory research team. Prior to discussions, all participants were provided an electronic copy of the tool. The participant interviews and focus groups were audio recorded and transcribed. If there was no audio recording, the interviewers took notes. The researchers explained the development of the PAS (i.e. the features will it have) and how it will be used in primary care. The discussion with participants was open (i.e., not structured), and focused on features of the tool such as use of appropriate language, the time commitment of using the PAS, and any information or resource gaps that may impact the adoption of the tool. After each discussion, the two reviewers (RC and LG) revised the tool based on the feedback provided. The revised tool was then sent to the next participant(s) for discussion. At the end of the data collection period, the researchers (RC and LG) discussed the main themes that emerged from the discussions and ensured the final PAS iteration reflected these themes. In some cases, feedback was received by email, which was documented. When competing ideas were presented, the researchers selected the idea that the majority of participants preferred.

After multiple iterations, two primary care physicians (and 2 residents) agreed to pilot test the PAS for a few days in primary care. The physicians blocked out a couple hours to half a day at a time for conduct the pilot test on patients 40 years and older, and who they deemed appropriate to screen. After the PAS was tested on patients, a short debrief interview was conducted with the physicians to discuss what worked well with the tool, what needed to be changed, suggested implementation strategies, time to complete the PAS and other comments. The PAS was revised further based on the feedback.

Figure 1: The iterative PAS tool revision process.



3.5 Validation of the Physical Activity Vital Sign

The purpose of the validation study was to evaluate criterion validity of the PAS, by evaluating agreement between PAS questions and accelerometer-measured physical activity levels.

3.5.1 *Recruitment*

Participants were recruited from the Kitchener-Waterloo region through primary care clinics, advertisements, and targeted recruitment in two retirement communities. Eligible study participants were 40 years and older, able to speak and understand English, and were ambulatory. The target sample size was 80 participants. This was a conservative and more realistic adjustment to the suggested sample size of 100 by Martin Bland (of Bland-Altman)(85). One physician from a local family health team assisted with recruitment of community dwelling participants. Eligible patients were asked if they would like to learn more about a physical activity study. If agreeable, the primary researcher contacted the patient to explain the research study in greater detail. For recruitment of individuals living in retirement homes, the primary researcher set up a recruitment booth in two local retirement communities, Schlegel Villages as well as the kinesiologists on staff recruited participants. The study visits took place in person at the University of Waterloo, a Schlegel Village location (Waterloo or Guelph, Ontario) or by telephone.

3.5.2 *Criterion Measure: Time spent in moderate or vigorous physical activity measured by accelerometer*

Participants were asked to wear a tri-axial accelerometer (Actigraph GT9X or Actigraph GT9X -BT) for seven days. Participants were instructed to remove the monitor for bathing and swimming, since the monitors were not waterproof. Accelerometers objectively measure physical activity by measuring the accelerations of movements along three axes: vertical, horizontal and perpendicular at a sample frequency of 30Hz. In general, the raw

accelerations from the monitor were categorized into different levels of physical activity intensities: sedentary (i.e. no movement), light, moderate and vigorous. The devices also contained an inclinometer, which provided information for analysis regarding the orientation of the device, including when the device was not worn. The accelerometers used were relatively small, had a long battery life and easily clipped to an individual's pants (or worn on a belt around the waist) making the monitor fairly unobtrusive. The accelerometers did not display any data to the participant, to reduce performance bias. The raw data from the accelerometer underwent numerous processes steps.

3.5.3 *Study Protocol*

During Study Visit One, all participants provided written consent. The researcher then asked participants a brief medical history and the PAS questionnaire (Appendix B). Participants were instructed how to properly wear the accelerometer and how to complete the log that indicated when the monitor was worn. The log provided additional information for the analysis of the accelerometer data, and is frequently used in accelerometer studies (86). Participants were instructed to continue their normal daily activities during the course of the seven-day collection period. At the end of the seven day period, the researcher conducted Study Visit Two with the participants either in person or over the telephone. During this visit, the researcher asked the PAS questions, completed a short interview and collected the accelerometer. If the participant wanted, the researcher worked through a physical activity goal setting exercise or counselling session with the participant. At the start of the interview (Appendix B), the researcher asked a few probing questions about the PAS questionnaire to determine general attitudes towards the questions, participants' confidence

regarding their responses, how the participant determined their answers, and any suggested changes to improve the questions. The rest of the interview focused on participants' attitudes and ideas about physical activity screening and counselling in primary care, where they currently get physical activity information, and in what format they prefer to receive information in (e.g., paper, electronic).

The protocol for the retirement homes differed slightly as the data was collected in collaboration with another research team doing a similar collection method. During the seven-day data collection period, the participants wore three monitors: hip worn accelerometer, a wrist monitor, and an ankle monitor. If the participant had a gait aid, a monitor was placed on it as well. Only the hip worn accelerometer was used in the analyses of this study. These participants did not have an interview with the researcher during Study Visit Two. Once the accelerometer data was analyzed, each participant received information regarding their physical activity levels (i.e. minutes in light, moderate and vigorous activity) captured by the accelerometer.

3.5.4 *Accelerometers Analysis*

All accelerometers were initialized prior Study Visit One. Data from the accelerometers was downloaded into the Actigraph software (Version 6.13.3, Actigraph LLC, Pensacola, FL). The activity counts were analyzed using the Freedson standard counts per minute cut points, which categorize the data into different intensities; <100 for sedentary behaviour, 100-1951 for light activity, >1952 for moderate-vigorous activity (53). These cut off points are frequently used for adults (87). There are specific cut off points available for older adults, which were used for a sensitivity analysis (>1041 for MVPA) (52). Data was

analyzed using 60-second epochs (87). Participants were included in the accelerometer analysis if they had a minimum of four days of wear time that were at least 10 hours or longer. Participants with only four to six valid days, the missing days were imputed. The minutes for the week were averaged per day and this average replaced the missing day(s). Non –wear time was removed from the analysis and was defined as at least 60 minutes of continuous zeros. Participants' logs were used for start times, stop times, and times the monitors were removed. If there was a discrepancy greater than 10 minutes between the log and accelerometer data for start or stop times, the accelerometer data was used. Although the Actigraph software calculated the moderate and vigorous values independently, they were combined during analysis. The moderate-vigorous physical activity minutes for each participant were extracted as bouted (i.e., at least 10 minutes or more of continuous MVPA), and un-bouted (i.e., all physical activity that meets the MVPA threshold). The Actigraph software, used the Freedson cut off points as the criteria for MVPA when the bouted minutes were calculated (53). Therefore, brief periods (i.e. <2 minutes) of light or sedentary activity within a longer session of MVPA would be excluded, potentially impacting the bouted minutes calculated.

3.5.5 *Statistical Analysis*

3.5.5.1 *Primary Outcomes*

The agreement between the PAS and the accelerometer (i.e., criterion measurement) was determined with Bland-Altman plots. A Bland-Altman plot was created comparing the MVPA (unbouted for seven days from the accelerometer and the total MVPA from the PAS

questionnaire completed at Study Visit 2. A second plot was done using the bouted MVPA from the accelerometers. The plots were created by subtracting the PAS physical activity minutes from the accelerometer physical activity minutes. The limits of agreement were set at 95%. A Bland-Altman plot (unbouted) was created with outliers removed in a post-hoc analysis. Outliers were defined as participants with greater than 300 minutes difference between accelerometer and PAS MVPA minutes.

3.5.5.2 *Secondary Outcomes*

Additional Bland-Altman plots were created looking at; PAS MVPA and total accelerometer physical activity (Figure 6), and PAS MPVA and accelerometer MVPA using the lower cut off points for participants 65 years and older (Appendix C). All comparisons were done as a total sample, and separately (i.e., community dwelling, and retirement). Spearman's rank correlations were calculated for all Bland-Altman plots because the data was not normally distributed. Box plots were used post-hoc to determine potential outliers. The main correlations comparisons were calculated without the identified outliers. To determine test-retest reliability of the PAS for aerobic and resistance training, an intraclass correlation co-efficient (single measure) was calculated. A 2x2 contingency table was created to assess sensitivity and specificity of the PAS questionnaire for identifying participants not meeting guidelines. This study defined sensitivity as the proportion of people with the disease (inactivity) that were identified by the screening tool as having the disease (i.e., not meeting the aerobic physical activity guidelines). Specificity was defined as the proportion of active people that the tool identified as being active (i.e., meeting the aerobic physical activity guidelines). The criterion for aerobic physical activity was 150

minutes of MVPA. A contingency table for strength training was not created since the accelerometer does not measure this domain.

Participant interviews were audio-recorded and transcribed verbatim. In the situation where an interview was not recorded, the researcher took notes instead to capture the participants' responses. Transcripts were analyzed by one researcher (RC) using thematic analysis as previously described and researcher field notes were reviewed. The researcher discussed the themes with LG to determine how they fit within the previous findings. The thematic results are included within the tool revision study results since participants were commenting on an existing version of the PAS tool. A general summary of participants' views on and responses to the PAS questions were summarized. The physical activity data from the PAS and accelerometers as well as demographics are reported descriptively. Continuous data was reported using means and standard deviations, and categorical data was reported using percentages. The criterion for statistical significance was set at $p < 0.05$. IBM SPSS Statistics (Version 25, Markham, Ontario) and Microsoft Excel (2016, Washington, United States) were used for all analyses.

4.0 Chapter 4: Results

4.1 Tool Development

38 physicians, nurses, patients and other stakeholders from Ontario and British Columbia (mean age 40.8 years, 40- 96 years) participated (Table 2). A majority of the participants (71%) worked in primary care clinics located in Ontario. There were three focus groups and sixteen interviews. Participants in focus groups ranged from five to nine participants and composed of a mixture of professionals (i.e., doctors, nurses, allied health professionals all together).

Table 2: Descriptive characteristics of the tool development participants.

N = 38[a]	Mean (SD) / N (%)
Age (years): mean(SD)	40.8 (13.9)
Female/Male: N(%)	23 (60.5)/15 (39.5)
Physicians/Nurses: N(%)	9 (23.6)/7 (18.4)
Other healthcare professionals: N(%)	11 (28.9)
Other stakeholders: N(%)	3 (7.9)
Patients: N(%)	4 (10.5)
Years of Practice (years): mean(SD)	13.1 (9.9)

[a] Some participants (n=4) did not provide demographic information for profession, age, gender and years of practice.

"There is this tension between the convenience for the clinician and the recognition that you need the time to make a difference in people's lives." – patient

This quote illustrates the two prominent themes pertaining to physical activity screening in primary care. HCPs are willing and interested in screening for physical activity,

but there are limits of what can be done within primary care. Therefore, a physical activity screening tool must attempt to overcome these barriers and support HCPs' interests in discussing physical activity.

4.1.2 *Theme 1: There is a willingness and interest for physical activity screening in primary care, but the current methods need to be improved.*

Many healthcare providers (HCP) already ask patients about physical activity in primary care although the extent of this discussion and how often it is done is variable. Physicians may briefly ask if a patient is engaging in activity during periodic health examinations (previously known as physicals) once every year or two. Physical activity is already briefly built into this examination, as are other lifestyle factors. Some HCPs discuss physical activity in relation to chronic conditions. A HCP described their current process for discussing physical activity, "…all my patients with diabetes. And then I think they're coming in for something that's related…hyperlipidemia… often time we will talk about the role of diet and exercise there… but I would say the average probably we don't really ask that." Patients also acknowledge that physical activity can come up in relation to certain conditions. One patient who has osteoporosis described what their doctor talks to them about, "So she would talk about walking being effective, some resistance or weight training…some benefits to those things." Other HCPs may rarely discuss physical activity in their practice. The HCPs who are screening for physical activity often use a simple unstandardized approach. For example, the specific questions a HCP asks regarding physical activity may differ among patients and the questions are often broad. One HCP described their current practice as, "It's usually just 'do you get this many minutes of exercise a week?'

More or less? And they answer and we move on." HCPs indicated that having patient physical activity levels documented in a standardized way within the EMR would help improve their current practices in a number of ways. Having documentation and a specific tool for physical activity allows HCPs to check patient progress during follow-up appointments, determine if goals were met, and receive notifications for patients who are not meeting guidelines or need to be screened. HCPs were concerned that using a standardized process would not allow the screening and counselling process to be patient centered. It was important to HCPs that the physical activity discussion resembles a conversation by using a positive non-confrontational approach. HCPs were more receptive to a tool that can be tailored, as they perceived patients to be more likely to change their behaviours with customized information. Key concepts participants wanted to be built into the tool are individual preferences (i.e., what the patient is willing or wants to do), health conditions (i.e. diabetes, arthritis), age and barriers (i.e., no time, transportation, cost) to ensure the process can be patient centered.

HCPs acknowledged that the information they provide to patients may not be based on current evidence nor do they provide concrete suggestions to achieve physical activity goals. One HCP described what information they provide to the patient, "…it's not evidenced based that's for sure because I don't know…So I would tell them very general, if it's good for you, I encourage them to go to physiotherapy… to walk after dinner or in the morning…" HCPs are willing to provide patients information about physical activity, but they acknowledge that they need better messaging and resources. Therefore, HCPs expressed interest in a tool and supplementary resources that could assist them to provide evidenced based care to a broad spectrum of patients. One HCP suggested a handout for patients with

osteoporosis, “I print off a hand out on… exercise and osteoporosis dos and don’ts, and then I know it’s evidenced based.” Another indicated, “So it would be great to have a little summary of [physical activity]. What do we know, what kind of exercise works…” HCPs are not willing to ask screening questions if they have nothing to say after patients have responded, “…it’s hard for us to know to ask the questions and not have anything to follow that up with. If they have a concern…what are we going to do about this now that we have identified it?” Lastly, HCPs were interested in a decision algorithm that would guide them through the screening and counselling process incorporating all the factors previously mentioned such as health conditions and age. HCPs already use decision algorithms to manage diseases such as diabetes or hypertension, and suggested physical activity could be implemented the same way. For example, one HCP commented, “I need…you to say ‘go to this guide, use this guide’ it has all the activities…cardiac risk, start with 10 minutes of moderate…”

For patients, to willingly participate in a conversation about physical activity, they want the entire process to be patient centered, and not just a series of confrontational questions. If the questions and conversation is too direct and not linked to health, patients may be offended and become defensive. A patient commented in regards to people who are overweight, “I think the doctor needs to make the patient feel comfortable and aware that the physical activity, his recommendations or suggestions have nothing to do with the individual’s weight…you have to get that off the table to get an overweight person thinking about their physical health.” Patients also stressed the importance of using sentences that are simple and free of jargon. Patients need to understand the questions to be able to answer them properly and fully engage in the conversation.

4.1.3 *Theme 2: Healthcare providers have limited opportunities and capabilities to screen for physical activity in primary care*

The HCPs in this study noted numerous barriers that limit their ability to consistently screen for physical activity in primary care. HCPs emphasized the short amount of time allotted for each patient and the need to address the primary reason for the visit first before other topics are discussed. Therefore, lack of time was a prominent barrier for HCPs. Likewise, patients also commented on the limited time HCPs have to address the primary reason of the visit, let alone additional topics.

Another barrier HCPs acknowledged was the reason for a primary healthcare visit. HCPs commented that physical activity is not part of a patient's agenda when coming for a visit, which may influence their receptiveness to discussing the topic. One HCP stated, "… a lot of people if they are coming in for something acute like a cold or pneumonia… they are not interested in discussing [physical activity]". The patients in the study actually conveyed the opposite message indicating they would be okay with talking about physical activity if the HCP approached the subject positively, although they did acknowledge that not all patients would feel this way.

Lack of knowledge is another barrier that limits HCP's capacity to discuss physical activity. HCPs are unfamiliar with current physical activity guidelines and what advice to provide patients with different chronic conditions. For example, one HCP's response when asked if they tailor the information they provide to patients with chronic conditions was, "Not from the point of view that different kinds of exercise benefits different diseases in different ways. Only from the point of view that each cause is a limitation that you have to

work around." HCPs also have limited knowledge regarding available programs or personnel that patients can be referred to in the community. One HCP was interested in referring patients for physical activity but lacked knowledge of local resources, "I don't know where they are, I don't know who's doing them and if I did then I would. But I can't say that I know." Stakeholders and patients also recognize HCPs often have limited and knowledge about physical activity. A stakeholder highlighted that HCPs need to be able to ask about physical activity as well as discuss it and the conversation is where problems may occur, "…being able to respond to…patient questions, concerns, issues…[HCPs] would likely feel they don't have the adequate knowledge or expertise." Similarly, a patient acknowledged that HCPs do not have a lot of knowledge about physical activity and other resources may be needed to supplement what the HCPs provide, "physician won't have that level of expertise likely so I think the referral to or suggestion that people link up with those kinds of resources would be great."

