Determining the Impact of an Educational Intervention on Family Medicine Residents’ Social Cognitions and Behavior for Discussing Physical Activity

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Key words: physical activity, resident, theory of planned behavior, chart review, social cognitions

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Abstract

**Problem:** Primary care providers are recognized as important advocates for physical activity (PA); yet, clinical PA discussions remain infrequent. Educational approaches promoting the uptake of strategies that are proven to increase patient PA levels are effective for improving primary care providers’ social cognitions and behavior for discussing PA with patients. However, research on the effectiveness of such educational interventions among family medicine residents is limited. **Intervention:** Using the Theory of Planned Behavior (TPB), an interactive, educational intervention was developed to increase PA discussion between first year family medicine residents and their patients. This study aimed to determine the impact of the intervention on residents’ social cognitions and behavior for discussing PA with all adult (18-64 years) patients. **Context:** The intervention condition was comprised of 15 first year residents (2017/2018) who: (1) received the full intervention, and (2) completed both the pre- and post-intervention TPB questionnaires assessing changes in PA discussion social cognitions, and (3) had their medical charts reviewed for PA discussion behavior. The non-intervention condition was comprised of 15 first-year residents (2016/2017) who were randomly selected to have their medical charts reviewed for PA discussion behavior. **Impact:** While no significant differences in social cognitions were observed pre- vs. post-intervention, intervention condition residents’ perceptions of feeling adequately trained to discuss PA increased post-intervention \((p = 0.005)\). A difference in residents’ PA discussion behavior was observed between conditions at post \((p = 0.01)\), where PA was discussed at more patient visits among intervention condition residents.
Lessons Learned: Findings suggest that the observed effect of resident PA discussion behavior being greater in the intervention condition at post may be attributed to the intervention condition residents having received the theory-based, educational workshops. This study highlights the importance of educating and training residents on strategies for PA discussion; however, future interventions should address both the reflective and automatic processing aspects of behavior and strive to influence organizational factors that impact resident behavior for discussing PA.

Keywords: physical activity, resident, theory of planned behavior, chart review, social cognitions

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**Introduction**

Physical inactivity is the fourth leading individual-level risk factor for overall morbidity and mortality worldwide.¹ Conversely, higher physical activity (PA) levels correlate with greater health and wellbeing.² Within Canada, 84% of adults do not meet the current Canadian PA Guidelines.³,⁴ One potential solution to increase PA levels is for primary care providers to promote PA among patients as they are in semi-frequent contact with a large part of the population and patients prefer to receive health information directly from their primary care provider.⁵–⁷ Primary care provider-delivered strategies are a prominent and effective approach implemented to promote patient PA in the healthcare setting. Examples of strategies found to be effective include provider use of the PA Vital Sign,⁸ PA counselling (PAC; including motivational interviewing),⁹–¹³ PA prescription,¹⁴ and referrals to community resources or counselors.⁹,¹⁵–¹⁷ Furthermore, there is evidence that the use of multi-component strategies can achieve greater and more sustained effects in patients’ PA levels.¹⁸,¹⁹

Despite this evidence,⁵–¹⁰,¹²–¹⁹ the prevalence of PA discussion by primary care providers is low.²⁰–²² Commonly-cited barriers that such providers face for discussing or counselling patients on PA include: a low confidence in helping patients make a behavioral change,²³ lack of knowledge on what amount and type of PA to prescribe,⁷ lack of knowledge on PAC,²³–²⁷ and strategies to enhance patient adherence to PA goals,⁶,²⁸,²⁹ how to incorporate PA prescription and counselling into an appointment,²³,²⁸ lack of incentive and reimbursement for PA prescription and counselling,⁶,²³,³⁰ and additional systemic (e.g., time restrictions, task complexity)³¹ and patient-specific barriers (e.g., interest, resources, motivation).³²,³³ Opportunities to develop the knowledge and skills necessary to implement PA discussion into routine medical practice would begin to alleviate some of these barriers.
Educational approaches are commonly used to promote the uptake of strategies for provider discussion of PA with patients. Studies examining the provision of training via interactive, educational approaches targeting primary care providers’ discussion of PA with patients have demonstrated an improvement in physicians’ social cognitions and behavior for PA discussion. Social cognitions are understood as reflections of an individual’s representation of their social world; assuming that people form mental or cognitive representations of their reality, social cognitions are constructed and modified through learning, shape what an individual says, and influence how an individual contemplates and manages action/behavior. The few studies that have focused on using educational approaches within family medicine residency have yielded mixed results for improving residents’ social cognitions and behavior for PA discussion. These mixed results may be attributed to an inconsistent use of theory for study design and evaluation, lack of a process evaluation to ensure the educational approaches were delivered as intended, and an emphasis on evaluating self-reported outcomes.

The lack of studies focusing on family medicine residents is surprising as family medicine residents are an ideal population to educate on the discussion of PA given they: (1) have protected academic time to acquire new knowledge and skills, (2) have a relatively high number of patient encounters and thus ample opportunities to apply and refine their newly acquired skills, and (3) are still malleable learners. Overall, this lack of primary care/family medicine resident-oriented education about PA promotion provided an opportunity to determine whether an intervention providing residents with the chance to develop knowledge and skills to implement PA discussion into practice would fill this gap.

Accordingly, the overarching objective of this study was to determine the impact of an interactive, workshop-based intervention on first year family medicine residents’ social
cognitions and (2) behavior for discussing PA with patients. Social cognitions were selected as an outcome given that they are theory-derived antecedents of behavior. Specifically, the theory used for intervention and evaluation design (i.e., the Theory of Planned Behavior; TPB) informed the selection of four social cognitions (i.e., attitudes, subjective norms, perceived behavioral control, and intentions) given their established ability to account for variance in PA discussion behavior among health care professionals. It was hypothesized that, following the intervention, there would be significant increases in family medicine residents’ (1) social cognitions to discuss PA with patients; and (2) PA discussion behavior with patients (assessed via chart review). In addition, as intervention implementation can influence intervention effectiveness, a process evaluation was also conducted to document dose delivered, fidelity, dose received, and quality/success of the intervention. To our knowledge, this is the first study to (1) examine the impact of an interactive, workshop-based, educational intervention explicitly designed and evaluated using behavior change theory, (2) include a thorough process evaluation, and (3) assess PA discussion behavior using a valid, proxy measure (i.e., chart review).