Patients have limited knowledge regarding physical activity, which can affect their understanding of a conversation with the HCP or their adoption of physical activity. One HCP commented lack of knowledge can cause a disconnect between a HCP and patient when discussing physical activity, "For me, what I think is exercise is not necessarily what my patients think is exercise." HCPs also noted that patients, particularly those who have not previously exercised, may be unfamiliar what certain exercises are, proper body postures or how to stay safe (e.g., not lift too much weight). A patient's lack of knowledge of these topics can lengthen the time needed to discuss physical activity or cause a HCP to hesitate when suggesting activities in fear of the patient's safety. HCPs and stakeholders reported that patients often lack awareness of the benefits of physical activity in general and those

specific to chronic conditions. HCPs and stakeholders perceive patients' unawareness can impact motivation and subsequent adoption of physical activity. A stakeholder commented, "I just don't think a lot of people are educated about the benefits of physical activity." Other knowledge gaps for patients include physical activity terminology such as moderate intensity physical activity, used in the EIMC questions. One HCP response regarding terminology used in the EVS questions was, "Not a lot of people know what light, moderate, vigorous activity is, to everybody it is a different definition." Similarly, a patient commented that language in the screening questions and discussion need to be simple and easy to understand, "Never use uh very difficult terminology…I don't know much of the medical terminology…so for me easy understanding is most important thing. Even for the paperwork if you make a questionnaire."

4.2 Content Analysis

The participants mentioned a wide range of ideas for the EMR based tool. The features can be summarized into three main components: wording of the physical activity screening questions (e.g., what the questions should be specifically), content of the tool (e.g., what should the provider see, or additional resources), and the specific format or implementation strategies of the tool (e.g., how the tool will be administered). One HCP nicely summarized what the physical activity screening tool should be, "I would like it to be EMR based, I would like it to calculate a score, And then I would like it to direct me to what I would say next once the score is calculated. I need some kind of legend… some kind of management at that point and I would like to know how we monitor it over time".

4.2.1 *Wording of the Physical Activity Screening Questions*

The specific wording of the questions was important to participants. When participants were shown the (EIMC) questions (i.e., How many days a week do you engage in moderate to vigorous physical activity (like a brisk walk)?), all groups (i.e., HCPs, patients and stakeholders) responded that the questions were too direct and confrontational. One participant stated, "I don't know it just seems like too direct of a question to me. Maybe something about…do you engage in physical activity or what types of physical activity do you enjoy." Instead, participants wanted the questions to be open-ended at first and become more specific as the discussion progressed, similar to how HCPs already address physical activity. One HCP's approach was, "…I just ask …a very simple question. Are you doing regular exercise? And then I see what comes back."

The language used within the questions needs to be simpler the EIMC questions. One patient stated, "Don't use the word engage [in the question]." HCPs and patients also indicated that they did not understand what the terms 'moderate' and 'vigorous' physical activity meant. It was suggested if 'moderate' and 'vigorous' are used, specific definitions are needed within the tool to provide more detail or examples of activities that fall under each category. There were also discussions about using the term physical activity or exercise within the screening tool. Participants preferred the term physical activity since it is more inclusive and has a more positive connotation associated with it. For example, one participant stated, "…exercise is a threatening word and it scares people." The term exercise may cause patients to feel bad about their activity; "I think you have some merit to changing the word exercise to physical activity. I do think the word exercise…puts like a guilt feeling

on people." The term exercise reminds people of planned activities such as going to the gym, exercise classes or sports whereas physical activity encompasses both structured activities and unplanned activities that are physical like yard work, cleaning the house, or walking for transport. One patient said, "…exercise, you think oh someone is going to make me run a marathon but when you think physical activity, any type of movement is a physical activity." Therefore, if HCPs only ask about exercise, patients may report no activity when they actually do engage in physical activities within their day.

4.2.2 *Content of the Physical Activity Screening Tool*

A physical activity screening tool should capture all relevant information from the patient regarding their activity, and provide HCPs the resources to facilitate patient behaviour change. First it was clear the questions need to address the types of physical activities that people do in addition to the frequency and duration of activities. The EIMC questions do not capture type. Healthcare providers and stakeholders emphasized that knowing the types of activities that patients do is helpful. This information can facilitate further discussion and provide a starting point for goal setting or progressions. Likewise, patients want to tell their provider what they are doing, regardless of the intensity of the activity. Second, healthcare providers need additional resources to discuss physical activity, and to provide patients recommendations. This relates to the limited knowledge HCP have regarding physical activity. Participants suggested simple resources such as definitions within the tool for certain physical activity terms as well as more complex resources such as a comprehensive website for patients to use. Some participants also preferred having to print off the relevant resources whereas others wanted more customizable forms (e.g., fillable

PDF). A list of suggested resources are presented in Table 3. The tool also needs to provide suggestions to HCPs for advice to provide patients based on a patient's age, medical conditions and preferences. For example, if an older adult with osteoporosis wanted to start exercising, the tool would provide a list of options, or resources that the HCP could give the patient that are tailored for someone with osteoporosis.

Table 3. Resources suggested by participants that should be included within the physical activity screening tool.

Suggested Resources designed for Patients
Paper handouts - General information about exercise and the benefits - General prescription (with and without progressions) - Physical activity guidelines based on age (children, adult, older adult) - Specific recommendations for chronic conditions (e.g., osteoporosis, arthritis) - Tips to overcome barriers patients face such as time, weather, pain - Information about strength training - Physical activity goal setting
List of local resources (programs and personnel) for reference or to provide patients
Website with videos, articles, ideas for home exercise
Posters for clinic rooms

4.2.3 *Design and Implementation of the Physical Activity Screening Questions*

Participants reported a wide range of features that could help them successfully use the tool in practice. Not all physical activities are classified as moderate and vigorous activity, and therefore do not count towards achieving the aerobic physical activity guidelines. Due to time constraints and limited knowledge, HCPs want a streamlined process for identifying which activities 'count' towards meeting the physical activity guidelines and should be quantified into days per week and minutes per day. To alleviate the decision

process, the use of metabolic equivalents (METs) was suggested. The idea of using METs to quantify physical activity intensities was first presented by a HCP who uses this method in practice to determine if a patient has improved or declined since their last visit by asking about the hardest activity a patient does in their day-to-day life. A MET is defined as "the amount of oxygen consumed while sitting at rest" (88). Every physical activity has a pre-determined MET value based on oxygen consumption in relation to one MET (88). Physical activities with MET values of 1-4 are considered low or light intensity, 5-8 METs is considered moderate intensity, and greater than 8 METs is high or vigorous intensity (88). For example, since gardening ranges from 3.5-4.5 METs it is considered a light activity (88). However, biking is 4.8 METs or greater and is categorized as moderate or vigorous depending on the speed (88). HCPs also wanted the tool to automatically calculate if a person is achieving 150 minutes of moderate or vigorous physical activity. HCPs do not have time to calculate this during a consult.

Regarding implementation of the screening tool into primary care, physicians expressed many different ideas, often based on their current practices. The researchers conducted interviews with participants with the intent of creating an EMR tool and asked for feedback regarding this implementation strategy. HCPs agreed that the EMR would be a good implementation strategy for the physical activity screening tool, however, the specific access points within the EMR that the tool would be available and used within practice was quite diverse (Table 4). For example, the most commonly suggested method for implementation was building the tool into the periodic health examination form that would be completed with patients once every year or two. Lifestyle factors including physical activity are often addressed within a periodic health examination and physicians are allotted

a greater amount of time to conduct this type of consultation. Therefore, physicians would have more time to discuss physical activity as well as have the reminder through the EMR to ask about it. One HCP said, "…it's actually all about lifestyle and you know assessing risk factors and talking about preventative screening… So if it prompts us to do it then we can actually capture more and give more information…" Second, HCPs noted the relevance for the tool when discussing certain chronic conditions. One HCP suggested the relevance for arthritis, "someone came in for a specific health problem that can be aided by you know being more physically active…an acute flair up of arthritis or something like that." Therefore, the tool needs to be readily accessible to the physician during a disease specific consultation. A third suggestion was doing a 'physical activity blitz' where every person within a given time period (e.g., the month of June) is screened for physical activity. This method requires the tool to be accessible to the nursing staff that often are responsible for the screening. How an EMR is set up and works for each provider is very personal and customizable. Therefore, a screening tool may be implemented and used in a variety of different ways to suit individual preferences.

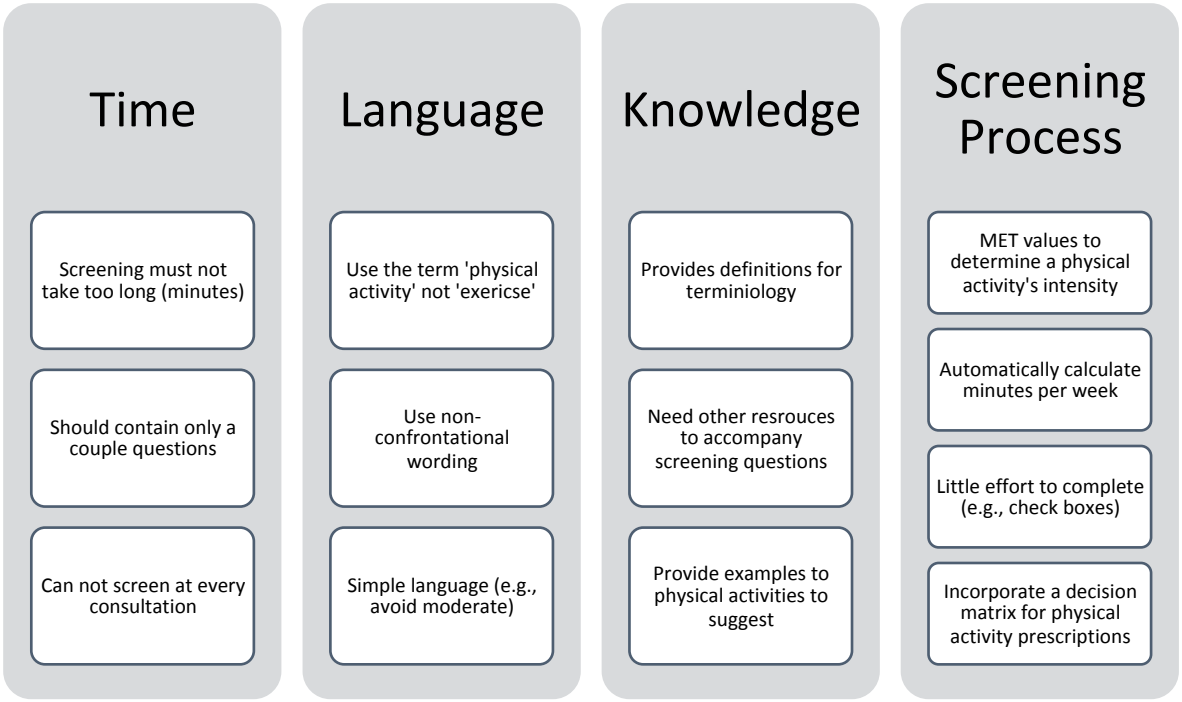
The second implementation strategy participants suggested was using the Ocean platform, which is a simple touchscreen interface that patients are given in the waiting room to complete health forms and update any information a HCP wants to know. Once a patient completes a questionnaire on the Ocean tablet, the responses are then automatically uploaded to the EMR from the tablet. The physician can decide to discuss the patient's responses if needed and time allows. Using Ocean reduces the time needed to screen for physical activity in a consult, which is barrier for HCPs. One HCP who uses Ocean said, "I think the Ocean tablet is helpful because they fill out lots of stuff and that's one of the things… before I go in

I look at it and I have to pick and choose what I have time to talk about today". Not all HCPs currently use Ocean or have access to tablets within their clinics to adopt this implementation strategy. The first draft of the PAS was created using the highly prevalent ideas from the content analysis and the main themes from the thematic analysis (Figure 2).

Table 4. Suggested implementation methods for the EMR based screening tool.

Suggested access points within the EMR for a physical activity screening tool
A stamp for physical activity
A custom form for physical activity
Build the screening tool into existing an encounter assistant (e.g., Pre-existing point and click forms designed for specific topics such as chronic conditions, periodic health examination)
Have the tool accessible in a tool bar on the main chart only
Have the tool accessible in a tool bar from multiple parts of the EMR
Create a custom form specific for 'screening blitzes'

Figure 2. Main ideas from the thematic and content analysis for the development of the PAS tool



4.3 Tool Revision

Participants in the tool revision process were composed of individuals from the tool development process (the selected participants represented all three users groups; patients, HCPs and stakeholders), and community-dwelling participants from the validation study. The tool revision results are also inclusive of feedback and information from the physicians who pilot tested the PAS in primary care. In the pilot test, 56 patients screened. See Tables 2 and 6 for demographic information. Participants were presented with a draft of the PAS tool (the specific version depended on when the participant was interviewed throughout the revision process), and asked to provide feedback on the tool. The ideas, and feedback participants expressed during the tool revision process re-affirm the main themes and barriers presented within the initial tool development process.

4.3.1 *Theme 1: There is a willingness and interest for physical activity screening in primary care, but the current methods need to be improved.*

Not only is there an interest from HCPs to discuss physical activity, but patients are receptive to discussing it as well. Many patients consider physical activity an important part of their health making it relevant to discuss during a healthcare consultation. A few patient comments included, “I think that’s a very important…question.” and “Well I think it’s important, this is apart of…people’s health.” Patients want their physician to know what physical activity they are doing and suggest any changes if needed. Some patients mentioned that if a HCP asks about physical activity they are showing a greater interest in a patient’s health. Also, discussing physical activity in primary care demonstrates a focus on prevention, which patients noted as a positive thing. One patient stated, “I think that is a very

valid thing for a physician to ask. I wished they'd focus on preventative medicine more than…giving out pills."

How physical activity screening is presented to HCPs is important for the adoption of the tool and for patients it can affect their receptiveness to the screening questions. One physician wanted the tool to incorporate a contextual statement or method to comfortably broach the subject of physical activity. HCPs noted that physical activity could be awkward to mention, especially if the consult is for something unrelated. An example of a contextual statement that the physician agreed might be appropriate was: 'I see that we haven't asked you about physical activity yet, do you mind if I do this now?' One HCP who piloted the tool commented, "some I think are totally fine with [the questions], but some you can tell some start to get just a little bit …a bit anxious about it." Once the screening is complete, the next steps in the discussion need to be positive and patient centered to facilitate behaviour change. For example, patients should be included in the decision making process regarding goals or next steps. One HCP said, …I don't want to give them one thing and then they'll say 'I can't do that', but then if I give them choices then they can say 'okay you know what maybe I can do this one'…" If the process is patient centered, HCPs perceived that it might help improve a patient's willingness to increase their physical activity.

From the provider perspective, after pilot-testing the PAS tool it was evident that it needs to be more than just a screening tool for HCPs to be willing to adopt it. HCPs need the PAS to provide specific directions for what to say and do regarding physical activity advice. For example, one HCP said, "What's the point of me asking more questions if I'm not going to get a plan? It's part of what we do as physicians. So we ask the question, we assess and then we give the plan." Another expressed, "You have to able to talk about [physical

activity] at the different levels." Many HCPs do not have the knowledge to counsel on physical activity without additional support from the PAS tool. Therefore HCPs' willingness to adopt physical activity screening may be reliant on having this guidance. Patients and HCPs are receptive to the idea of physical activity screening tool in primary care, HCPs just need assistance to implement it better into practice.

4.3.2 *Theme 2: Healthcare providers have limited opportunities and capabilities to screen for physical activity in primary care.*

Both patients and HCPs can have limited knowledge on physical activity, which can negatively affect the screening process and increase the time needed to complete the PAS questionnaire and counselling. During a pilot implementation of the PAS tool, physicians noted that patients did not understand all physical activity terminology or concepts. For example, patients did not understand what strength training was and needed the HCP to give examples. HCPs also noted patients had difficulties classifying their walks into either light or moderate intensity activity.

While patients are okay with being asked about and discussing physical activity, it was clear that many do not have the expectation that it will happen. Some participant responses when asked how they would feel discussing physical activity with a HCP included, "I would be surprised…" and "I would be quite astonished if they asked me because I've never thought about doctors being concerned with your wellbeing, more about treating your immediate problem." Collectively, these responses indicate patients do not believe HCPs focus on preventative medicine or considered HCPs sources of information

regarding physical activity. Patients also mentioned they are fully aware of the time constraints of primary care. One participant said, "I think a lot of physicians are so busy…they don't have time. They just want to rush you in and rush you back out again." It is clear that despite being receptive to the idea of screening for physical activity, both patients and HCPs are aware that lack of knowledge and time can affect whether or not it occurs. Even the keen HCPs who already screen for physical activity face challenges. Therefore, it is important that the tool is designed to address both internal (i.e., motivation) and external barriers (e.g., time, resources).

4.3.1 *Summary of patient feedback on the PAS questions and researcher's notes*

Participant feedback on the PAS questionnaire was positive. Participants reported that the PAS questionnaire was easy to answer. Most participants reported they were confident in their answers to the PAS questions. A majority of participants suggested no changes to the current wording of the questions. Two suggestions that were noted was if the administrator of the PAS worked through the past week day by day to help with recall, and separating employment and leisure time physical activity would be good, especially for individuals that work full time.

From the researcher's perspective, few issues came up when administering the PAS questionnaire. For example, some participants would report leisure activities or hobbies in response to the PAS questions such as reading, watching TV, knitting or socializing with friends. Participants often needed examples of strength training to be able to answer that question. Some participants would not report all activities they do during the questionnaire, but the activity would be mentioned later on in the discussion. Exercise classes are one

example of an activity that participants did not initially report. Lastly, it was evident that some participants were self-imposing a timeframe on the question despite no time frame being associated with the questions. Participants would make statements referencing to the past week, especially during the second study visit.

The thematic analysis and feedback received from participants during the tool revision process informed a number of changes to the PAS tool (Table 5). The wording of the questions also went through changes based on participants' preferences. The final wording of the PAS questions is based on participant feedback, but does not reflect the preference of all participants (Figure 3). The exact wording of the questions, and the visual design of the EMR tool may change once implemented (Figure 4).

Table 5. Changes and decisions that were made regarding the PAS tool during the tool revision process.

Changes/Decisions made to the PAS tool	**Rationale**
Addition of a contextual statement	Assist HCPs to bring up the topic of physical activity, which can be awkward for the provider.
Categorizing physical activities into light, moderate and vigorous based on pre-established MET values.	Many HCPs do not know the MET values for physical activities so the tool is designed to determine this.
Grouping of moderate and vigorous activities into one section (*i.e., not having three different sections in the chart)*	Does not matter what intensity an activity is as long as it meets guidelines (i.e., moderate or vigorous). This also simplifies the chart.
Creation of two categories; summer and winter sports	Simpler than listing all common sports separately. Allows for all the sports to be captured easily, and HCPs will not have to manually add every uncommon sport.
Inclusion of light physical activities *Light physical activities not quantified.*	HCPs want to document what patients are doing for follow up appointments and progressions. Patients want to report what they are doing, regardless of intensity. Light activities do not meet guidelines so it is unnecessary to spend time quantifying them.
Addition of the options: - I keep busy throughout the day - Patient reports not being active beyond moving around during daily activities.	Allows HCPs to document the physical activities of patients along the entire continuum (i.e., no planned physical activity).
Addition of a occupation related option	Some patients may have physically demanding jobs that contribute to meeting guidelines
Creation of the option to classify a physical activity as 'active in season, not now' *When this option is selected, no quantification is done.*	Allows HCPs to document activities the patient likes to do, but not currently doing since it is off season E.g., The PAS is completed in January and the patient reports golfing. HCP would select this option.

Figure 3. Development of the PAS questions during the tool revision process.

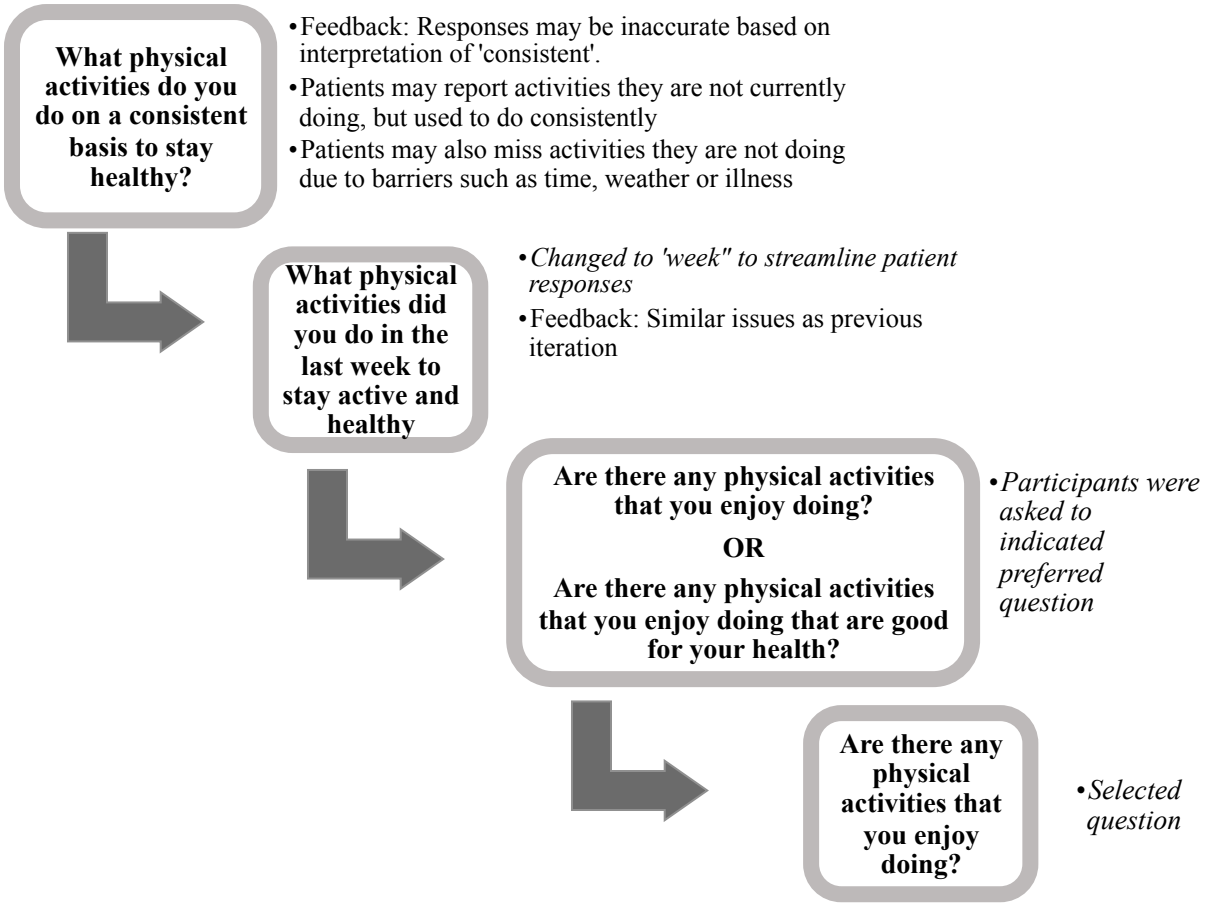


Figure 4. The final version of PAS questionnaire.

I see in our charts that I haven't asked you about physical activity in a while, do you mind if I ask you now? Yes → proceed, No → stop here

1. **Are there any physical activities you enjoy doing?**
   - ○ Patient reports not being active beyond moving around during daily activities. Move to Q2.

   OR check the activities that patient mentions below.

Light Intensity Activities *(optional)*	
○ Gardening	○ Balance exercises
○ Casual Walking	○ I keep busy throughout the day
○ Yoga/Flexibility	○ Other:

Moderate or Vigorous Intensity Physical Activities: *If seasonal and not doing right now, check "Active in season but not now" and do not quantify days/minutes.*	Active in season, not now	How many days per week?	How long did you do each activity for on average each time, in minutes?	Total min per week (autocalc)
○ Brisk Walking	○			
○ Cycling	○			
○ Exercise class	○			
○ Running	○			
○ Swimming	○			
○ Heavy Yard Work	○			
○ Summer sports (e.g., Golf, softball):	○			
○ Winter sports (e.g., curling, skiing):	○			
○ Physically demanding job	○			
○ Other:	○			
Guidelines: Total Moderate-Vigorous Intensity PA should be **150 minutes** or greater, in bouts of 10 minutes or more. More physical activity results in more benefits.			Total moderate or vigorous activity minutes (autocalc)	

2. **How many days a week did you perform muscle strengthening exercises, such as exercises with weights, or elastic tubing?**
   _____ days

Guidelines: Strengthening exercises should be at least **twice per week.**

4.4 Validation

In total, there were 60 participants in the study. The average age was 74 years (range: 40-96 years), 75% were female**,** 30% used a gait aid to ambulate and 38.8% lived in a retirement community (Table 6). According to the PAS 33.3% of participants met the aerobic guidelines (i.e., 150 minutes of MVPA per week), and 60% met the strength guidelines at the second study visit (40% and 60% respectively for study visit 1). Participants reported on the PAS an average of 120.1 (140.0) minutes of MVPA and 2.1 (1.9) days of resistance training per week (Table 7). Some physical activities participants reported included walking (casual and brisk), gardening, exercise classes, yoga, and seasonal activities among others (Table 8). Based on the data from the accelerometer a lower percentage of participants compared to the PAS met aerobic guidelines, 28.8 % and 16.9% for unbouted and bouted (i.e., at least 10 minutes of continuous activity) respectively. The accelerometer found an average of 109.9 (137.7) unbouted MVPA minutes and 63.7 (99.2) bouted MVPA per week (Table 9). One participant was not included in the validity analysis because of invalid accelerometer wear time and two participants were not included in the reliability analysis since the researcher was unable to ask the PAS questionnaire during both study visits.

Table 6: Descriptive characteristics for the participants in the validation study.

Characteristics (N=60)	Mean (SD) or n (%)
Age (years): mean (SD)	75.3 (13.9)
Female: n (%)	45 (75.0)
BMI (kg/m^2): mean (SD)	26.2 (4.2)
Community dwelling: n (%)	37 (61.7)
Uses an assistive aid: n (%)	18 (30)
Employed either full time or part time: n (%)	12 (20)
Volunteers part time: n (%)[a]	25 (41.7)
Heart disease or stroke: n (%)[a]	5 (8.3)
Hypertension: n (%)[a]	13 (21.7)
Diabetes: n (%)[a]	3 (5.0)
Arthritis: n (%)[a]	18 (30.0)
Abnormal sensation in extremities: n (%)[a]	5 (8.3)
Osteoporosis: n (%)[a]	10 (28.6)

[a] There is missing information from some participants (n=23) for volunteering, and all chronic diseases.

Table 7. Description of physical activity from the PAS questionnaire.

Physical Activity Intensity	Visit 1 PAS Questionnaire Median (IQR) N (%)	Visit 2 PAS Questionnaire Median (IQR)/ N (%)
Light activities (yes): N(%)	46 (76.7)	42 (70)
MVPA[a] (min): Median (IQR)	60 (206.3)	80.0 (180.0)
Strength training (day): Median (IQR)	2.0 (3.0)	2.0 (3.0)

[a] MVPA: moderate-vigorous physical activity

Table 8. Examples of reported physical activities from the PAS questionnaire.

Light Activities	Moderate/Vigorous Activities
Casual walking	Brisk walking
Exercise classes	Exercise classes
Tai Chi	Cycling
Gardening	Swimming

Table 9. Description of physical activity from the accelerometers using both sets of cut off points.

Physical Activity Intensity	Freedson (unbouted) Mean (SD)/ Median (IQR) (N=59)	Freedson (bouted) Mean (SD)/ Median (IQR) (N=59)	Copeland (65yr+) Mean (SD)/ Median (IQR) (N=47)
Light activity (min)	1419.3 (657.3)/ 1428 (199-2997)		1882 (579)/ 1846 (1460-2210)
Moderate activity (min)	106.2 (130.8)/ 39 (0-463)		
Vigorous activity (min)	3.7 (14.9)/ 0 (0-105)		
MVPA[a] (min)	109.9 (137.7)/ 39 (0-500.5)	63.7 (99.2)/ 0 (0-382)	766 (518)/ 698.0 (354-698)
Total activity (min)	1529 (732.7)/ 1516.0 (205-3378)		2648 (958)/ 2606 (1734-2606)

[a] MVPA: moderate-vigorous physical activity

4.4.1 *Primary Objective*

The Bland-Altman plot shows moderate agreement between the PAS MVPA and the unbouted accelerometer MVPA (Figure 5). The mean difference between the two measures was -12.2 (195.2) minutes. In other words participants reported an average of 12 minutes more MVPA on the PAS compared to the accelerometer results. The upper and lower limits of agreement were 296.5 and -320.9 minutes, respectively. The mean difference was worse for bouted MVPA, -58.5 (136.1) minutes (Figure 6). The Bland-Altman plot shows the PAS

has a systematic bias with bouted accelerometer data since the confidence intervals around the mean difference (-58.5 minutes) do not include the point of equality. The upper and lower limits of agreement are very similar to the unbouted limits at 208.2 and -325.2 minutes, respectively. With outliers removed, the unbouted agreement improved. The mean difference was 7.3 (124.2) minutes, and the upper and lower limits of agreement was tighter than the initial Bland-Altman plots, 250.8 and -236, respectively (Appendix C).

Figure 5. Bland-Altman plot of unbouted accelerometer MPVA compared to the PAS MVPA.

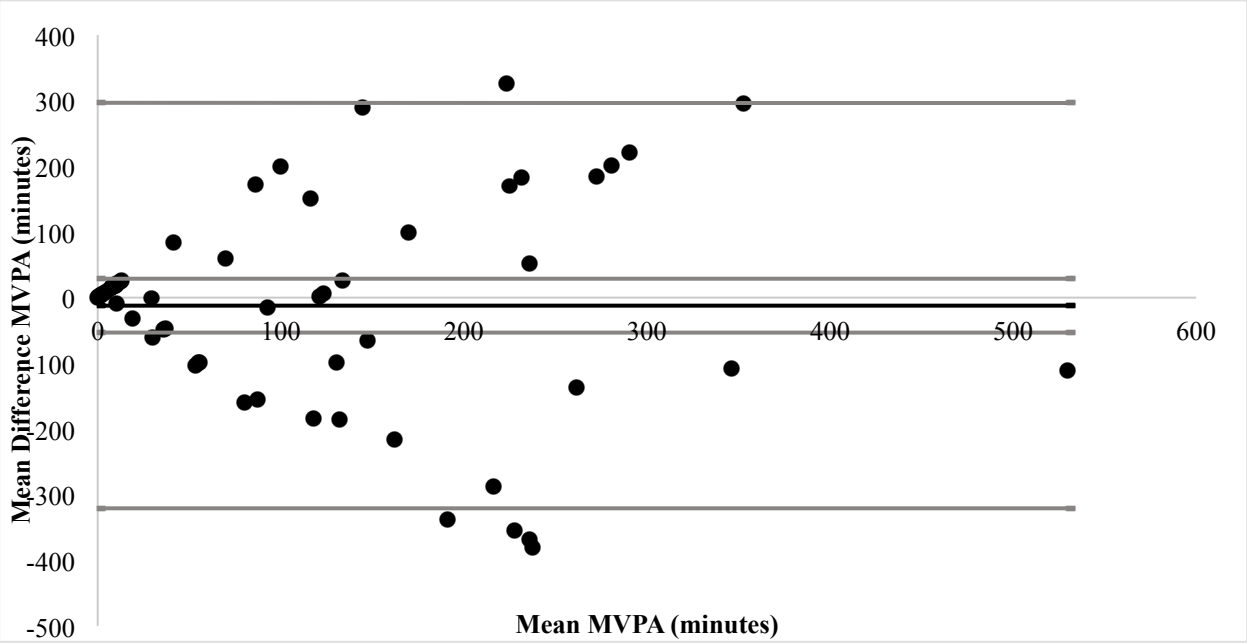
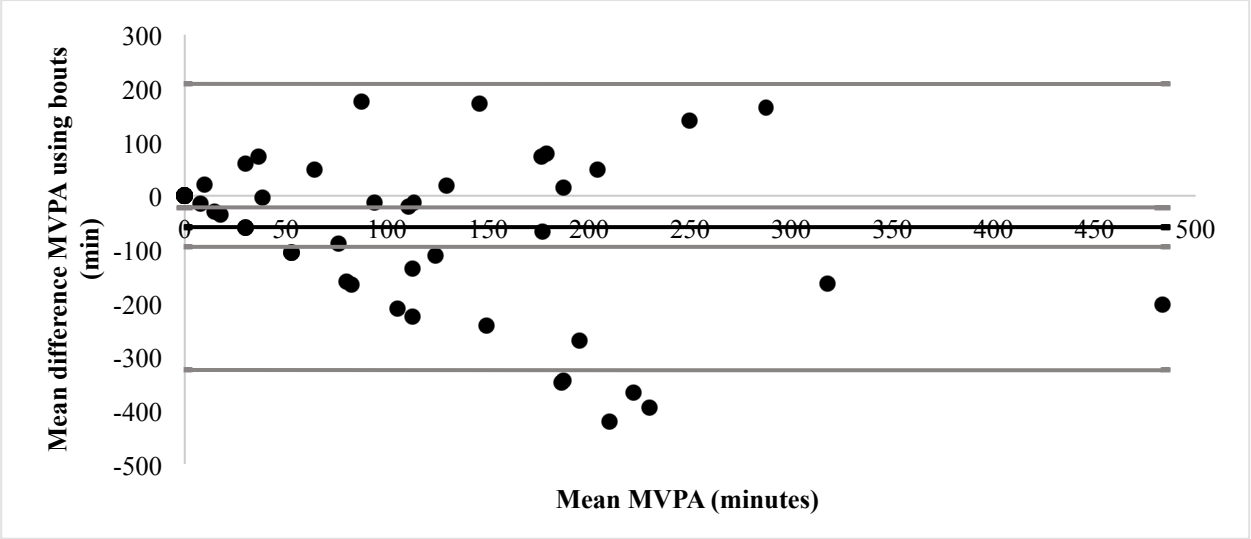


Figure 6. Bland-Altman plot of bouted accelerometer MPVA compared to the PAS MVPA.