Methods

Intervention

Design Overview

The intervention was facilitated by Queen’s University’s chapter of Exercise is Medicine Canada (EIMC-QU; an on-campus graduate-student run group that designs and implements initiatives that promote PA). An academic Family Health Team reached out to EIMC-QU in March 2017 requesting the group to provide evidence-based workshops on motivational interviewing for PA, PAC, and exercise prescription to first-year family medicine residents to
enhance residents’ knowledge and skills in discussing, counseling, and prescribing PA to patients.\textsuperscript{45} 

The TPB\textsuperscript{43} guided both the development and evaluation of the intervention, given its usefulness for understanding and promoting knowledge application among physicians,\textsuperscript{46–48} including the discussion of PA among physicians.\textsuperscript{35,49} The TPB posits that an individual’s intention to perform a behavior (e.g., discussing PA) is influenced by his or her attitudes (beliefs about the consequences of one’s behavior), subjective norms (perceptions of what significant others want one to do, and the value attached to these perceptions), and perceived behavioral control (confidence in one’s abilities to perform the behavior regardless of barriers) for said behavior.\textsuperscript{43} Both intentions and perceived behavioral control serve as direct antecedents of behavior; thus, interventions that improve resident intentions and perceived behavioral control for discussing PA with patients may increase the likelihood that residents will discuss PA with patients in practice.

\textit{Delivery and Description of the Intervention}

The intervention consisted of two workshops delivered by EIMC-QU to the 2017/2018 first-year family medicine residents. Due to the nature of residents’ clinical rotations, there were two cohorts of family medicine residents (Cohort A and B). The intervention was consequently delivered twice (once to Cohort A; once to Cohort B). Figure 1 provides a timeline of the workshops.

Each workshop was 90-minutes long and attendance was mandatory. Workshop One provided residents with an introduction to motivational interviewing, with a focus on PAC. Workshop Two provided residents with the evidence behind the importance of PA for prevention and treatment purposes, practical steps for discussing PA, which included instruction on: the
PA/Exercise Vital Sign, how to provide an PA/exercise prescription, and referral and follow-up. As the purpose of this intervention was to encourage resident discussion of PA with all patients, residents were provided with instruction for the above practical steps for discussing PA with various demographics of patients they may see in clinic, including both patients with chronic conditions (e.g., cardiovascular disease, diabetes, obesity, chronic obstructive pulmonary disease, osteoporosis) and otherwise ‘healthy’ patients. Furthermore, residents were provided with opportunities to consider PA discussion for both prevention and treatment purposes. Behavior change techniques were prospectively incorporated into the intervention to maximize the potential of the workshop to facilitate the impact of the intervention on residents’ TPB social cognitions and behavior. For example, to target residents’ perceived behavioral control, the behavior change technique “behavioral practice/rehearsal” was incorporated by engaging residents in a simulated patient-physician encounter to practice their motivational interviewing skills. The workshops incorporated both didactic (e.g., lecture) and interactive educational methods (e.g., role playing and case discussion). A full description of the workshop content, behavior change techniques used, and TPB construct alignment can be found in Supplemental Digital Appendix 1. The study was approved by the institutional Research Ethics Board. The process evaluation revealed that the intervention was implemented as intended. Detailed methods and results of the process evaluation can be found in Supplemental Digital Appendix 2.

Assessment of the Intervention’s Impact on Residents’ Social Cognitions and Behavior

Participants

Social Cognitions. Eligible study participants (N = 53 [Cohort A: n = 26 and Cohort B: n = 27]) were 2017/2018 first-year family medicine residents training at an academic Family
of the 53 residents, 25 agreed to participate in the current study and completed a pre-questionnaire. From this pool, 15 residents attended both workshops (i.e., received the full intervention) and completed both the pre- and post-questionnaire (28% response rate). As EIMC-QU received a request to provide evidence-based workshops, the sample size for this study was limited by the number of residents within the family medicine 2017/2018 resident cohort, as well as the engagement of these residents in the study itself. A 28% response rate is reasonable and is typical of studies that recruit health care providers and medical students.\textsuperscript{46,52}

\textbf{Behavior.} As above, the intervention condition was comprised of the 2017/2018 first year family medicine residents who received the full intervention (i.e., attended both workshops) and completed both the pre- and post-questionnaires ($n = 15$). The non-intervention condition was comprised of fifteen randomly selected 2016/2017 first year family medicine residents who attended a motivational interviewing workshop with minimal PA-related information delivered by a preceptor as part of their behavioral medicine block.

\textit{Procedure}

\textbf{Social Cognitions.} Residents were recruited via e-mail nine days prior to attending their first workshop (pre-intervention). Interested individuals read the Letter of Information and provided consent prior to voluntarily completing the online pre-questionnaire. Immediately following the completion of the second workshop (post-intervention), the online post-questionnaire was e-mailed to those residents who completed the pre-questionnaire. All questionnaires were administered online via Qualtrics.

\textbf{Behavior.} Patient visits one-month prior to the intervention (pre) and one-month immediately following the intervention (post) were examined for both conditions. Patients <18 and >64 years were excluded as the intervention focused on providing knowledge and skills for
discussing PA with adults (ages 18-64 years). Due to a lack of reporting of a priori sample size calculations in previous studies that have used medical chart reviews for assessing physician PA discussion,\textsuperscript{22,34} the total number of patient visits to review was determined by following the steps recommended by Gregory and colleagues.\textsuperscript{53} Recommended steps were adapted from statistical techniques used to determine the sample size for descriptive studies that examine dichotomous variables (i.e., whether a clinical behavior is performed or not).\textsuperscript{54} The process used the following equation: \( N = 4z_\alpha^2P(1-P) + W^2 \), where \( z_\alpha \) is the critical value, \( P \) is the expected proportion, and \( W \) is the total width of the confidence interval. First, in order to calculate a statistically valid sample size for a chart review (\( N \)), the expected proportion of patient visits where residents discuss PA had to be estimated. Two published studies have used medical chart review to assess family physicians’ discussion of PA with patients. Galaviz and colleagues\textsuperscript{34} reported that 43% of a sample of adult patients had their PA level assessed during a one-month period by their physician. Baillot and colleagues\textsuperscript{22} reported that 52% of a sample of adult patients had their PA level assessed during an 18-month period by a primary health care provider. Based on these findings, for this study, the expected proportion (\( P \)) of adult patients that residents would discuss PA with at every office visit was set to 50% (i.e., 0.50). Next, the desired precision (total width; \( W \)) of the confidence interval was specified at 0.2 and a confidence level of 95\% (i.e., \( z_\alpha = 1.96 \)) for the interval was selected, as recommended by Gregory and colleagues.\textsuperscript{53} These values yielded a required sample size of 96 patient visits per condition at each time point. The target number of patient visits per condition was increased to 150 (10 visits for each of the 15 residents in both conditions at each time point [total \( N = 600 \)]) to further ensure adequate power. This sample size was in line with the previous study conducted by Baillot and colleagues\textsuperscript{22} in which approximately 11 patient visits per physician were examined.
The search strategy for the chart review was developed in collaboration with the Electronic Medical Record (EMR) Project Manager and the Quality Improvement Analyst from the academic Family Health Team and was based on the participant inclusion criteria outlined above. Ten patient visits per resident were randomly selected for review using an online list randomizer. These 10 patient visits represented 16-63% of the total visits each resident completed within the study periods. The first and second authors received a one-hour training session on the EMR system from the academic Family Health Team EMR Project Manager. The first author was responsible for performing the retrospective medical chart review for all 600 patient visits. Within the first week of the chart review process, the second author independently abstracted data from 10% of patient visits (i.e., 60 patient visits) to check for accuracy of data abstraction. A PABAK coefficient was calculated as an indicator of inter-rater reliability between the two abstractors. Inter-rater agreement was excellent between the two abstractors (PABAK = 0.97); thus, the chart review and abstraction procedures required no adjustments.