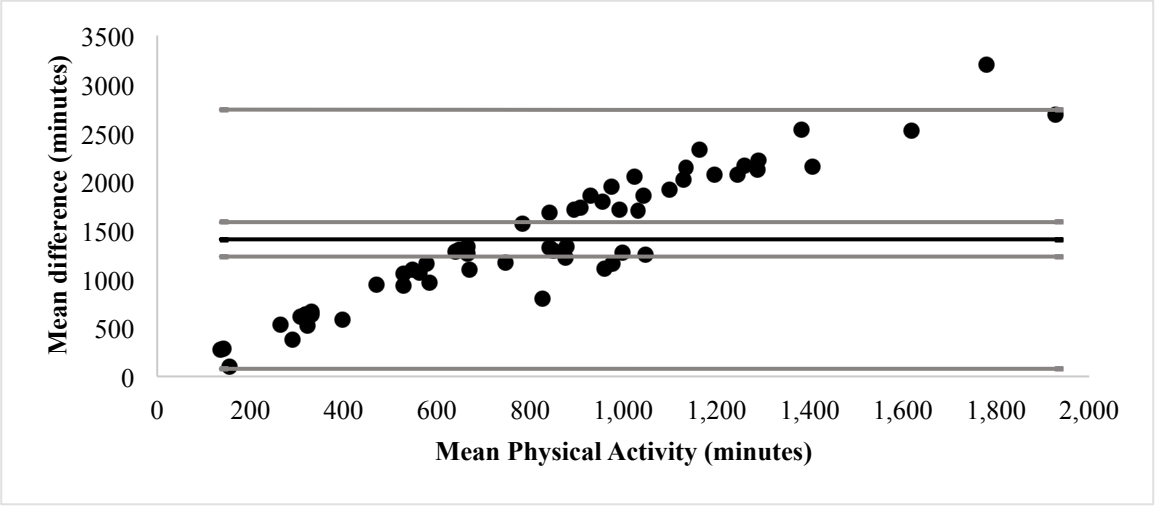
4.4.2 *Secondary Objectives*

When comparing the PAS MVPA and total minutes of activity from the accelerometer the Bland-Altman plot shows poor agreement. The mean difference is 1407.1 (678.0) minutes (Figure 7). The mean difference for the retirement participants for total activity was 871.1 (498.5) and 1725.8 (561.8) for the community dwelling participants. The sensitivity of PAS for identifying patients who are not meeting guidelines according to both bouted and unbouted accelerometer data is 71.4% (Table 10). The specificity of the PAS for identifying patients who meet guidelines with unbouted accelerometer data is 47.1% (bouted is 60%). For the retirement group, the sensitivity was 95.2% and the specificity was 100.0% (results are the same for both bouted and unbouted) (Table 10).

Table 10. Sensitivity and specificity of PAS to identify inactive patients compared to accelerometer outputs.

		Total Population (N=59)	Community Dwelling (N=37)	Retirement (N=22)
PAS MVPA and Accelerometer MVPA (unbouted)	Sensitivity	71.4% 30	47.6% 10	95.2% 20
	Specificity	47.1% 8	43.8% 7	100% 1
PAS MPVA and Accelerometer MPVA (bouted)	Sensitivity	71.4% 35	53.6% 15	95.2% 20
	Specificity	60.0% 6	55.6% 5	100% 1
		N=47	N=25	N=22
PAS MPVA and Copeland Accelerometer	Sensitivity	100% 3	None	100.0% 3
	Specificity	31.8% 14	48.0% 12	10.5% 2

Figure 7. Bland-Altman plot of accelerometer total activity minutes compared to the PAS MVPA.



Using the Copeland cut off points for the accelerometer for participants over the age of 65 years found a mean difference of 649.4 (456.2) between PAS MVPA and unbouted accelerometer MVPA (52). Therefore, the Copeland cut off points report more MPVA minutes than participants report on the PAS. The Spearman's rank correlation between PAS MVPA and unbouted accelerometer MVPA is 0.451 ($p<0.01$)(Table 11, Figure 8). The correlation is better between PAS MVPA and bouted accelerometer MVPA at 0.487 ($p<0.01$)(Table 11, Figure 9). When the outliers were removed, the correlation between PAS MVPA and unbouted accelerometer MVPA improved to 0.406 ($p<0.01$) and the bouted correlation was 0.445 ($p<0.01$). The intra-rater reliability for PAS aerobic activity was moderate (ICC=0.584 (0.384-0.731). The strength training reliability coefficient was also moderate, ICC=0.589 (0.391-0.735).

Table 11. Spearman's rank correlation values for the comparisons between the visit 2 PAS and accelerometer data.

	Total Population (N=59)	Community Dwelling (N=37)	Retirement (N=22)
Correlations			
PAS MVPA and Accelerometer MVPA (unbouted)	0.451*	0.077	-0.120
PAS MPVA and Accelerometer MPVA (bouted)	0.487*	0.095	0.395
PAS MPVA and Accelerometer total PA	0.479*	0.248	0.042
	N=47	**N=25**	**N=22**
PAS MVPA and Copeland Accelerometer MVPA	0.497*	0.353	-0.049
PAS MPVA and Copeland Accelerometer total PA	0.549*	0.561*	0.085

*p< 0.01

Figure 8. Scatter plot of PAS MVPA and unbouted accelerometer MVPA.

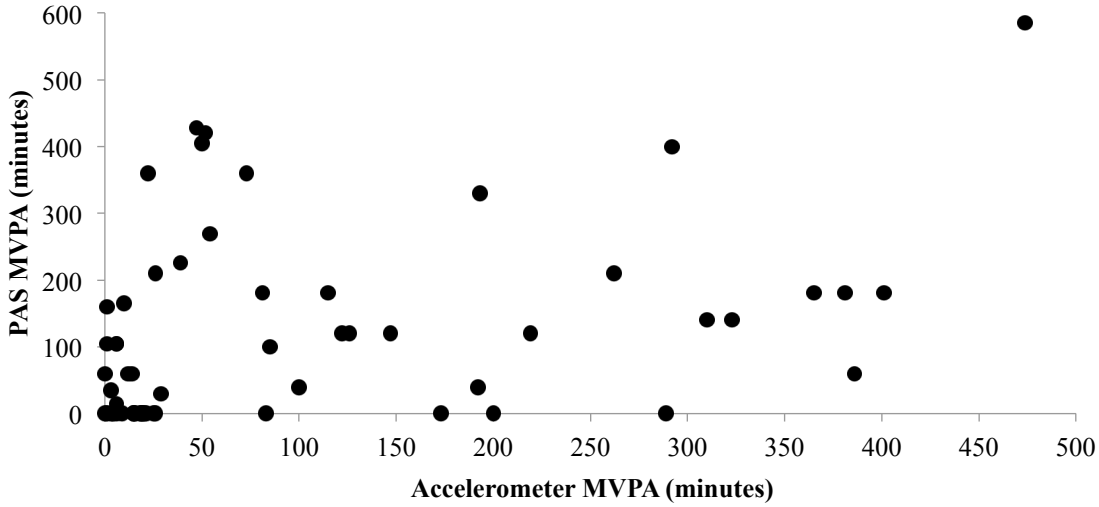
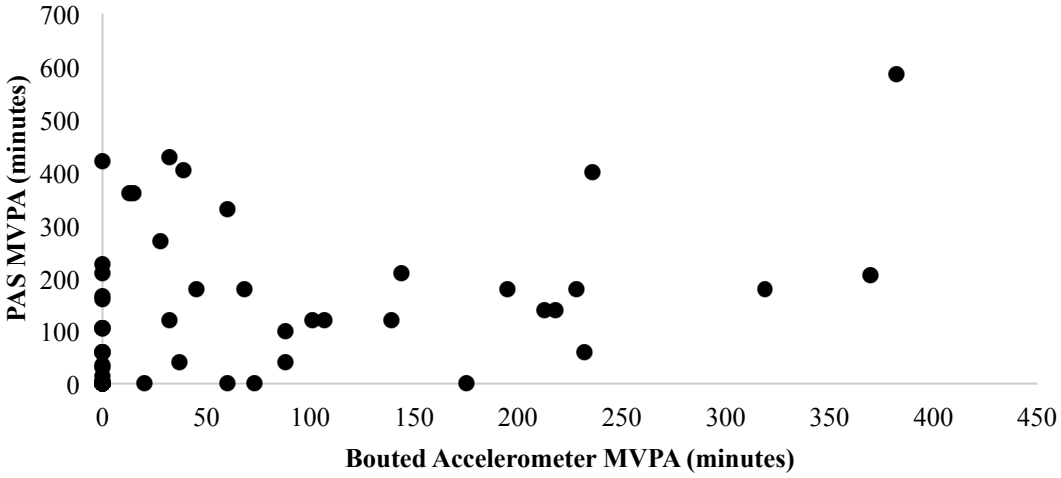


Figure 9. Scatter plot of PAS MVPA and bouted accelerometer MVPA.



5.0 Chapter 5: Discussion

There is willingness for physical activity screening to be in primary care, but HCPs acknowledge they are not doing it well due to limitations. This study's iterative methodology, and guidance from the larger research team composed of key users groups facilitated the design of a physical activity questionnaire that aims to be easy to use and patient centered, while being a valid assessment of patients' physical activity. The PAS MVPA showed good agreement with the accelerometer MVPA. In addition, the PAS had moderate sensitivity and specificity compared to accelerometry, and moderate intra-rater reliability for aerobic activity and strength training.

The KTA cycle guided the exploration of physical activity screening in primary care and subsequently facilitated the development of a new physical activity screening tool for Ontario. To our knowledge this is the first physical activity questionnaire for primary care that was developed using an iterative framework driven methodology inclusive of key user groups. First the study identified the existing barriers and facilitators for physical activity screening in primary care. Participants reported barriers such as minimal time, lack of knowledge, and no incentives. These barriers align with the results of previous studies for healthcare providers and patients (11,13,18–20,41,42). It is important to assess the barriers and facilitators of a new context prior to implementing interventions (21). Second, the study explored participant's attitudes towards existing physical activity screening questionnaires such as the EVS. Despite the successful implementation, and validation of the EVS within the United States, the EVS concept was not favoured for implementation within Ontario (26,27). HCPs in Ontario were not receptive to either the EVS questions or asking about

physical activity at every consultation. Participants expressed the questions were too confrontational, and used complex language (e.g., moderate). HCP and patient feedback and attitudes about the EVS, PAVS and similar screening tools have not been reported despite the evidence that screening tools were not fully adopted in practice or study settings (27,89). Grant et al. did comment that the decision to implement the EVS at each clinic was at the administration level and not necessarily at the provider level. The lack of provider driven enthusiasm and acknowledging the EVS questions were not completed at every consultation (i.e., not every provider completed it at every visit) may indicate that the providers in the study were not in favour of the concept or aspects of the tool itself, which our study was able to determine (27). Similarly, a study in a chiropractic clinic found that an exercise screen was also not completed at every visit, further highlighting there may be issues with attempting to implement physical activity screening during certain types of visits (89). Due to time constraints, competing priorities and other factors, HCPs preferred the questions be implemented into the periodic health examinations or used for relevant chronic conditions. Therefore, we identified the need for an entirely new physical activity screening tool. Simply tailoring the EIMC questions and implementations strategy would not meet the needs of HCPs, patients and stakeholders, nor facilitate the adoption of physical activity screening in primary care.

Due to the qualitative methodology, this study identified new information using in-depth interviews about physical activity screening that previous studies have not reported. This study determined why certain factors are barriers, and what HCPs need in place to overcome identified barriers, rather than simply listing the barriers as previous studies have done. It also explored HCP's attitudes towards a physical activity screening tool. The

literature is currently lacking information from HCPs, patients and stakeholders on their perceived utility of and preferences on physical activity tools in primary care (43,46). For example, time is a barrier during regular consultations, but less of a barrier during periodic health examinations where the visits are longer. Furthermore, HCPs do not currently refer many patients because they do not know where to refer. If HCPs had a list of local resources and personnel, they would be quite willing to refer. Previously surveys have been used to identify HCPs' barriers and attitudes towards physical activity screening and counselling in primary care (41). This methodology does not allow for HCPs to provide additional details about the barriers they face or explain the reasons behind their attitudes, unlike interviews of focus groups. The rationale behind a user's thoughts and attitudes is often lost in quantitative studies, limiting the implications the results can have on the design, revision or implementation strategy of a tool for primary care.

Another unique finding is that although HCPs, patients and stakeholders are willing to implement physical activity in primary care, they need more than just a screening tool. HCPs understand the value of physical activity screening, and identified numerous contexts in which physical activity screening would be relevant within their practice, but they are not comfortable screening patients without additional information to provide or counselling techniques to use. This finding indicates that internal motivation may not always be a limiting factor determining whether physical activity screening occurs. HCPs have limited knowledge regarding physical activity, especially for prescriptions or tailoring advice to chronic conditions, therefore resources are needed to help HCPs have an effective conversation with patients. These resources could include evidenced based information and statements HCPs could use when assisting patients with managing their barriers to physical

activity participation, or educating patients on specific health benefits. HCPs also reported the desire for a list of local resources or trained physical activity personnel that patients could be referred to in addition to the internal programs that some primary care clinics have available. Grant et al. (27) did comment that due to the limited success in changing patient outcomes over the implementation period of the EVS, a more comprehensive tool than the screening questions may be needed. There is some evidence that more intensive physical activity interventions are more successful at changing patient behaviour and outcomes, which supports the idea of adding resources to the current screening tool (28). While primary care is a great starting point physical activity promotion, additional external resources would nicely supplement HCPs' screening and counselling efforts. For example, residents in British Columbia, can call a Physical Activity Line (PAL), and speak with a qualified exercise professional or use an email service to have questions answered (90). Grant et al. (27) did comment that due to the limited success in changing patient outcomes over the implementation period of the EVS, a more comprehensive tool than the screening questions may be needed. There is some evidence that more intensive physical activity interventions are more successful at changing patient behaviour and outcomes, which supports the idea of adding resources to the current screening tool (28).

The PAS MPVA has moderate agreement with accelerometry-measured MVPA. The mean difference of -58.5 (136.1) minutes for bouted MVPA is similar to a study that compared the EVS questions to bouted accelerometry, and found an average of 66 minutes difference between the two measures (76). The upper and lower limits of agreement in this study were 208 and -325 respectively, which are very similar to previous results for physical activity questionnaires that report ranges of 349 and -217 minutes for the EVS and GPPAQ,

and 262 and -233 for the modified Leisure Time Physical Activity Questionnaire (75,76). The unbouted MVPA had a smaller mean difference of -12.2 minutes, but the limits of agreement were further apart. It is surprising that the mean difference with unbouted accelerometer data is smaller, since the PAS questions ask about activity in bouts. The unbouted may have better agreement since generally, people over-report MVPA, which is common for self report measures (76,91). Therefore, the over-estimation of MVPA may be compensated by random bursts of activity that meet the moderate threshold, but are not sustained long enough to be counted in the bouted analysis. Both bouted and unbouted plots contain outliers indicating a small systematic bias with the PAS. From the Bland-Altman plots, it is also evident that the PAS questionnaire had better agreement with lower levels of physical activity and the agreement worsens with higher levels of physical activity regardless if the accelerometer data is bouted or not (Figure 5 and 6). A study comparing the PAVS and SNAP also found the agreement was better when true physical activity minutes were lower (47).

The PAS questionnaire aligns with existing physical activity assessment tools regarding validity with accelerometers, intra-rater reliability and sensitivity to patients not meeting guidelines. The validity of the PAS could be improved, but changes to the PAS questions may come at the expense of the utility and function of the tool. Longer duration activities such as heavy yard work or skiing are potential sources of the PAS overestimating MVPA. These activities are considered moderate intensity, but in many cases an individual is not engaging at a moderate intensity for the entire duration reported. This may have been the case for the participants who reported these activities and were identified as outliers. It is important to keep in mind that while the Bland-Altman agreement improved once outliers

were removed, reporting longer duration activities during screening is expected. Therefore, to improve validity and ensure the PAS is more reflective of a patient's physical activity levels. HCPs will need to invest more time into the screening process as well as use clinical judgment how longer duration activities should be reported and whether they should be included in the weekly MVPA total. In addition, participants may overestimate if they are achieving moderate activity or not. A recent study found that many people underestimate how hard they have to work to achieve moderate or vigorous activity (34). It will be the HCP's decision how to classify ambiguous patient responses. Another strategy that may improve the validity of the PAS is limiting answers to a specific time frame (i.e., in the last 7 days). Participants would often self impose a seven day timeframe to the PAS questionnaire, particularly during the second visit which fell approximately seven days after the first visit. Since some participants used a timeline and others may not have, this could help explain the variability in the PAS responses compared to the accelerometer data. A timeframe may improve validity by aligning better with patients' interpretations of what the PAS questions are asking. We speculate that adding a time frame will not affect the HCPs experience using the PAS or patients' understanding of the questions since other physical activity questions use a seven day period. The current PAS question, "Are there any physical activities you enjoy doing?" has limitations. For example, if an individual does not enjoy all the physical activities they engage in they may not report them. Currently, the PAS questions address the physical activities an individual likes to do, and therefore is not designed to capture all activity an individual actually does. This would impact the agreement between the PAS and the accelerometer. Changing the wording to specifically target what an individual normally does could improve the validity of the questionnaire since the PAS questions and the

accelerometer would then be measuring the exact same outcome (i.e., all physical activity a patient does in a given time frame, not just what the individual likes to do). Re-wording the questions does come with potential risks though. The questions could become more confrontational affecting both the providers and patients' receptiveness to the questions, and no longer determines a patient's preferred activities that can be used to set goals or progress. Similarly, some participants did not initially report all activities or non-physical activities were reported. This emphasizes the need for an additional statement HCPs could use to help gather all the necessary information or clarify what is being asked. A potential statement could be, "Are there any other exercises or physical activities that you do?" Lastly, the agreement did improve once outliers were removed (Appendix C). The limits of agreements are smaller and fewer participants fell outside of them. Outliers consisted of people who swam, participated in longer duration sports or activities and did heavy yard work. Some of these activities may not have been well captured (or at all for swimming) by the accelerometer. The PAS may have better agreement for individuals who engage in shorter bouts of structured exercises.

The sensitivity of the PAS for determining patients who are not meeting the Canadian physical activity guidelines is higher than other physical activity questionnaires, including the EVS (ranges from 27-73%) (46,75,76). The specificity of the PAS is lower than other questionnaires which report specificities of 50-89% (46,75,76). Although the tool may miss patients who are not meeting guidelines, using the PAS will allow for systematic screening and capture more inactive patients than were previously identified. The PAS may also flag patients who already meet guidelines, but additional counselling will only be beneficial. The PAS tool should provide HCPs the capacity to discuss physical activity with

the patients and provide opportunities for the HCPs to provide additional counselling if necessary.

The correlation between PAS MVPA and accelerometer MVPA was good for bouted and unbouted (0.487 and 0.451, $p< 0.01$, respectively). These correlation values are on the higher end of correlation values reported in the literature. Similar self report questionnaires frequently low to moderate criterion validity when compared to accelerometry ($p= 0.29$-0.52)(47,60,75). It is unsurprising that the bouted accelerometer data is better correlated with the PAS than the unbouted data. When reporting physical activity, many people think of the planned bouted activities that they do. These activities are easier to remember and quantify compared to more sporadic activities (e.g., walking for transport). Another study, with a very different sample (i.e., healthcare professionals) also found stronger correlations with bouted than unbouted accelerometer data (47).

The intra-rater reliability of the PAS for MVPA and strength training was moderate (ICC= 0.584 and 0.589, respectively). Compared to the GPPAQ, 3Q Physical Activity Questionnaire and the Rapid Assessment Disuse Index, the PAS has lower reliability (ICC = 0.82-0.95, 0.94-0.98, 0.79, respectively). No physical activity screening tool has excellent reliability of those that have been assessed (43). In general, reliability of physical activity questionnaires for primary care is lacking and more efforts are focused on validation of the questionnaires (76). One explanation for the reliability values are the self-imposed time frames (i.e. seven days) participants attached.

The implementation and design of the PAS and further development of the counselling portion of the tool will facilitate both HCP and patient behaviour change by targeting multiple barriers through a variety of intervention functions. For patients, having

an HCP address physical activity in primary care mitigates a number of commonly reported barriers to activity participation such as knowledge (e.g., knowing what exercises patients should do), safety concerns (e.g., how can a patient with arthritis safely exercise), access to information and trained professionals (i.e., patients regularly see HCPs), and finances (i.e., HCPs are free to see) (12,13,92). For HCPs, the PAS tool targets multiple barriers through the implementation method and design components of the tool to promote behaviour change within practice. According to the Behaviour Change Wheel framework, select interventions are more effective for specific barriers (22). Implementing the PAS in the EMR and using the Ocean platform is an example of environmental restructuring, which addresses physical and social opportunity barriers such as time and remembering to complete the screening tool. EMR interventions have improved HCP behaviours in the past (27,69,89). Providing definitions, examples and resources within the tool targets a HCPs capability by increasing their knowledge about physical activity through education. In the future, additional interventions can be used to promote the PAS tool such as modeling or changes made at the policy level such as incentivisation.

While the PAS is designed to facilitate physical activity screening in primary care using behaviour change interventions and incorporating desired features, the tension between high quality and effective conversations about physical activity, and the limitations in primary care will always exist to some extent. The PAS is unable to overcome all the barriers HCPs face, as some barriers require more complex interventions that are beyond the scope of this study. Further, the limitations of primary care and competing interests of certain patient continually fluctuating, which will impact the adoption of the PAS. Therefore,

the results and implications should be taken in context of the study and the individuals who participated.

5.1 *Limitations*

Both the tool development and the validation studies have a number if limitations. First, the participants in the tool development study were primarily from urban locations within Ontario. While many of the barriers and facilitators to the implementation of an EMR based physical activity screening tool will be similar across Canada, differences between the provincial healthcare systems, may elicit barriers, and preferences not captured through this study. Most of the participants were also from urban centres, which also have different priorities and barriers than individuals in rural environments. For example, limited resources may be more of a barrier for rural locations. Therefore, the design and implementation of the PAS will be most suited to urban primary care clinics in Ontario. Second, the tool development study is subject to self-selection bias, limiting the generalization of the tool to all primary care practitioners. Many of the HCPs who participated in the study reported doing some level of physical activity screening within their practice (e.g., at least asking if a patient does any physical activity). Therefore, the tool was designed with input from individuals who already screen in some capacity or understand the value of physical activity for the prevention and treatment of acute and chronic conditions. The needs and preferences of a HCP who is not currently engaging in screening may be very different.

Another limitation is the small size of the validation study. Similar validation studies have samples over 100 people (58,61). This small sample limits the statistical power and generalization of the results. However, the sample population is diverse in age, and physical

function making the results relevant to more than one population. A second limitation of the validation study is the use of a single accelerometer worn on the hip. Since accelerometers measure movement and not energy expenditure, certain activities that a person may engage in are not well captured or are misclassified as light or sedentary. For example, the physical activity an individual is doing during a strength training session that meets the aerobic threshold for moderate activity may be misclassified due to little movement at the hip. Therefore, perfect agreement between the two measures is not likely considering they technically measure two different outputs.

Like the tool development study, the validation study is subject to self-selection bias. Recruitment through primary care and retirement homes did help to diversify the study sample and the sample had a wide range of physical activity levels, including participants who self –reported no physical activity beyond their daily activities. Despite this wide range, the sample did not have many participants who met the aerobic guidelines according to accelerometry. Therefore, to further investigate the specificity and sensitivity of the tool, recruitment of more active participants may be beneficial. Lastly, the Freedson cut off points were used to analyze the accelerometer data for all participants (53). Accelerometer cut off points are based on MET values, which provide a general idea of the energy expenditure required to do an activity, but have limitations. Certain personal characteristics are ignored such as body size, physical fitness and age (88). Therefore, accelerometer cut off points may over or under estimate an individual's true threshold for different physical activity intensities. In many cases, older adults have lower physical fitness, meaning it takes an older adult more energy to do the same activity compared to a fitter person. It is suggested that lower cut off points, which do exist, may be more appropriate for older adults (65 years of

age and older) than the ones this study used (52). The Freedson cut offs points were used for easier comparisons of physical activity levels across different age groups (87). Lastly, the validation study is also subject to self-selection bias. Overall, the sample did not have many participants who met the aerobic guidelines according to accelerometry. To further investigate the specificity and sensitivity of the tool, recruitment of more active participants may be beneficial.

5.2 *Next Steps*

The initial tool development and validation study are only the first steps to successfully implement physical activity screening in primary care. According to the KTA cycle, once an intervention has been selected and tailored to the context, the next step is implementation of the tool. Once the tool has been implemented into primary care, the use of the PAS needs to be monitored and selected outcomes should be evaluated to determine successful knowledge translation and behaviour change. These steps will be part of a future study. In addition, the results of the tool development study indicate a clear need for additional resources for practitioners to implement the tool and for patients to understand more about physical activity. This includes resources to aid HCPs with physical activity counselling such as physical activity prescriptions, guidance for management of patient barriers to physical activity, and point of care resources to provide to patients (Table 3). In addition educational materials for HCPs may also be appropriate as well to further their knowledge of the physical activity outside of the PAS tool's guidance. It is important that the resources integrated into the screening tool are assessed using the PAR process, similar

to the development of the PAS questionnaire to ensure they meet the needs and preferences of users.

5.3 *Conclusion*

Despite the many barriers to physical activity screening in primary care, patients, HCPs and other stakeholders all expressed a willingness to screen for physical activity within primary care. HCPs and patients understand the importance and relevance of physical activity screening in primary care, they just lack of resources and knowledge to do it consistently and effectively. The PAS was designed with continual input from patients, HCPs and other stakeholders. It is designed to overcome some of the barriers to physical activity screening and counselling, and desirable features mentioned by participant have been incorporated to help HCPs' adoption the tool. The newly designed PAS is a valid screening tool that can be used to assess patients' physical activity levels compared to the physical activity guidelines. Currently, no physical activity assessment tools have both high validity and reliability making the PAS a reasonable tool for HCPs to use in practice. By routinely screening for physical activity, HCPs will gain a better understanding of a patient's lifestyle, and can suggest changes or set goals accordingly. As a result, patients can have the knowledge and support they need to become more active.

References

1. Colley RC, Garriguet D, Janssen I, Craig CL, Clarke J, Tremblay MS. Physical activity of Canadian adults : accelerometer results from the 2007 to 2009 Canadian Health Measures Survey. Heal Reports. 2011;22(1):1–8.
2. Statistics Canada. Directly measured physical activity of adults, 2012 and 2013 [Internet]. Ottawa, ON; 2015. Available from: https://www150.statcan.gc.ca/n1/pub/82-625-x/2015001/article/14135-eng.htm
3. Canadian Society for Exercise Physiology. Canadian Physical Activity Gudielines: for adults 18-64 years [Internet]. 2017. Available from: http://csepguidelines.ca/wp-content/themes/csep2017/pdf/CSEP_PAGuidelines_adults_en.pdf
4. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Comprrehensive Physiol. 2012;2(2):1143–211.
5. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. Int J Behav Nutr Phys Act [Internet]. 2010;7(39):1–220.
6. Sherrington C, Michaleff ZA, Fairhall N, Paul SS, Tiedemann A, Whitney J, et al. Exercise to prevent falls in older adults: an updated systematic review and meta-analysis. Br J Sport Med [Internet]. 2016;0:1–10.
7. De Kam D, Smulders E, Weerdesteyn V, Smits-Engelsman BCM. Exercise interventions to reduce fall-related fractures and their risk factors in individuals with low bone density: A systematic review of randomized controlled trials. Osteoporos Int. 2009;20:2111–25.
8. ParticipACTION. ParticipACTION [Internet]. 2018. Available from: https://www.participaction.com/en-ca
9. Osteoporosis Canada. Too Fit to Fracture : Managing Osteoporosis through Exercise [Internet]. 2016. Available from: https://www.osteoporosis.ca/wp-content/uploads/OC-Too-Fit-To-Fracture-Osteo-Exercise-Book.pdf
10. Statistics Canada. Contact with a medical doctor, by age group and sex [Internet]. 2016. Available from: http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/health115b-eng.htm
11. Baert V, Gorus E, Mets T, Bautmans I. Motivators and barriers for physical activity in older adults with osteoporosis. J Geriatr Phys Ther. 2015;38(3):105–14.
12. Ziebart C, Mcarthur C, Lee L, Papaioannou A, Laprade J, Cheung AM, et al. "Left to my own devices, I don't know": using theory and patient-reported barriers to move from physical activity recommendations to practice. Osteoporos Int [Internet]. 2018;29:1081–91.

13. Bethancourt HJ, Rosenberg DE, Beatty T, Arterburn DE. Barriers to and facilitators of physical activity program use among older adults. Clin Med Res [Internet]. 2014;12(1):10–20.

14. Petrella RJ, Lattanzio CN, Overend TJ. Physical activity counseling and prescription among Canadian primary care physicians. Arch Intern Med [Internet]. 2007;167(16):1774–81.

15. Pedersen BK, Saltin B. Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. Scand J Med Sci Sport. 2015;(Suppl. 3)(25):1–72.

16. Wechsler H, Levine S, Idellson R, Schor E, Coakley E. The physician's role in health promotion revisited - a survey of primary care practitioners. N Engl J Med. 1996;334(15):996–8.

17. Zhao X, Greiver M, Kalia S, Alizrzadeh B, Meaney C, Moineddin R, et al. Associations between presence of data relevant to Chronic cisease prevention screening and management: analytical approaches. In: North American Primary Care Research Group Annual Meeting. 2016.

18. Clark RE, McArthur C, Papaioannou A, Cheung AM, Laprade J, Lee L, et al. "I do not have time. Is there a handout I can use?": combining physicians' needs and behavior change theory to put physical activity evidence into practice. Osteoporos Int. 2017;28(6):1953–63.

19. Walsh J, Swangard D, Davis T, McPhee S. Exercise counselling by primary care physicians in the era of managed care. Am J Prev Med. 1999;16(4):307–13.

20. Windt J, Windt A, Davis J, Petrella R, Khan K. Can a 3-hour educational workshop and the provision of practical tools encourage family physicians to prescribe physical activity as medicine? A pre–post study. BMJ Open [Internet]. 2015;5(7):e007920.

21. Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W, et al. Lost in knowledge translation: time for a map? J Contin Educ Health Prof [Internet]. 2006;26(1):13–24.

22. Michie S, Stralen MM Van, West R. The behaviour change wheel : a new method for characterising and designing behaviour change interventions. Implement Sci [Internet]. 2011;6(42):2–11.

23. Shojania KG, Jennings A, Mayhew A, Ramsay C, Eccles M, Grimshaw J. Effect of point-of-care computer reminders on physician behaviour: a systematic review. CMAJ. 2010;182(5).

24. Sallis RE. Exercise is medicine and physicians need to prescribe it! Br J Sport Med [Internet]. 2009 Jan 1;43(1):3–4.

25. Sallis R. Developing healthcare systems to support exercise: exercise as the fifth vital sign. Br J Sports Med [Internet]. 2011;45(6):473–4.

26. Coleman KJ, Ngor E, Reynolds K, Quinn VP, Koebnick C, Young DR, et al. Initial validation of an exercise "vital sign" in electronic medical records. Med Sci Sports

Exerc. 2012;44(11):2071–6.

27. Grant RW, Schmittdiel JA, Neugebauer RS, Uratsu CS, Sternfeld B. Exercise as a vital sign: a quasi-experimental analysis of a health system intervention to collect patient-reported exercise levels. J Gen Intern Med [Internet]. 2013;29(2):341–8.

28. Orrow G, Kinmonth A-L, Sanderson S, Sutton S. Effectiveness of physical activity promotion based in primary care: systematic review and meta-analysis of randomised controlled trials. BMJ [Internet]. 2012;344(March):e1389.

29. Wen CP, Wai JPM, Tsai MK, Yang YC, Cheng TYD, Lee MC, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. Lancet [Internet]. 2011;378(9798):1244–53.