Any information relating to PA documented by the resident was abstracted into a form specifically developed for this study. In line with previous studies examining physician PA discussion behavior via chart reviews, the following chart notes were considered PA discussion with the patient: assessment of patient’s current level of PA (i.e., inactive/active, minutes of PA/week, etc.); noting the types of PA patients do or do not currently engage in or have previously engaged in; offering verbal or written advice in relation to PA, discussion of making PA-related lifestyle modifications; and referring patients to PA resources.

**Measures**

**Social Cognitions.** The pre-questionnaire included questions about resident demographics, TPB social cognitions for discussing PA, and barriers to discussing PA with
patients. The post-questionnaire was identical to the pre-questionnaire excluding the
demographic questions.

**Demographics.** Residents were asked their age, gender, ethnicity, and academic
background. Residents also reported the number of minutes per week they spent engaging in
moderate to vigorous intensity aerobic PA. To then determine whether residents were meeting
the PA recommendation within the Canadian PA Guidelines for Adults (i.e., accumulating at
least 150 minutes of moderate to vigorous intensity aerobic PA each week), authors classified
residents as meeting or not meeting the Guidelines (i.e., reporting >150 or <150 minutes/week,
respectively). Residents were also asked to recall the Canadian PA Guidelines for Adults, and
self-report their frequency of discussion of PA with patients which was measured on a seven-
point Likert scale anchored at 1 (*never*) to 7 (*always*).

**Social Cognitions for Discussing PA.** Residents were asked to report their attitudes,
subjective norms, perceived behavioral control, and intentions for discussing PA with their
patients. Questionnaire items were adapted from questionnaires previously shown to be reliable
in studies examining health care professionals’ social cognitions for discussing and prescribing
PA. As advised by Ajzen, TPB questionnaire items should be formulated to be exactly
compatible with the behavioral criterion and the research sample should be clearly specified. As
such, items were adapted to reflect the specific behavior of interest (i.e., discussing PA with
patients) and to be relevant to the research sample (i.e., first year family medicine residents). All
social cognition items were rated on a seven-point Likert scale. TPB scales with more than two
items targeting the same construct were averaged to give an overall construct score. Table 1 lists
the full item descriptions and response scales.

**Barriers for Discussing PA.** Six items adapted from Hefnawi and colleagues were used
to assess residents’ perceptions of commonly reported barriers to discussing PA with patients (e.g., time). Table 2 lists the full item descriptions and response scales.

**Behavior.** Each patient visit was scored as a 1 (i.e., PA discussed) or a 0 (i.e., PA not discussed). A total score was then calculated for the 10 randomly selected patient visits for each resident at pre- and post-intervention. These total scores were then averaged for residents in both conditions at each time point. Residents in both conditions were unaware that a chart review was being conducted.

To further delineate whether the intervention impacted the type and detail of PA discussion residents had with patients, the abstracted data were classified into one of the following behavior categories: the resident (1) made an assessment of PA level, (2) provided PAC, and/or (3) made an arrangement of a PA referral and/or follow-up. Each patient visit was scored as a 1 (i.e., behavior performed) or a 0 (i.e., behavior not performed) for each type of PA discussion.

**Data Analysis**

All analyses were conducted with SPSS (Version 24 for Mac; IBM). Data normality and outliers were assessed using established guidelines.58

**Social Cognitions.** Descriptive statistics were calculated for all demographic variables. Statistical tests were used to examine demographic differences between the two Cohorts of residents and between study completers and non-completers. Repeated measures tests were used to assess changes in residents’ self-reported discussion of PA with patients and recall of the Canadian PA Guidelines for Adults.4 Repeated-measures ANOVAs were conducted for each of the four TPB cognitions between pre- and post-intervention (α = 0.05/7 comparisons = 0.007). Repeated-measures ANOVAs were also conducted for the six barrier items across the two time
points ($\alpha = 0.05/6$ comparisons $= 0.008$). Cohen’s $d$ was calculated to determine effect size changes in TPB constructs and the six barrier items.

**Behavior.** Descriptive statistics were computed for residents’ age and gender. Independent $t$-tests and Fisher’s Exact Tests were conducted to determine whether significant demographic differences existed between conditions. To assess the effectiveness of the intervention on residents’ discussion of PA with patients, a two-way mixed ANOVA was conducted. The between-subject factor was condition (i.e., intervention and non-intervention) and the within-subject factor was time (pre- and post-intervention). To examine type of PA discussion by residents, descriptive statistics were calculated. Chi-square tests were used to test differences in type of PA discussion between conditions at both pre- and post-intervention, as well as to test changes in the type of PA discussion (i.e., assessment of PA level, PAC, and/or referral/follow-up) from pre- to post-intervention in each condition.

**Results**

There were no significant differences for intervention implementation (as determined by the process evaluation; see Supplemental Digital Appendix 2) or demographics between Cohort A and B residents who completed pre-questionnaires ($n = 11$ and $n = 14$); consequently, the two cohorts were analyzed as one group for all subsequent outcome evaluation analyses ($n = 25$; see Table 3).