30. Kaleth AS, Saha CK, Jensen MP, Slaven JE, Ang DC. Effect of moderate to vigorous physical activity on long-term clinical outcomes and pain severity in fibromyalgia. Arthritis Care Res (Hoboken) [Internet]. 2013;65(8):1211–8.

31. Pinto RZ, Ferreira PH, Kongsted A, Ferreira ML, Maher CG, Kent P. Self-reported moderate-to-vigorous leisure time physical activity predicts less pain and disability over 12 months in chronic and persistent low back pain. Eur J Pain (United Kingdom). 2014;19:1190–8.

32. Statistics Canada. Physical activity during leisure time, by age group and sex (percent) [Internet]. 2017. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310009613

33. Clarke TC, Norris T, Schiller JS. Early release of selected estimates based on data From the 2016 national health interview survey. 2017.

34. Canning KL, Brown RE, Jamnik VK, Salmon A, Ardern CI, Kuk JL. Individuals underestimate moderate and vigorous intensity physical activity. PLoS One. 2014;9(5).

35. Canadian Society for Exercise Physiology. Canadian Physical Activity Guidelines: for older adults 65 years & older. 2017. Available from: http://www.csep.ca/CMFiles/Guidelines/CSEP_PAGuidelines_older-adults_en.pdf

36. Wee CC, McCarthy EP, Davis RB, Phillips RS. Physician counseling about exercise. JAMA [Internet]. 1999 Oct 27;282(16):1583–8.

37. Diehl K, Mayer M, Mayer F, Goerig T, Bock C, Herr RM, et al. Physical activity counseling by primary care physicians: attitudes, knowledge, implementation, and perceived success. J Phys Act Health. 2015;12(2):216–23.

38. Carroll JK, Antognoli E, Flocke SA. Evaluation of physical activity counseling in primary care using direct observation of the 5As. Ann Fam Med. 2011;9(5):416–22.

39. Glasgow RE, Eakin EG, Fisher EB, Bacak SJ, Brownson RC. Physician advice and support for physical activity. Results from a national survey. Am J Prev Med. 2001;21(3):189–96.

40. Barnes PM, Schoenborn CA. Trends in adults receiving a recommendation for exercise or other physical activity from a physician or other health professional. NCHS Data Brief [Internet]. 2012;86:1–8. Available from: http://www.cdc.gov/nchs/data/databriefs/db86_tables.pdf#1.

41. Hébert ET, Caughy MO, Shuval K. Primary care providers' perceptions of physical activity counselling in a clinical setting: a systematic review. Br J Sports Med [Internet]. 2012;46(9):625–31.

42. O'Brien MW, Shields CA, Oh PI, Fowles JR. Health care provider confidence and exercise prescription practices of Exercise is Medicine Canada workshop attendees. Appl Physiol Nutr Metab [Internet]. 2017;42:384–90.

43. Smith TO, McKenna MC, Salter C, Hardeman W, Richardson K, Hillsdon M, et al. A systematic review of the physical activity assessment tools used in primary care. Fam Pract [Internet]. 2017;34(4):384–91.

44. Lee PH, Macfarlane DJ, Lam T, Stewart SM. Validity of the international physical activity questionnaire short form (IPAQ-SF): A systematic review. Int J Behav Nutr Phys Act [Internet]. 2011;8(115).

45. Heron N, Tully MA, Mckinley MC, Cupples ME. Physical activity assessment in practice: a mixed methods study of GPPAQ use in primary care. BMC Fam Pract [Internet]. 2014;15(11):1–9.

46. Golightly YM, Allen KD, Ambrose KR, Stiller JL, Evenson KR, Voisin C, et al. Physical Activity as a Vital Sign: A Systematic Review. Prev Chronic Dis [Internet]. 2017;14 (E123).

47. Ball TJ, Joy EA, Goh TL, Hannon JC, Gren LH, Shaw JM. Validity of two brief primary care physical activity questionnaires with accelerometry in clinic staff. Prim Health Care Res Dev. 2015;16(1):100–8.

48. Welk GJ, Blair SN, Wood K, Jones S, Thompson RW. A comparative evaluation of three accelerometry-based physical activity monitors. Med Sci Sport Exerc. 2000;32:S489–97.

49. Ward DS, Evenson KR, Vaughn A, Rodgers AB, Troiano RP. Accelerometer use in physical activity: Best practices and research recommendations. Med Sci Sports Exerc. 2005;37(11 SUPPL.).

50. Corder K, Brage S, Ekelund U. Accelerometers and pedometers: methodology and clinical application. Curr Opin Clin Nutr Metab Care [Internet]. 2007 Sep;10(5):597–603.

51. Santos-lozano A, Bailón R, Bergmeir C, Ruiz JR, Lucia A, Garatachea N. Actigraph GT3X : Validation and Determination of Physical Activity Intensity Cut Points Personal pdf file for Actigraph GT3X : Validation and Determination of Physical. 2013;(May):975–82.

52. Copeland J, Esliger D. Accelerometer assessment of physical activity in active, healthy older adults. J Aging Phys Act. 2009;17(1):17–30.

53. Freedson PS, Melanson E, Sirard J. Calibration of the Computer Science and Applications, Inc. accelerometer. Med Sci Sport Exerc. 1998;30(5):777–81.

54. Freedson P, Pober D, Janz KF. Calibration of accelerometer output for children. Med Sci Sports Exerc. 2005;37(11 SUPPL.):523–30.

55. Aguilar-Farías N, Brown WJ, Peeters G. ActiGraph GT3X+ cut-points for identifying sedentary behaviour in older adults in free-living environments. J Sci Med Sport. 2014;17:293–9.

56. Exercise is Medicine Canada. EIMC Exercise Prescription and Referral Tool [Internet]. 2014. Available from: http://www.exerciseismedicine.org/canada/support_page.php/eimc-exercise-prescription-and-referral-tool/

57. Cowan RE. Exercise Is Medicine initiative: physical sctivity as a vital sign and prescription in adult rehabilitation practice. Arch Phys Med Rehabil [Internet]. 2016;97(9 Suppl 3):S232–7.

58. Ball TJ, Joy EA, Gren LH, Shaw JM. Concurrent validity of a self-reported physical activity "vital sign" questionnaire with adult primary care patients. Prev Chronic Dis [Internet]. 2016;13(2).

59. Portney LG, Watkins MP. Foundations of Clinical Research. 3rd ed. Philadelphia: F.A.Davis Company; 2015.

60. Skender S, Ose J, Chang-Claude J, Paskow M, Brühmann B, Siegel EM, et al. Accelerometry and physical activity questionnaires - a systematic review. BMC Public Health [Internet]. 2016;16(515).

61. Dyrstad SM, Hansen BH, Holme IM, Anderssen SA. Comparison of self-reported versus accelerometer-measured physical activity. Med Sci Sports Exerc. 2013;46(1):99–106.

62. Meriwether RA, McMahon PM, Islam N, Steinmann WC. Physical Activity Assessment. Validation of a Clinical Assessment Tool. Am J Prev Med. 2006;31(6):484–91.

63. Tulloch H, Fortier M, Hogg W. Physical activity counseling in primary care: who has and who should be counseling? Vol. 64, Patient Education and Counseling. 2006. p. 6–20.

64. Moore C, Lee J, Milligan J, Giangregorio L. Physical activity as medicine among family health teams: an environmental scan of physical activity services in an interdisciplinary primary care setting. Appl Physiol Nutr Metab [Internet]. 2015;40(3):302–5.

65. Sanchez A, Bully P, Martinez C, Grandes G. Effectiveness of physical activity promotion interventions in primary care: a review of reviews. Prev Med (Baltim) [Internet]. 2015;76:S56–67.

66. Petrella RJ, Lattanzio CN. Does counseling help patients get active? systematic review of the literature. Can Fam physician [Internet]. 2002;48:72–80.

67. Kallings L V., Leijon M, Hellénius M-L, Ståhle A. Physical activity on prescription in primary health care: a follow-up of physical activity level and quality of life. Scand J Med Sci Sports [Internet]. 2007;18(2):154–61.

68. Petrella RJ, Koval JJ, Cunningham DA, Paterson DH. Can primary care doctors prescribe exercise to improve fitness? The Step Test Exercise Prescription (STEP) project. Am J Prev Med. 2003;24(4):316–22.

69. Tang JW, Kushner RF, Cameron KA, Hicks B, Cooper AJ, Baker DW. Electronic tools to assist with identification and counseling for overweight patients: A randomized controlled trial. J Gen Intern Med. 2012;27(8):933–9.

70. Calfas KJ, Long BJ, Sallis JF, Wooten WJ, Pratt M, Patrick K. A controlled trial of physician counselling to promote the adoption of physical activity. Prev Med [Internet]. 1996 [cited 2017 May 9];25(3):225–33.

71. Canadian Institute for Health Information. How Canada compares: results from The Commonwealth Fund 2015 International Health Policy survey of primary care physicians [Internet]. 2016. Available from: https://www.cihi.ca/en/health-system-performance/performance-reporting/international/commonwealth-fund-survey-2015

72. Sequist TD, Gandhi TK, Karson AS, Fiskio JM, Bugbee D, Sperling M, et al. A Randomized Trial of Electronic Clinical Reminders to Improve Quality of Care for Diabetes and Coronary Artery Disease. 2005;12(4):431–7.

73. Minkler M, Wallerstein N. Community-Based Participatory Resarch for Health: From Process to Outcomes. Second. San Franciso: Jossey-Bass; 2008.

74. Baum F. Participatory action research. J Epidemiol Community Heal [Internet]. 2006;60(10):854–7.

75. Fowles JR, O'Brien MW, Wojcik WR, D'Entremont L, Shields CA. A pilot study: validity and reliability of the CSEP−PATH PASB-Q and a new leisure time physical activity questionnaire to assess physical activity and sedentary behaviours. Appl Physiol Nutr Metab [Internet]. 2017;42(6):677–80.

76. Fitzgerald L, Ozemek C, Jarrett H, Kaminsky LA. Accelerometer validation of questionnaires used in clinical settings to assess MVPA. Med Sci Sports Exerc. 2015;47(7):1538–42.

77. Milton K, Bull FC, Bauman A. Reliability and validity testing of a single-item physical activity measure. Br J Sports Med. 2011;45(3):203–8.

78. Helmerhorst HJF, Brage S, Warren J, Besson H, Ekelund U. A systematic review of reliability and objective criterion-related validity of physical activity questionnaires. Int J Behav Nutr Phys Act. 2012;9.

79. Green L, George MA, Daniel M, Frankish C, Herbert C, Bowie W, et al. Study of Participatory Research in Health Promotion. 1995:43-50.

80. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. 2004;82(4):581–629.

81. Keegan DA, Scott I, Sylvester M, Tan A, Horrey K, Weston WW. Shared Canadian Curriculum in Family Medicine (SHARC-FM). Can Fam Physician [Internet]. 2017;63:223–31. Available from: http://www.cfp.ca/content/cfp/63/4/e223.full.pdf

82. Braun V, Clarke V. Using thematic analysis in psychology. Qual Resaerch Psychol. 2006;3(2):77–101.

83. Corbin J, Strauss A. Grounded Theory Research: Procedures, Canona and Evaluative Criteria. Zeitschrift fur Sociol [Internet]. 1990;13(1):3–21.

84. Spall S. Emerging Operational Models Sharon Spall. Qual Inq. 1998;4(2):280–92.

85. Bland JM. How can I decide the sample size for a study of agreement between two methods of measurement? [Internet]. 2004.

86. Napolitano MA, Borradaile KE, Lewis BA, Whiteley JA, Longval JL, Parisi AF, et al. Accelerometer Use in a Physical Activity Intervention Trial. Contemp Clin Trials [Internet]. 2010;31(6):514–23.

87. Gorman E, Hanson HM, Yang PH, Khan KM, Liu-Ambrose T, Ashe MC. Accelerometry analysis of physical activity and sedentary behavior in older adults: a systematic review and data analysis. Eur Rev Aging Phys Act. 2014;11:35–49.

88. Jetté M, Sidney K, Blümchen G. Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. Clin Cardiol. 1990;13(8):555–65.

89. Howitt S, Simpson K, Suderman D, Mercer A, Rutherford S, Hons BA, et al. Exercise as a vital sign : a preliminary pilot study in a chiropractic setting. J Can Chiropr Assoc. 2017;61(3):231–8.

90. Healthlink BC. Physical Activity Line [Internet]. 2018. Available from: https://www.healthlinkbc.ca/physical-activity%0A

91. Troiano RP, Berrigan D, Dodd KW, Sse LCM, Tilert T, Mcdowell M. Physical activity in the United States measured by accelerometer. Med Sci Sport Exerc [Internet]. 2008;40(1):181–8.

92. Nicholson S, Sniehotta FF, Van Wijck F, Greig CA, Johnston M, Mcmurdo MET, et al. A systematic review of perceived barriers and motivators to physical activity after stroke. Int J Stroke. 2013;8(5):357–64.

Appendices

Appendix A: Tool Development

1. Information letter and consent form
2. Sample EA form
3. Exercise is Medicine Exercise and Referral form
4. Canadian Family Medicine Clinical Card
5. Demographics
6. Interview guide

Title of Project: Exercise Vital Sign in Primary Care: Feasibility and Validity

Faculty Supervisor: Dr. Lora Giangregorio, Ph.D.
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Student Investigator: Rebecca Clark, BSc.
Department of Kinesiology
University of Waterloo

Co-investigators: Dr. James Milligan, M.D., Dr. Upender Mehan, M.D. Debra Butt, M.D., Maureen Ashe, PhD, Guy Faulkner PhD
Sponsors: University of Waterloo Incentive Fund, Canadian Institutes of Health Research

Why is this research being done?

Physical activity is often recommended in the management of multiple chronic diseases. In general, physicians are not consistently discussing physical activity with patients. We want to develop an electronic medical records tool to help physicians and nurses ask about physical activity, and determine the feasibility of implementing the tool. This project is being done for Rebecca Clark's Master's Thesis.

What is the purpose of the study?

Our team wants to gather information from physicians, nurses and patients about physical activity screening in primary care. By determining what healthcare professionals and patients want the screening tool to look like, and what resources should be included, we can design a user friendly and effective tool that is desirable to use in primary care.

What will your responsibilities be if you decide to take part in the study?

You are being invited to take part in this research study. You will be asked to participate in one or more interviews or focus groups that will be conducted over the phone or in person. Most participants will participate in one or two interviews. The conversation will be audio recorded and transcribed verbatim. You will not be identified in any way. If you do not wish to be audio-recorded, please inform the researcher. Each interview should take approximately 30 minutes and the focus group should take approximately 45 minutes. You will also be asked to provide some descriptive information about yourself, such as your age, your gender, or your occupation.

What are the possible benefits of the study for me and/or society?

We will use the results of this study to develop tools to help family physicians screen for physical activity. You will learn about Canada's Physical Activity Guidelines.

What are the possible risks and discomforts?

There are no foreseeable risks and discomforts. You can skip any questions you do not want to answer. If you do not wish to be audio-recorded, please inform the researcher.

What information will be kept private and confidential?

When the data is transcribed, no participant will be identified. However, if you are participating in a focus group, the group will know your identity. Although we will ask focus group participants to maintain confidentiality, we cannot guarantee that all participants will do so. With your permission, anonymous quotations from the interview may be used in reports, presentations, or publications.

Your data will not be shared with anyone except with your consent or as required by law. All personal information will be removed from the data and will be replaced with an ID code. Your information will be stored in Dr. Giangregorio's lab space at the University of Waterloo. Paper and electronic records will be retained for 7 years after the study is complete. Study data and forms will be kept confidential and stored in a locked office, and electronic data will be stored on a password-protected computer. Any identifying electronic data will be encrypted. Only the research team members will have access to the data.

Can I end my participation early?

Participation in this research is voluntary. If you do not wish to take part, you do not have to. If you volunteer to be in this study, you may withdraw at any time.

Will I be paid to participate in the study?

You will not be paid to participate in the study.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22082). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions contact Rebecca Clark at 1-519-888-4567 ext. 38779.

Thank you for your interest in our research and for your assistance with this project.

Consent of Participant

By providing consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about the study Exercise Vital Sign in Primary Care: Feasibility and Validity, being conducted by Rebecca Clark under the supervision of Dr. Lora Giangregorio. I have had the opportunity to ask any questions related to the study, and have received satisfactory answers to my questions. I under stand the purpose and risks of the research described in the information letter.