**Intervention Impact on Residents’ Social Cognitions**

**Participants**
Residents who completed both pre- and post-intervention questionnaires and who received the full two-part intervention (i.e., \( n = 15 \)) were considered “completers” and included in subsequent analyses. Completers had a mean age of 26.2 ± 2 years. The majority of residents who participated were female (67%) and had 7.5 ± 2 years of post-secondary education. The majority (87%) of residents had previous academic experience in Life Sciences/Health Science. While few residents had previous PAC (27%) training, the majority of residents (67%) had received previous motivational interviewing training. At baseline, more than half of residents (73%) were classified as meeting the moderate to vigorous intensity aerobic PA recommendation within the Canadian PA Guidelines for Adults. The only significant difference between completers (\( n = 15 \)) and non-completers (\( n = 10 \)) was in meeting the aerobic PA recommendation, with more completers vs. non-completers meeting the aerobic PA recommendation \( (p = .049) \).

At pre-intervention, only two residents accurately reported the Canadian PA Guidelines for Adults. Following the intervention, the number of residents accurately reporting the Guidelines increased to seven residents (47%); however, this difference was not statistically significant \( (p = .062) \).

There were no statistically significant differences in self-reported frequency of discussing PA with adult patients as part of their regular practice between pre- and post-intervention \( (4.40 ± 1.06 \text{ vs. } 4.73 ± 0.88 \text{ (out of seven); } F(1, 14) = 1.75, p = .21, d = 0.34) \).

**Social Cognitions for Discussing PA**

The distributions of the TPB measures were normal, except for affective attitudes, instrumental attitudes and intentions for discussing PA with patients, which were negatively skewed at both time points (Shapiro-Wilk’s \( p \)-values < 0.05). However, repeated measures ANOVAs are fairly robust against deviations from normality\(^{59,60} \); therefore, the repeated
measures ANOVAs were run on these items as planned. Internal reliability of the items for each scale were reviewed, leading to the removal of one of the perceived behavioral control items (i.e., “There are factors outside my control that would prevent me from discussing PA with my patients”) in order to improve the perceived behavioral control scale internal consistency score [from $\alpha = 0.201$ to $\alpha = 0.781$ (at pre) and from $\alpha = 0.228$ to $\alpha = 0.581$ (at post)]. No other items were removed. Residents had high baseline social cognitions for discussing PA (all $M$s > 4.76 out of 7; Table 1). There were no significant differences between pre- and post-intervention for any of the social cognition scales (all $ps > .007$).

**Barriers for Discussing PA**

Descriptive statistics for the barrier items at both time points are presented in Table 2. From pre- to post-intervention, the only statistically significant change in barriers was “adequate training to discuss PA”, which increased at post-intervention (Table 2). While not statistically significant, residents reported an increase in having resources they need to discuss PA, which yielded a large effect size (Table 2).

**Intervention Impact on Residents’ Behavior**

**Resident Demographics**

The majority of residents within both the intervention and non-intervention conditions ($M_{age} = 26.2 \pm 2; n = 15$ and $M_{age} = 26.7 \pm 2; n = 15$ respectively) were female. There were no significant gender or age differences between the conditions.

**Resident Behavior for Discussing PA**
There was one outlier within the intervention condition at pre-intervention as assessed by boxplot, which was replaced with a value within three standard deviations of the mean. Once the outlier was removed, the data was normally distributed as determined by Shapiro-Wilks test.

A 2 x 2 mixed ANOVA revealed a statistically significant group x time interaction, $F(1, 28) = 5.40, p = .028$, partial $\eta^2 = 0.16$ (see Figure 2). An analysis of simple main effects showed that there was a statistically significant difference in resident behavior between conditions at post, $F(1,28) = 7.72, p = .01$, partial $\eta^2 = 0.22$, where resident behavior was greater in the intervention condition compared to the non-intervention condition ($M \pm SE; 3.4 \pm 0.37$ vs $1.93 \pm 0.37$). There was no statistically significant effect of time on resident behavior for the intervention condition ($F(1,14) = 2.23, p = .16$, partial $\eta^2 = 0.14$) or the non-intervention condition ($F(1,14) = 3.30, p = .09$, partial $\eta^2 = 0.19$).

Type of PA Discussion by Residents

When PA was discussed with patients it was predominately in the form of assessment of PA level (e.g., inactive or active), followed by providing PAC, with arrangement of PA referral and/or follow-up being the least executed by residents (see Table 4).

All expected cell frequencies were greater than five for ‘assessment of PA level’ and ‘PAC’; however, expected cell frequencies were less than five for ‘arrangement of PA referral and/or follow-up’. Consequently, Chi-square tests were only computed for ‘assessment of PA level’ and ‘PAC’. At post-intervention, a significantly larger number of patient visits in the intervention condition included an assessment of patient PA levels when compared to the non-intervention condition ($p = .02$).

Discussion
The purposes of this study were to determine the impact of an interactive, workshop-based, educational intervention on first year family medicine residents’ social cognitions and behavior for discussing PA with patients. As well, a process evaluation was conducted to determine intervention implementation (i.e., dose delivered, fidelity, dose received, and quality/success of the intervention). While the intervention was implemented as intended, in contrast with our hypothesis, the educational workshop was not effective for enhancing residents’ social cognitions but may account for a difference in behavior between conditions at post-intervention. Several notable findings will be discussed in turn.

**Intervention Impact on Residents’ Social Cognitions**

Although the intervention within this study was framed around the TPB which has been shown to be beneficial for promoting healthcare professional behavior change, there were no significant changes in residents’ social cognitions for discussing PA with patients from pre- to post-intervention. However, residents’ social cognitions for discussing PA with patients remained relatively high from pre- to post-intervention indicating that ceiling effects may have been observed. Due to high intentions at baseline, it is possible that a post-intentional construct (such as planning) which is not captured by the TPB, may be influencing residents’ behavior for discussing PA with patients. It is also possible that the time points selected for evaluation may have affected the study’s findings, as the items used to assess residents’ social cognitions for discussing PA with patients refer to residents’ current practice and may not be altered until residents use the intervention information with patients. Consequently, future evaluations of similar interventions should consider adding follow-up time points (e.g., one-month post-intervention).
From pre- to post-intervention, a significant increase was observed where residents reported improvements in feeling adequately trained to discuss PA with their patients, and an increase in residents’ feeling as though they had the resources they needed to discuss PA approached significance. These findings suggest that while providing PA promotion education is sufficient to improve knowledge on PA and feelings of preparedness to discuss PA, it may not be enough to see improvement in social cognitions. Previous research examining guideline implementation in clinical settings has demonstrated that the most effective strategies for changing providers’ behavior involve minimizing the barriers of time and task complexity. Addressing these barriers may also be important for encouraging changes in residents’ PA discussion social cognitions, specifically perceived behavioral control, and subsequently their behavior; however, alleviating these barriers requires organizational-level vs. individual-level interventions. For instance, such interventions may include lengthening patient appointments and integrating PA assessment into EMRs. Future interventions aiming to increase PA discussion among residents should consider including strategies beyond the individual-level to better address barriers to residents’ PA discussion.

**Intervention Impact on Residents’ Behavior**

A significant difference in resident behavior for discussing PA was observed between conditions at post-intervention, where PA was discussed at more patient visits among intervention condition residents. This difference may be attributed to the intervention condition having received the educational intervention, suggesting that intervening about PA discussion during residency is worthwhile. Indeed, at post-intervention the mean number of patient visits residents within the intervention condition discussed PA was 3.4 per 10 visits versus 1.9 per 10
visits by residents within the non-intervention condition. Accordingly, receiving this intervention may result in discussion of PA at 1.5 more patient visits per 10 patient visits per resident. The number needed to treat with a PA promotion intervention (e.g., PA Vital Sign®) for one additional sedentary adult to report recommended levels of activity at 12 months is 12. Therefore, within the context of this study the discussion of PA at 1.5 more patient visits per 10 patients visits per resident could be projected to represent 18 of 120 patients who had PA discussed with them and now meet the recommended levels of PA. The timeframe for this change at this specific academic Family Health Team (i.e., for residents to have 120 visits), would be 2- to 3-months. These findings have important implications for not only patient health, but healthcare costs due to improved patient clinical outcomes. Although a statistically significant difference between conditions was seen at post-intervention, the frequency of PA discussion at patient visits by residents within the intervention condition was still sub-par. These findings highlight that while educational workshops are a preferred means of continuing medical education for primary care providers, educational workshops alone may not be the most effective intervention tool to help residents adopt complex behaviors, such as discussing PA with patients. Moreover, educational workshops focus exclusively on reflective processing for behavior change to occur (i.e., knowledge must be reflected on to be assimilated into memory, then consciously retrieved when called upon); such interventions may not be the most appropriate method to target the automatic processing aspect of cognition that influences residents’ behavior in clinic. Automatic cognition is guided by a set of largely unconscious processes that occurs in response to situational or contextual cues. As both reflective and automatic processes have been shown to operate in parallel and predict ongoing behaviors, specifically in relation to clinician behavior, it may be more
effective to address both processes within an intervention. For example, future interventions that provide relevant information for behavior change to residents through the use of interactive educational methods (i.e., targeting reflective processes) should also consider incorporating prompts or cues to remind residents to discuss PA when in practice (i.e., targeting automatic processes).\textsuperscript{72} Thus, the current intervention may be enhanced by including a prompt in the EMR that appears when a resident opens a patient’s chart, or by including patient-mediated prompts.\textsuperscript{42,63} Such multi-component strategies would also move beyond focusing on individual-level factors that influence behavior change and address necessary organizational level changes.\textsuperscript{64}

The regulation of behavior by both reflective and automatic processes may also explain the lack of change in social cognitions observed from pre- to post-intervention. The TPB proposes that behavior is determined by a reflective process of active decision-making.\textsuperscript{48} While the TPB has been shown to predict provider intentions\textsuperscript{35} and behavior\textsuperscript{34} for discussing PA, behavior has only been previously measured via self-report.\textsuperscript{34} Previous literature has found that primary care providers do not accurately self-assess their behavior, and tend to over-report their performance.\textsuperscript{74} Indeed, residents within this study were asked to indicate how frequently they discuss PA with their adult patients as part of their regular practice on a scale from 1 (never) to 7 (always) – residents’ self-reported discussion of PA (pre 4.40 ± 1.06 vs. post: 4.73 ± 0.88) was greater than their actual behavior for discussing PA with adult patients, as observed by the chart review. Self-report measures are reflective in nature and may not capture the automatic cognitive process that occurs when residents are actually performing the behavior in practice. Consequently, an alternative theory may be required to examine the effect of an intervention on both the reflective and automatic processes underlying this resident behavior.\textsuperscript{71,75} One such
model that may prove beneficial for both designing and evaluating interventions for changing provider behaviors in practice is the Capability, Opportunity, and Motivation Model of Behavior (i.e., COM-B) which takes into account both the reflective and automatic sources of motivation that generate behavior. First, one would identify what needs to change in regard to residents’ capability, opportunity, and motivation for engaging in discussion of PA with patients. Next, and similar to the approach used in this study, behavior change techniques would then be selected to address physical and psychological capability, social and physical opportunity, and automatic and reflective motivation. Finally, the evaluation would be designed to assess residents’ capability, opportunity, and motivation for PA discussion.

Examination of the type of PA discussion revealed that within both conditions and across both time points, residents were more likely to assess a patient’s PA level than provide PAC, and relatively few arranged PA referrals and/or follow-up. This low provision of PAC and PA referral and/or follow-up could be explained by residents’ lack of: time and resources, confidence with prescribing PA, standard format for assessing and prescribing PA, and/or limited familiarity with their patients compared to their more senior colleagues. As demonstrated by questionnaire findings, the intervention did not result in the reduction of some of these barriers (e.g., time and priority), perhaps accounting for why these more complex behaviors were not performed. However, even studies examining PA discussion behavior in more experienced primary care providers find that less complex types of PA discussion occur more frequently than complex types. Taken together, these findings suggest that regardless of years of experience, additional intervention support is required to improve the frequency with which residents and primary care providers engage in PAC, refer patients to exercise professionals and follow-up with patients on PA. Given that residents cite time as a barrier to PA discussion, an
important avenue for future interventions would be to use a team effort where all disciplines within the primary health care setting (e.g., nurse practitioners, registered nurses, physician assistants, etc.) discuss PA, or at a minimum use the PA Vital Sign, with patients. The inclusion of PA modules within curricula may be needed in other healthcare programs. Furthermore, not only would the team approach improve PA behaviors of patients due to continuity and repetition of messaging, but may also serve as an important prompt for residents (and primary care providers in general) to discuss, counsel, and refer if the PA Vital Sign is noted during patient intake.8