I am aware that I may withdraw at any time form the study with no penalty by advising the researcher of this decision. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 22082). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I agree that I may be audio-recorded during interviews or focus groups.
YES ☐ NO ☐

I agree to the use of de-identified data in future (student) research projects.
YES ☐ NO ☐

I agree that anonymous quotes may be used in future publications.
YES ☐ NO ☐

Would you like to be contacted with the main results of this research study when they are available?
YES ☐ NO ☐

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Name of Participant

_____ (please print)

Signature of Participant

_____

Witness **Date**

_____ _____

Participant Copy

Consent of Participant

By providing consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about the study Exercise Vital Sign in Primary Care: Feasibility and Validity, being conducted by Rebecca Clark under the supervision of Dr. Lora Giangregorio. I have had the opportunity to ask any questions related to the study, and have received satisfactory answers to my questions. I under stand the purpose and risks of the research described in the information letter.

I am aware that I may withdraw at any time form the study with no penalty by advising the researcher of this decision. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 22082). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

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I agree that anonymous quotes may be used in future publications.
YES ☐ NO ☐

Would you like to be contacted with the main results of this research study when they are available?
YES ☐ NO ☐

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Name of Participant

_____ (please print)

Signature of Participant

_____

Witness **Date**

_____ _____

Investigator Copy

Sample EA Form

A) Questions

1. How many days a week do you engage in moderate to vigorous exercise (like a brisk walk)?

Insert number Days

2. On average, how many minutes per day do you exercise at this level?

Insert number Hours *Insert number* Minutes

Once the patient has answered the questions, please ask the following question:

B) Complete if questions not asked:

○No (patient too ill) ○No (RN too busy) ○No (patient refused)

Once the patient has answered the questions, please ask the following question:

C) We are doing a study of physical activity in patients; may I let one of the researchers know your phone number so they can call you to tell you more about the study?

_____ No

_____ Yes

D) Physician Notes – Recommendations and handouts/information given

Handouts given? □Yes

Notes:

Exercise prescription & referral

Name _____

Date _____ Age _____

Relevant diagnoses _____

REDUCE SEDENTARY BEHAVIOUR

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

PHYSICAL ACTIVITY RECOMMENDATIONS

AEROBIC / CARDIOVASCULAR ACTIVITY

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

STRENGTH / RESISTANCE ACTIVITY

2 3 4 5 6 7 days / week

Example

CANADIAN PHYSICAL ACTIVITY GUIDELINES FOR ADULTS 18 YEARS AND OLDER

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

REFERRAL FOR ADDITIONAL EXERCISE ASSESSMENT AND COUNSELING

Name / Contact _____

Follow-up / Other _____

YOUR HEALTH PROFESSIONAL

Name Signature Licence #

WHAT DO WE KNOW ABOUT EXERCISE?

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

WHAT ABOUT AEROBIC INTENSITY AND MUSCLE STRENGTHENING?

How can I assess intensity?

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

What is strength and resistance exercise?

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

For more information

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

CASEM ACMSE

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

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

Canadian Physiotherapy Association / Association canadienne de physiothérapie

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

Canadian Family Medicine Clinical Card A18-21 2013 www.sharcfm.ca 17

Wickenheiser HM
Corbett S
Keegan DA

Exercise Prescriptions

- exercise history (inc. prior success/failures)
- **URGENT cardiac work-up if history of syncope or presyncope during exercise**
- existing illnesses, injuries & barriers
- pt. motivation, supports, resources, etc.
- check medication/supplement use

RPE: Rate of Perceived Exertion		
	10	maximum effort; unable to speak
	9	very hard effort; single words only
	7-8	vigorous effort; speak in sentences
	4-6	moderate effort; short conversations
	2-3	light effort; carry conversation
	1	very light effort

Goal-Setting

- determine long-term goals (e.g. weight loss, ↓ frailty)
- break goals into achievable 2-4 week short-term goals
- document plan; pt. to return if any barrier encountered

Key Components of Exercise Planning for All Patients

1. Aerobic Stamina	- if new, start at RPE 4-6, then gradually move up - when done should feel better/great, not exhausted - add variety to ↓ injury risk and boredom (e.g. games, dance, hikes)
2. Core / Flexibility	- key to reduce risk of injury from falls and exercising in poor posture - stretching, yoga, pilates, exercise (Swiss) ball work
3. Strength	- slow and controlled; always tighten core and keep good posture - don't strength train same muscle groups 2 days in a row
4. Nutrition	- ensure protein in every meal; eat breakfast every day - eat pre- and post- exercise (carbs and protein within 30 minutes) - drink water (ensure urine maintains a tinge of yellow) - ensure sufficient caloric intake

Specific Scenarios

Sedentary	- start with 20 min aerobic, 5-7 days/week; RPE 4-6 - plus 3x20min strength training/week
Obesity	- lower intensity exercise for longer duration - progress weekly up to 60min 5-7x/wk RPE 7-8 - try to make sitting active (e.g. sitting on ball, using treadmilll, etc.)
Frail Elderly	- go at own pace, never give up (gradually increase intensity + freq.) - focus on strength & muscle-building (eg. resistance bands, dumbbells) - balance work (e.g, standing single leg, changing directions) - range of motion exercises to minimize stiffness
Osteo-porosis	- inc. weight-bearing exercise and balance work (e.g. single leg stand) - strengthen back extensors & **avoid** back flexion
Depression	- any activity will help ↓ low mood, especially if daily; try team sports
Cardiac Risk	- start with 10 min of moderate exercise 2-3 times/day - increase episodes by 5 minutes every week
Lower Back Pain	- brace core by contracting all muscles around spine - repeat stabilization exercises (e.g. planks) multiple times per day - maintain a neutral spine while doing exercises (e.g. side planks) - strive for quality of movement, not quantity; strive for symmetry
Leg Joint Pain	- exercise bike, swimming, snowshoeing all decrease lower joint strain - ensure assessment to rule out treatable causes
Asthma	- ensure asthma is under good control (through inhaled steroids, etc.) - breath-control exercise (yoga and tai-chi) improve asthma control - moderate intensity warm up should precede any significant exercise - spurt activity (e.g. racquet sports) are ideal
Type 2 Diabetes	- drink ++ fluids during exercise; bring food/glucose tablets - ensure proper exercise footwear and daily foot inspection
Chronic Dz	- most are improved with active living/exercise

Key References: Borg GAV. *Borg's Perceived Exertion and Pain Scales*. Human Kinetics. 1998; *ACSMs Resource Manual for Guidelines for Exercise Testing and Prescription*. Lippincott Williams & Wilkins. 7th Ed. 2013; Ehrman JK et al. *Clinical Exercise Physiology*. Human Kinetics. 3rd Edition. 2013.

Tool Development and Feasibility - Demographics

Demographics:

1. Age: _____

2. Sex: _____M _____F

3. City of Practice: _____

4. Profession: _____

5. Years of Practice: _____

Thank you for your participation in the study.

POISE Semi-structured interview questions

Study 1: Developing a physical activity screening tool for primary care:

1. How do you currently ask patients about physical activity? What works well? What doesn't? OR Has your primary care provider ever asked about physical activity or provided you with exercise information? Tell me more about that.
2. What do you think about the feasibility of doctors or nurses asking about exercise during medical visits? (complexity)
    a. Tell me about whether you feel a need for a physical activity screening tool your practice. (compatability)
    b. What do you see as the benefits of implementing an EVS tool in primary care? How about disadvantages? (relative advantage)
    c. What would it take to make it a standard practice?
3. If we were to develop a physical activity screening tool for primary care, what would need to be in place?
    a. What features should it have?
    b. Would you prefer an EMR tool or a tablet-based tool for the waiting room?
    c. How often do you think a doctor or nurse should ask about your/(a patient's) exercise?
    d. What patients would it best be suited for? (e.g., age groups, conditions)
    e. Who might you avoid using it with?
    f. How do you feel about testing an EVS tool in your practice? About widely adopting it with all your patients? (trialability)
    g. How might you determine whether implementing the tool improves the health of your patients? How would you know?

4. If a doctor/nurse felt you/a patient needed more physical activity, what should they do?
    a. (physician prompt) How would you feel about providing recommendations? What would support you in doing that?
    b. What information should be provided? In what format? What resources would you like embedded in the EMR?
    c. How can a doctor or nurse support patients to participate in regular physical activity? In strength or balance training?
    d. Here is an example prescription - what do you think about it? What would influence adoption?

Provide visual example of a prescription e.g., EIMC pad

5. Here are example questions (provide a visual template of what the EMR tool might look like), what do you think about them?

- How many days a week do you engage in moderate to vigorous exercise (like a brisk walk)?
- On average, how many minutes per day do you exercise at this level?

Study 2: Current practices, experiences and preferences related to delivery of exercise evidence – how to make knowledge translation of exercise evidence patient-centred;

6. (Health care providers, policy makers or organizations) – How do you assemble and share research on exercise with your patients/stakeholders?
   a. What information or sources do you use to generate the messages that patients receive?
   b. How do you tailor the messages for patients?
   c. What messages do they receive now? Can you share the resources you would give to them?
   d. How confident are you in your ability to access, interpret and share exercise evidence?

7. (patients) Where do you currently go for exercise information?
   e. What messages do you frequently see?
   f. In what format do you often receive that information (e.g., text or videos on website, print materials, multimedia)?
   g. What's missing?

8. If there was new research on exercise, how would you like to learn about it?
   a. How should research on exercise be communicated to you/your stakeholders/your patients? And by whom?
   b. What formats are preferred?
   c. What information should be included (e.g., sources, images, examples)?

9. Where should one go for exercise information or services?
   a. Describe any challenges or successes you or your patients/stakeholders have had with access to or adoption of exercise information or services.
   b. What do you think about referring people to non-traditional places, like doctor's offices, libraries, retirement communities or long term care homes for exercise services or information?

10. What do you think about technologies to enhance exercise participation?
    a. What do you think about telemedicine?
    b. What do you think about wearable technologies, for example a physical activity monitor like a Fitbit?
    c. What do you think about apps or tools on the internet?
    d. Do you have any experience using technologies to help you participate in exercise (or support patient's participation in exercise)?*If Yes,* What did you like? What did you dislike about it? What do you think would work? What

a. Describe any challenges or successes you or your patients/stakeholders have had with access to or adoption of exercise information or services.
b. What do you think about referring people to non-traditional places, like doctor's offices, libraries, retirement communities or long term care homes for exercise services or information?

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    c. What do you think about apps or tools on the internet?
    d. Do you have any experience using technologies to help you participate in exercise (or support patient's participation in exercise)?*If Yes,* What did you like? What did you dislike about it? What do you think would work? What might limit adoption?

Patient-centred exercise recommendations:

11. When it comes to exercise, what are your needs or preferences? (*prompts: therapeutic needs, exercise preferences, exercise frequency, intensity, time and type*)

12. What goals might (you, your patient, your stakeholders) have that exercise might help you/them achieve? What is a meaningful, functional, life-relevant goal?

13. How can we make exercise information patient-centred?

Research Priorities

14. What do we need to research or know more about to influence uptake of exercise evidence? What types of studies might convince patients/physicians/policy makers to make a change?
    a. What needs to change when it comes to encouraging patients to participate in regular physical activity? In strength or balance training?
    b. What needs to change to encourage doctors to prescribe exercise? To encourage governments to fund exercise services?

15. If we conduct a study to increase physical activity screening and patients' participation in exercise, what should we measure to know if we had an impact?
    a. What outcomes are important to patients?
    b. What outcomes are important to physicians?

Appendix B: Validation Study

1. Information letter and consent form
2. Contact information
3. Medical history
4. Physical Activity Questionnaire (PAS)
5. Accelerometer instructions and log
6. Interview guide

Title of Project: Exercise Vital Sign in Primary Care: Feasibility and Validity

Faculty Supervisor: Dr. Lora Giangregorio, Ph.D.
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Student Investigator: Rebecca Clark, BSc.
Co-investigators: Dr. James Milligan, M.D., Dr. Upender Mehan, M.D.
Sponsors: University of Waterloo CIHR Incentive Fund

Why is this research being done?

Physical activity is recommended for multiple chronic diseases. In general, doctors are not consistently talking to patients about physical activity. While many physical activity questionnaires exist, they often take a long time to complete and are not practical for doctors to use. Therefore we want to figure out if two simple questions about physical activity could provide doctors helpful information about each patient. This project is being done for a Rebecca Clark's Master's Thesis.

What is the purpose of the study?

Our team wants to determine if the physical activity questions can accurately describe an individual's activity levels. We also want to hear your ideas on how best to use the physical activity questions in primary care.

What will your responsibilities be if you decide to take part in the study?

You are being invited to take part in this research study. You will be asked to participate in one study visit at the beginning of the study at either the University of Waterloo in Waterloo, Centre for Family Medicine in Kitchener or Lang's in Cambridge, depending on your preference. The study visit will take approximately one hour. During this study visit, you will be asked some questions about to your medical history as well as your physical activity levels. You would then wear a physical activity monitor for 8 days straight. The monitor is worn on a band around the waist while you are awake. It is removed during any water activities such as swimming and showering. You will be asked to keep a log of when you wear the monitor. At the end of the 8 days, the monitor will be mailed to the University of Waterloo. A researcher will then call you to complete a short physical activity questionnaire, and an interview about physical activity. The interview will be audio-recorded with your permission. The call should take approximately 30 minutes to complete.

What are the possible benefits of the study for me and/or society?

You will find out how much time you were sedentary and how much time you spent at various activity levels (e.g. light activity, vigorous activity).

The results of this study will help doctors use the physical activity questions in the future. We will be able to determine if the physical activity questions are good to use in primary care and if they describe a person's average physical activity well.

What are the possible risks and discomforts?

There are no foreseeable risks and discomforts. You do not have to wear the monitor at all times if you are uncomfortable wearing it in certain situations. If you do not want to indicate on your log why you removed the monitor, you do not have to. You can skip any questions you do not want to answer. If you do not want the interview to be audio-recorded, please inform the researcher.

What information will be kept private and confidential?

Your data will not be shared with anyone except with your consent or as required by law. All personal information will be removed from the data and will be replaced with an ID code. Your information will be stored in Dr. Giangregorio's lab space in AHS 4689. Paper and electronic records will be retained for 7 years after the study is complete. Study data and forms will be kept confidential and stored in a locked office, and electronic data will be encrypted and stored on a password-protected computer. Only the research team members will have access to the data. With your permission, anonymous quotations from the interview may be used in reports, presentations, or publications.

Can I end my participation early?

Participation in this research is voluntary. If you do not wish to take part, you do not have to. If you volunteer to be in this study, you may withdraw at any time with no penalties.

Will I be paid to participate in the study?

You will not be paid to participate in the study. We will reimburse any parking costs for the study visit.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 22082). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions contact Rebecca Clark at 1-519-888-4567 ext. 38779.

Thank you for your interest in our research and for your assistance with this project.

Consent of Participant

By providing consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about the study Exercise Vital Sign in Primary Care: Feasibility and Validity, being conducted by Rebecca Clark under the supervision of Dr. Lora Giangregorio. I have had the opportunity to ask any questions related to the study, and have received satisfactory answers to my questions. I under stand the purpose and risks of the research described in the information letter.

I am aware that I may withdraw at any time form the study with no penalty by advising the researcher of this decision. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 22082). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I agree that I may be audio-recorded during the interview.
YES ☐ NO ☐

I agree to the use of de-identified data in future (student) research projects.
YES ☐ NO ☐

I agree that anonymous quotes may be used in future publications.
YES ☐ NO ☐

Would you like to be contacted with the main results of this research study when they are available?
YES ☐ NO ☐

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Name of Participant

_____ (please print)

Signature of Participant

_____

Witness **Date**

_____ _____

Participant Copy

Consent of Participant

By providing consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

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YES ☐ NO ☐

I agree that anonymous quotes may be used in future publications.
YES ☐ NO ☐

Would you like to be contacted with the main results of this research study when they are available?
YES ☐ NO ☐

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Name of Participant

_____ (please print)

Signature of Participant

_____

Witness **Date**

_____ _____

Investigator Copy

Confidential Information

Participant ID: _____

Date of Assessment: _____

Name (First, Last): _____

Address:

Number and Street: _____

City: _____

Postal Code: _____

Phone Number: _____

Medical History

Participant ID: _____

Date of Assessment: _____

Script: Read each question as written.