Future Directions

While multi-component strategies are likely ideal (e.g., combining strategies to target both reflective and automatic processes), brief workshop-based training has been shown to be effective for increasing PA counseling and prescription behavior among primary care providers.32,37 Educators who choose to implement an educational, workshop-based intervention should strive to include behavioral techniques to move beyond solely focusing on individual-level factors that influence behavior change to also addressing upstream organizational factors. A multi-level approach may improve residents’ impressions of a system that they may perceive to be out of their control. For example, educators may a) identify and acknowledge the limitations of billing practices for lifestyle prescriptions, b) spend more time on content, such as the number needed to treat for PA prescription and the comparative cost-effectiveness of PA prescription to medication prescription, and c) spend more time identifying resources that support PA counseling and referral (in addition to highlighting use of the EMR for tracking purposes). While the intervention delivered in this study did include content on the number needed to treat and
resources to support PA counseling and referral, it is likely that three hours (i.e., two 90-minute workshops) is insufficient for addressing all of the individual and organizational factors impacting residents’ discussion of PA. Certainly, this aligns with the study’s findings where the frequency of PA discussion at patient visits by residents within the intervention condition was still sub-par at post-intervention. Future educational interventions should solicit for more time to be allotted for resident education and training regarding PA discussion and counselling.

Strengths & Limitations

The important strengths of this study were including stakeholders from various groups in the development and implementation of the intervention, including a detailed process evaluation, explicitly designing and evaluating the intervention using behavior change theory, chart review as an external, proxy measure of resident behavior that is more reliable than self-reported measures,77 and including a standard care (i.e., non-intervention) condition. However, several limitations should be noted. The intervention was specific to resident discussion of PA with adults (i.e., individuals aged 18-64 years), and evaluation of resident behavior was specific to the adult population. However, evidence has shown that older adult patients (i.e., individuals aged 65 years and older) are more likely to receive advice on PA given they are typically less active and have a greater prevalence of chronic diseases.78 Therefore, it is a possibility that frequency of resident discussion of PA may be greater with older adult versus adult patients, which was not examined within this study. Residents may not have recorded all instances they discussed PA with patients in their charts, which may have resulted in an underestimation of resident behavior.77 In addition, the same patient charts were not reviewed at pre- and post-intervention, potentially contributing to patient profile variability – however, given the short time frame and
residents’ rotating schedules it was not feasible to consider this design for our study. 

Furthermore, it is difficult to discern whether the PA information recorded by residents reflects whether the resident or the patient initiated the discussion of PA. Even though significant differences for some findings were observed within our study, future studies with larger sample sizes may improve statistical power. Studies of a similar nature (e.g., surveys administered to medical students/residents) reported response rates ranging from 12% to 80.6%, highlighting that while the response rate for our study (28%) is in line with the literature, there is room for future intervention studies to increase response rate. Finally, residents within the intervention condition could be considered an ‘ideal’ population, given that 73% met the Canadian PA Guideline recommendation at baseline, and research suggests that physicians who are physically active are more likely to discuss PA with their patients. This may also account for residents’ high social cognitions reported at pre- and post-intervention. However, residents’ discussion of PA with patients was still suboptimal. In order to have a better understanding of how an educational intervention can impact residents’ social cognitions and behavior for discussing PA with patients, future studies should endeavor to include a more varied sample of residents in regard to their own personal PA levels.

**Conclusion**

To our knowledge, this is the first study to examine the impact of an interactive, workshop-based, educational intervention, explicitly designed and evaluated using behavior change theory to target first year family medicine residents’ social cognitions and behavior for discussing PA with patients. This study also included a thorough process evaluation and assessed PA discussion behavior using a valid, proxy measure (i.e., chart review). While the intervention
did not significantly change residents’ social cognitions, a significant difference in resident behavior for discussing PA was observed between conditions at post, where PA was discussed at more patient visits among intervention condition residents. Altogether, this research highlights the importance of educating and training residents on evidence-based strategies for PA discussion; however, more time for such education and training should be allotted within Canadian family medicine residency curricula. Such interventions should consider incorporating behavior change techniques (e.g., prompts and cues) within clinic in order to engage the automatic processing aspect of behavior that cannot be targeted by educational workshops.
Ethical Approval

Ethical approval was granted for this study by the Health Sciences Research Ethics Board at Queen’s University (PHE-156-15).

Declaration of Interest Statements

Funding/Support: The first author, SMF, was supported by a SSHRC Canada Graduate Scholarship-Master’s.

Other disclosures: SD was an interventionist in the MI workshop and also contributed to the research project. SS was a 2nd year family medicine resident at the academic Family Medicine Team in 2017/2018. KH was the behavioral medicine lead for the Department of Family Medicine at Queen’s University in 2017/2018 and provided time for the intervention and research study. KH was not aware of which learners participated in the study. All other authors report no conflicts of interest.
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<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TPB construct</td>
<td>Response Scale</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Attitudes</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Affective attitudes</strong></td>
<td></td>
</tr>
<tr>
<td>1. Complete the statement, “I think that discussing physical activity to promote my patients’ health is generally ___.”</td>
<td></td>
</tr>
<tr>
<td>a. bad practice/good practice</td>
<td></td>
</tr>
<tr>
<td>b. unhelpful/helpful</td>
<td></td>
</tr>
<tr>
<td>c. inappropriate/appropriate</td>
<td></td>
</tr>
<tr>
<td>d. unnecessary/necessary</td>
<td></td>
</tr>
<tr>
<td><strong>Instrumental attitudes</strong></td>
<td></td>
</tr>
<tr>
<td>2. Attending the physical activity counselling workshop will help me discuss physical activity with my patients.</td>
<td></td>
</tr>
<tr>
<td>1 = Strongly disagree</td>
<td>6.87 ± 0.74</td>
</tr>
<tr>
<td>7 = Strongly agree</td>
<td></td>
</tr>
<tr>
<td><strong>Perceived-Behavioral Control</strong></td>
<td></td>
</tr>
<tr>
<td>1. Discussing PA with patients:</td>
<td></td>
</tr>
<tr>
<td>a. Discussing physical activity with my patients is:</td>
<td></td>
</tr>
<tr>
<td>b. I am confident that I could discuss physical activity with my patients if I wanted to.</td>
<td></td>
</tr>
<tr>
<td>c. I have complete control over whether or not to</td>
<td></td>
</tr>
</tbody>
</table>
discuss physical activity with my patients.

d. How likely is it that you would discuss physical activity with your patients in the next four weeks?
   
   1 = Very unlikely
   7 = Very likely
   
   6.40 ± 0.74  6.27 ± 0.80


e. If you were really motivated and had all the resources that you needed, how confident are you in your ability to discuss physical activity with your patients?
   
   1 = Not at all confident
   7 = Very confident

   6.07 ± 0.70  6.07 ± 0.70

2. Motivating patients to participate in PA:

   a. If you were really motivated and had all the resources that you needed, how confident are you in your ability to motivate your patients to participate in physical activity?
   
   1 = Not at all confident
   7 = Very confident

   5.20 ± 1.15  5.13 ± 0.92  F(1, 14) = 0.07,  p = .79

Subjective Norms

   \( \alpha = 0.69 \)
   \( \alpha = 0.70 \)
   
   5.72 ± 0.77  5.90 ± 0.65  F(1, 14) = 0.88,  p = .37

   a. Most general practitioners discuss physical activity to promote patients’ health.
   
   1: Strongly Disagree
   7: Strongly Agree

   4.53 ± 1.06  5.27 ± 1.03

   b. The Canadian Medical Association would approve of me discussing physical activity to promote my patients’ health.
   
   1: Strongly Disagree
   7: Strongly Agree

   6.80 ± 0.56  6.87 ± 0.35
c. Other physicians think I should discuss physical activity with my patients.
   1: Strongly Disagree  6.40 ± 1.12  6.40 ± 0.91
   7: Strongly Agree
   5.13 ± 1.36  5.07 ± 1.10

d. My patients think I should discuss physical activity with them.
   1: Strongly Disagree
   7: Strongly Agree

Intentions

1. Discussing PA with patients:
   \( \alpha = 0.91 \) \( \alpha = 0.82 \)
   \( 6.36 ± 0.72 \) \( 6.42 ± 0.57 \)
   \( F(1, 14) = 0.09, \quad p = .08 \)
   
   a. I intend to discuss physical activity with my patients to promote their health.
      1: Strongly Disagree  6.27 ± 0.80  6.33 ± 0.82
      7: Strongly Agree
   
   b. I would like to discuss physical activity with my patients to promote their health.
      1: Strongly Disagree  6.53 ± 0.74  6.73 ± 0.46
      7: Strongly Agree
   
   c. I plan to discuss physical activity with my patients to promote their health.
      1: Strongly Disagree  6.27 ± 0.80  6.20 ± 0.68
      7: Strongly Agree

2. Seeking out additional information:
   In the next four weeks, I intend to seek out additional information...
   \( r = 0.89 \) \( r = 0.91 \)
   \( p < 0.001 \) \( p < 0.001 \)
   \( F(1, 14) = 0.85, \quad p = .37 \)
   -0.24
   
   a. …about physical activity for my patients.
      1: Strongly Disagree
      7: Strongly Agree
      5.00 ± 1.65  4.47 ± 1.25
   
   b. …to use to motivate my patients to engage in physical activity.
      1: Strongly Disagree
      7: Strongly Agree
      4.53 ± 1.55  4.33 ± 1.23

Note. PA: Physical Activity, TPB: Theory of Planned Behavior. Using the Bonferroni method, alpha was adjusted for the seven comparisons (\( \alpha = 0.05/7 = .007 \)).

*Means ± SDs of individual TBP item are italicized, whereas scale Means ± SDs of TPB social cognition scale are not.
Table 2. Barrier items and descriptive statistics for residents’ agreement with barriers to discussing PA with their patients (n = 15)

<table>
<thead>
<tr>
<th>Barrier Item</th>
<th>Pre</th>
<th>Post</th>
<th>F</th>
<th>Pre-Post</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Belief in effectiveness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I believe that discussing physical activity with my patients will improve their physical activity behavior.</td>
<td>5.47 ± 1.30</td>
<td>5.00 ± 1.00</td>
<td>$F(1, 14) = 1.78$, $p = .20$</td>
<td>-0.35</td>
</tr>
<tr>
<td><strong>Training</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I feel that I am adequately prepared/trained to discuss physical activity with my patients.</td>
<td>4.73 ± 0.96</td>
<td>5.53 ± 0.74</td>
<td>$F(1, 14) = 10.84$, $p = .005^*$</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I have adequate time during a routine appointment, checkup or consultation to discuss physical activity with a patient.</td>
<td>3.53 ± 1.30</td>
<td>3.53 ± 1.25</td>
<td>$F(1, 14) = 0.00$, $p = 1.00$</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Priority</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I feel that discussing physical activity with a patient is a priority.</td>
<td>4.73 ± 0.88</td>
<td>4.93 ± 1.03</td>
<td>$F(1, 14) = 0.46$, $p = .51$</td>
<td>0.18</td>
</tr>
<tr>
<td><strong>Professional role</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I feel that another healthcare professional should discuss physical activity with my patients.</td>
<td>4.00 ± 1.73</td>
<td>4.27 ± 1.53</td>
<td>$F(1, 14) = 0.35$, $p = .57$</td>
<td>0.16</td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I have the resources I need to discuss physical activity with a patient.</td>
<td>4.40 ± 0.99</td>
<td>5.21 ± 0.86</td>
<td>$F(1, 14) = 9.33$, $p = .01$</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Note. All items measured on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Using the Bonferroni method, alpha was adjusted for the 6 comparisons ($\alpha = 0.05/6 = .008$). $^* p < .008$
Table 3. Resident demographics of participants included in the evaluation of social cognitions