Age at start of study (years):	
Sex	☐ Male ☐ Female ☐ Other/prefer not to say
Use of assistive device:	If Yes: ☐ Cane ☐ Walker If Yes: ☐ Always ☐Occasional
Are you employed full- or part-time?	☐ No ☐ Yes- PT ☐ Yes-FT
Do you do volunteer work?	☐ No ☐ Yes- PT ☐ Yes-FT
Where do you live? Do you live with others?	☐ In community and lives alone ☐ In community and lives with others ☐ In community with caregiver ☐ Retirement community with assistance ☐ Retirement home/assisted living facility Use of home care in last 30 days? ☐ No ☐ Yes

Script:
- For each disease read, " *Has a doctor ever told you that you have or had _____?"*

Disease/System	History of Disease	Current Disease	Details
Heart disease or stroke	☐ No ☐ Yes	☐ No ☐ Yes	
High blood pressure	☐ No ☐ Yes	☐ No ☐ Yes	
Diabetes	☐ No ☐ Yes	☐ No ☐ Yes	
Chest pain/angina	☐ No ☐ Yes	☐ No ☐ Yes	
Arthritis	☐ No ☐ Yes	☐ No ☐ Yes	
Abnormal sensation in feet or hands (e.g. presence of numbness, tingling, lack of sensation)	☐ No ☐ Yes	☐ No ☐ Yes	

Script: *Are there any other health conditions or diseases that you have experienced that you think we should know about?*

Other: _____	☐ No ☐ Yes	☐ No ☐ Yes	
Other: _____	☐ No ☐ Yes	☐ No ☐ Yes	
Other: _____	☐ No ☐ Yes	☐ No ☐ Yes	

Script: *I am now going to measure your height and weight.*

Weight: _____ lbs. OR _____ kg.

Height: _____ ft. _____ in. OR _____ cm.

Self Reported: Yes _____ No _____

Date: _____ Participant ID: _____

Are there any physical activities you enjoy doing?

- ○ Patient reports not being active beyond moving around during daily activities.

OR check all the activities that apply below.

Light Intensity Activities			
○ Gardening ○ Casual Walking ○ Yoga/Flexibility	○ Balance exercises ○ I keep busy throughout the day ○ Other:		
Moderate or Vigorous Intensity Physical Activities	How many days per week?	How long did you do each activity for on average each time, in minutes?	Total min per week (autocalc)
○ Brisk Walking			
○ Cycling			
○ Exercise class			
○ Running			
○ Swimming			
○ Heavy Yard Work			
○ Summer sports (e.g., Golf, softball):			
○ Winter sports (e.g., curling, skiing):			
○ Other:			
○ Other:			
Guidelines: Total Moderate-Vigorous Intensity PA should be **150 minutes** or greater, in bouts of 10 minutes or more. More physical activity results in more benefits.		Total moderate or vigorous activity minutes (autocalc)	

How many days a week did you perform muscle strengthening exercises, such as bodyweight exercises or resistance training? _____ days

Guidelines: Strengthening exercises should be at least **twice per week.**

Time for screen: _____

Date: _____ Participant ID: _____

Click on words above for definitions:

Light intensity activities will not cause adults to sweat or breathe harder. It is easy to carry on a conversation. Walking is an example of a light activity.

Moderate intensity activities may make you sweat a little, and breathe a little harder. You should still be able to carry on a conversation in short sentences. Brisk walking (like when you are late!) is an example. **Vigorous intensity activities** will cause adults to sweat and be out of breath. You will not be able say more than a few words without stopping to catch your breath

Participant ID: _____

Accelerometer Activity Log

Directions:

Thank you very much for participating in this study. Your time and contribution are greatly appreciated.

Please wear the accelerometer for the next **7** days, starting tomorrow, from the time you wake up until the time you go to sleep.

If you have any problems or questions, please call Rebecca Clark at 519-888-4567, ext. 38779 or email at rekclark@uwaterloo.ca

1) The accelerometer can attach to your clothes using the clip on the back of the monitor. It can be worn over or under your clothes. The accelerometer should be positioned in the front, just slightly above the hip with the "Actigraph" letters facing outwards.
2) The accelerometer should be worn all day from the time you wake up until you go to bed. It should only be removed if you are going swimming having a bath or taking a shower. **Please note it is not waterproof**.
3) Shake the accelerometer in your hand **5 times** before wearing it each day.
4) When you remove the accelerometer, please place it with the "Actigraph" letters facing up.
5) Please use the log (on reverse side of this form) to write down the time you first put the accelerometer on and when it is taken off daily. Please note anything that affected your movement patterns on any given day.
6) The accelerometer is like a smart "pedometer" but it is very valuable.

Thank you very much for your participation on the study!

Monitor:	**DAY 1**	**DAY 2**	**DAY 3**	**DAY 4**	**DAY 5**	**DAY 6**	**DAY 7**
Dates							
On Time AM							
Off Time PM							
Was the monitor removed during wear time? (Circle one)	No	No	No	No	No	No	No
	Yes	Yes	Yes	Yes	Yes	Yes	Yes
If yes, what time? (specify AM/PM)	__:___ to __:___	__:___ to __:___	__:___ to __:___	__:___ to __:___	__:___ to __:___	__:___ to __:___	__:___ to __:___
Why was the monitor removed?							
Any problems? Please explain.							

Please return this sheet with the physical activity monitor!

Thank you for your participation!

POISE Semi-structured interview questions

1. We went through some questions about your physical activity.
    a. How hard was it to answer those questions?
        i. If hard: What can we change about them to make them easier to answer?
    b. How sure are you of your answers?
    c. How would you feel if your doctor asked those questions during regular visits?
    d. Was there anything you did not like about the questions?
    e. If a doctor/nurse felt you needed more physical activity, what should they do?
    f. What information should be provided? In what format?

2. When it comes to exercise, what are your needs or preferences?
(*prompts: therapeutic needs, exercise preferences, exercise frequency, intensity, time and type*)

3. What goals might you have that exercise might help you achieve? What is a meaningful, functional, life-relevant goal?

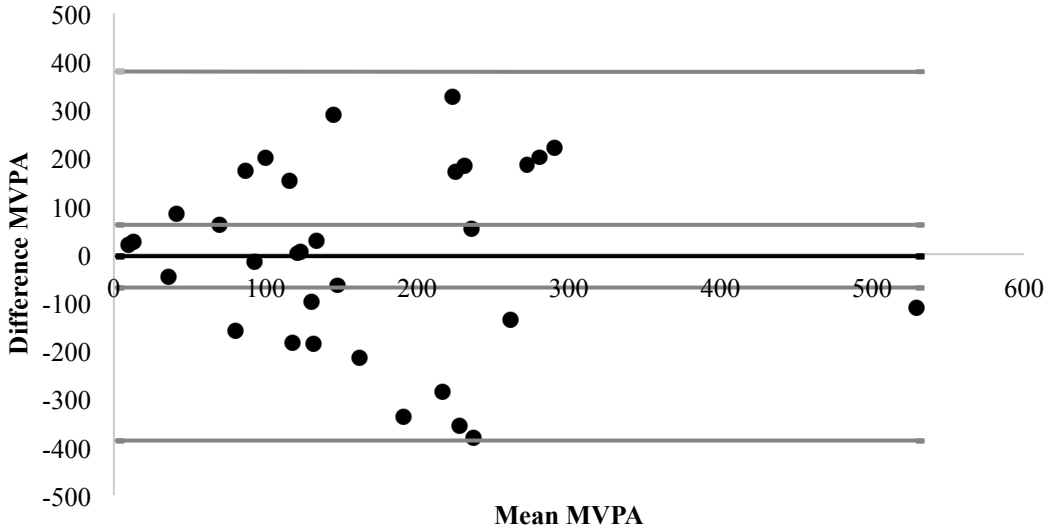
4. How can we make exercise information patient-centred?

Appendix C: Additional Statistical Outputs

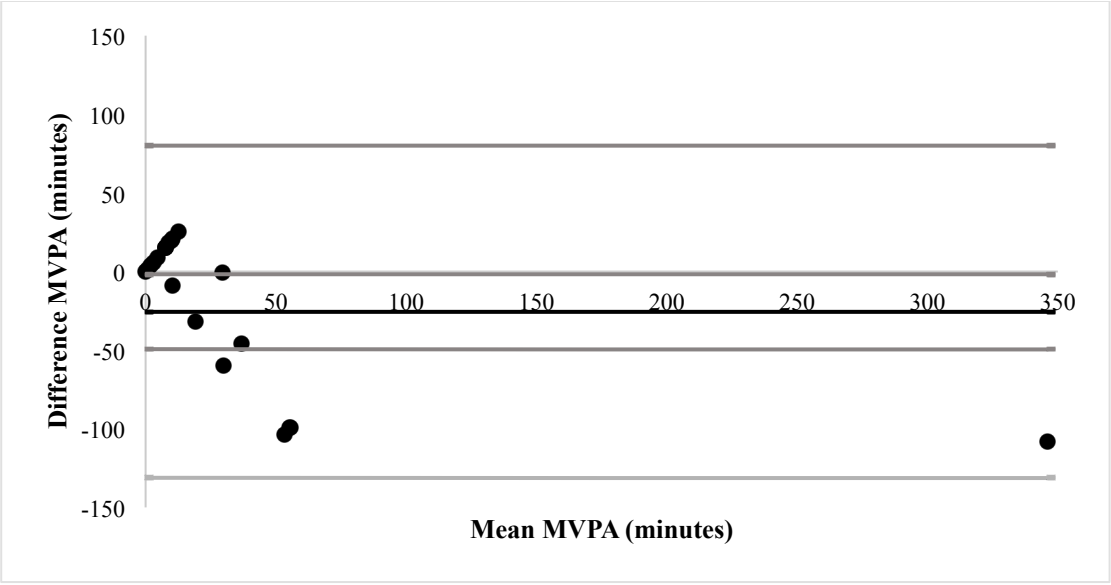
1. Bland-Altman Plots
   a. PAS and accelerometer MVPA for community only
   b. PAS and accelerometer MVPA for retirement only
   c. PAS and accelerometer MVPA for all participants excluding outliers
   d. PAS MVPA and Copeland accelerometer MVPA for all participants over 65 years of age

2. Scatter plots
   a. PAS MVPA and total accelerometer activity for all participants
   b. PAS MVPA and Copeland accelerometer MVPA for all participants over 65 years of age

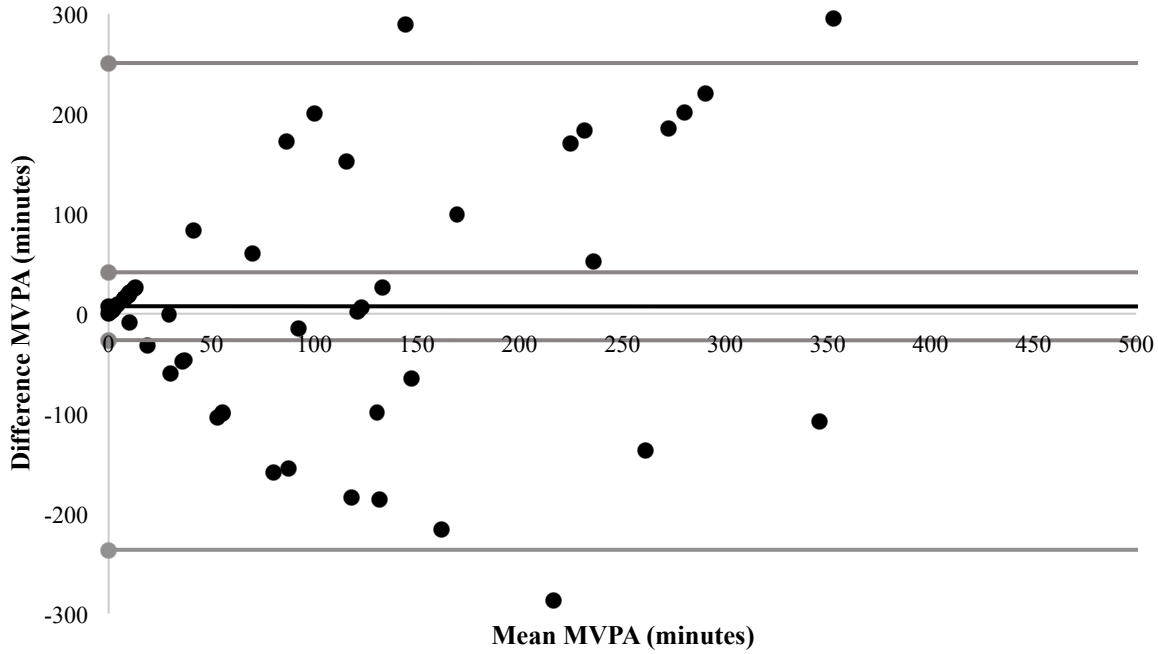
Bland-Altman plot for the accelerometer MVPA compared to the PAS MVPA for community dwelling Participants.



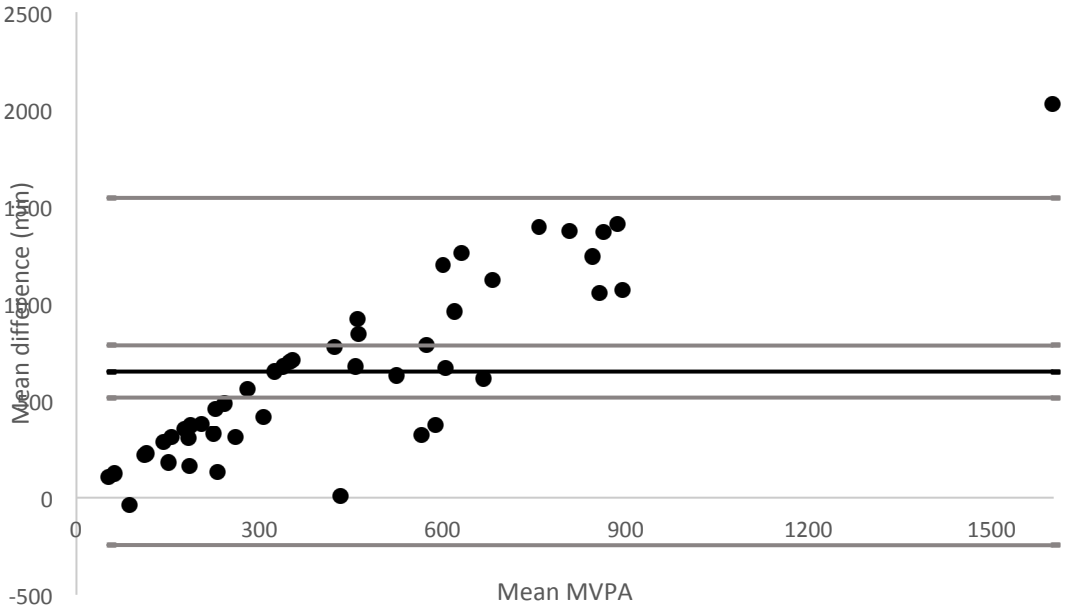
Bland-Altman plot for the accelerometer MVPA compared to the PAS MVPA for retirement participants.



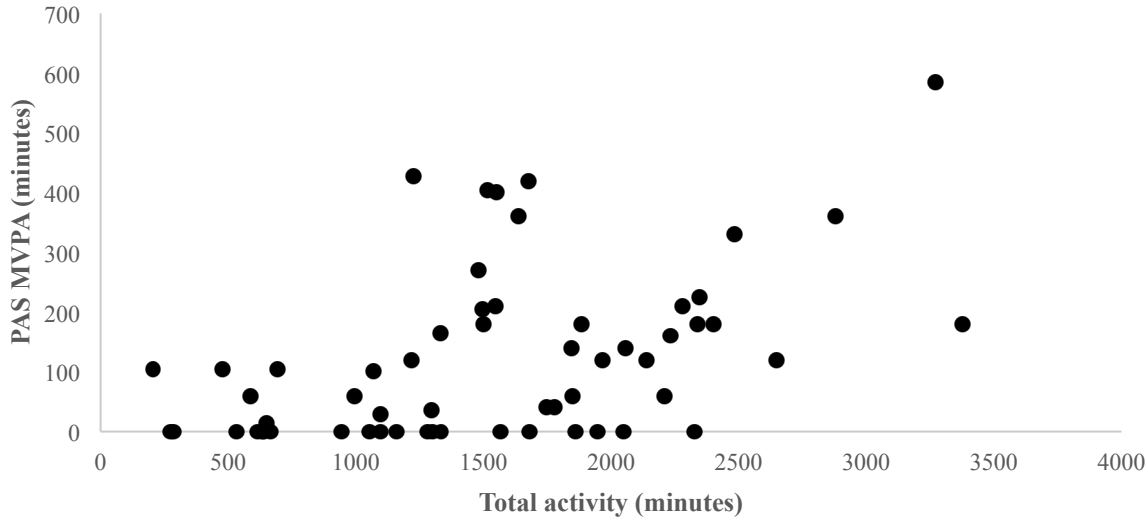
Bland-Altman plot for the accelerometer MVPA compared to the PAS MVPA for all participants excluding outliers.



Bland-Altman plot for the Copeland accelerometer MVPA compared to the PAS MVPA for all participants.



Scatter plot for PAS MVPA and total accelerometer activity for all participants.



Scatter plot for PAS MVPA and Copeland accelerometer MVPA for all participants over 65 years of age.