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All (n = 25)</th>
<th>Completers (n = 15)</th>
<th>Non-Completers (n = 10)</th>
<th>Group Comparisona</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>7 (28)</td>
<td>5 (33)</td>
<td>2 (20)</td>
<td>( p = .66 )</td>
</tr>
<tr>
<td>Female</td>
<td>18 (72)</td>
<td>10 (67)</td>
<td>8 (80)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td>( p = 1.00 )</td>
</tr>
<tr>
<td>Caucasian</td>
<td>24 (96)</td>
<td>14 (93)</td>
<td>10 (100)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1 (4)</td>
<td>1 (7)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>26.8 ± 3b</td>
<td>26.1 ± 2c</td>
<td>27.7 ± 4c</td>
<td>( t(21) = 1.26, p = .22 )</td>
</tr>
<tr>
<td>Meeting PA Guidelines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;150 min/week moderate-vigorous PA</td>
<td>11 (44)</td>
<td>4 (27)</td>
<td>7 (70)</td>
<td>( p = 0.049* )</td>
</tr>
<tr>
<td>≥150 min/week moderate-vigorous PA</td>
<td>14 (56)</td>
<td>11 (73)</td>
<td>3 (30)</td>
<td></td>
</tr>
<tr>
<td>Years of Post-Secondary Education</td>
<td>7.7 ± 2</td>
<td>7.5 ± 2</td>
<td>7.9 ± 2</td>
<td>( t(23) = 0.45, p = .66 )</td>
</tr>
<tr>
<td>Undergraduate School of Medicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ontario Medical School</td>
<td>13 (52)</td>
<td>8 (53)</td>
<td>5 (50)</td>
<td>( \chi^2(2) = 3.96, p = .14 )</td>
</tr>
<tr>
<td>Other Canadian Medical School</td>
<td>9 (36)</td>
<td>4 (27)</td>
<td>5 (50)</td>
<td></td>
</tr>
<tr>
<td>International Medical School</td>
<td>3 (12)</td>
<td>3 (20)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Previous Academic Program</td>
<td></td>
<td></td>
<td></td>
<td>( \chi^2(2) = 4.74, p = .09 )</td>
</tr>
<tr>
<td>Life Sciences/Health Studies</td>
<td>19 (76)</td>
<td>13 (87)</td>
<td>5 (50)</td>
<td></td>
</tr>
<tr>
<td>Kinesiology/Exercise</td>
<td>1 (4)</td>
<td>0 (0)</td>
<td>1 (10)</td>
<td></td>
</tr>
<tr>
<td>Science/Physical Education</td>
<td>5 (20)</td>
<td>2 (13)</td>
<td>4 (40)</td>
<td></td>
</tr>
<tr>
<td>Received Previous MI Training</td>
<td></td>
<td></td>
<td></td>
<td>( \chi^2(1) = 0.69, p = .41 )</td>
</tr>
<tr>
<td>Yes</td>
<td>15 (60)</td>
<td>10 (67)</td>
<td>5 (50)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>10 (40)</td>
<td>5 (33)</td>
<td>5 (50)</td>
<td></td>
</tr>
<tr>
<td>MI Training (Hours)</td>
<td>2.6 ± 2</td>
<td>2.9 ± 2</td>
<td>2.0 ± 1</td>
<td>( t(13) = 1.10, p = .29 )</td>
</tr>
<tr>
<td>Baseline MI Knowledged</td>
<td>3.6 ± 1</td>
<td>3.8 ± 1</td>
<td>3.4 ± 1</td>
<td>( t(13) = 0.89, p = .39 )</td>
</tr>
<tr>
<td>Received Previous PAC Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6 (24)</td>
<td>4 (27)</td>
<td>2 (20)</td>
<td>( p = 1.00 )</td>
</tr>
<tr>
<td>No</td>
<td>19 (76)</td>
<td>11 (73)</td>
<td>8 (80)</td>
<td></td>
</tr>
<tr>
<td>PAC Training (Hours)</td>
<td>1.8 ± 1</td>
<td>1.8 ± 1</td>
<td>2.0 ± 1</td>
<td>( t(4) = 0.27, p = .80 )</td>
</tr>
</tbody>
</table>

Note. MI: Motivational Interviewing, PA: Physical Activity, PAC: Physical Activity Counselling. All values are n (%) except for age, years of post-secondary education, number of hours of MI training, baseline MI knowledge, and number of hours of PAC training, which are \( M \pm SD \). Examples of “Other” Academic Programs include biochemistry, biology, biomedical science, physiology and pharmacology, and teaching. Independent t-tests, Chi-Square Tests, and Fisher’s Exact Tests were conducted to determine whether significant differences existed between the demographics of completers vs. non-completers.

aIn instances when a Fisher’s Exact Test was run, only the \( p \)-value is provided for the group comparison for the relevant characteristic.

bTwo participants declined to report age, \( n = 23 \)

cOne participant declined to report age, hence \( n = 14 \) and \( n = 9 \) respectively

dMeasured on a 7-point scale ranging from 1 (no knowledge) to 7 (strong knowledge)

*Indicates a significant difference between completers and non-completers.
Table 4. Type of PA discussion in patient visits pre- and post-intervention

<table>
<thead>
<tr>
<th>Number of Patient Visits Containing:</th>
<th>Intervention</th>
<th>Non-Intervention</th>
<th>Intervention vs. Non-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre n = 150</td>
<td>Post n = 150</td>
<td>Comparison</td>
</tr>
<tr>
<td>Assessment of Patient PA</td>
<td>35 (23)</td>
<td>43 (29)</td>
<td>$\chi^2(1) = 1.11, p = .29$</td>
</tr>
<tr>
<td>PAC</td>
<td>18 (12)</td>
<td>25 (17)</td>
<td>$\chi^2(1) = 1.33, p = .25$</td>
</tr>
<tr>
<td>Arrangement of Referral and/or Follow-Upa</td>
<td>4 (3)</td>
<td>3 (2)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Note. PA: Physical Activity, PAC: Physical Activity Counselling. All values are n (%).

*aExpected cell frequencies were less than five for ‘arrangement of referral and/or follow-up’, consequently, chi-square tests were not computed.

*Indicates a significant difference between intervention conditions at post-intervention, $p < .05$. 
**Figure Captions**

**Figure 1.** Timeline of the intervention and study evaluation. Due to the scheduling of residents’ clinical rotations, behavior data for two cases (post-behavior for intervention condition Cohort A, and pre-behavior for the non-intervention condition) was collected in two segments to accommodate for the evaluation period being interrupted by off-clinic rotations.

**Figure 2.** Number of patient visits where PA was discussed at pre- and post-intervention in both the intervention and non-intervention conditions. Mean (SD). *Indicates a significant difference between conditions at post-intervention, \( p < .01 \).
Determining the Impact of an Educational Intervention on Family Medicine Residents’ Social Cognitions and Behavior for Discussing Physical Activity

Supplemental Digital Appendix 1 – Description of Workshops

<table>
<thead>
<tr>
<th>Workshop One Items</th>
<th>Duration (minutes)</th>
<th>Content</th>
<th>Objectives</th>
<th>Activities</th>
<th>Behavior Change Techniques¹ (TPB Construct(s)² Targeted)</th>
</tr>
</thead>
</table>
| **Introduction**   | 20                 | -MI-related concepts³:  
- Ambivalence  
- The ‘Righting Reflex’  
- Purpose of MI  
- Spirit of MI  
- The four processes of MI³:  
- Engaging  
- Focusing  
- Evoking  
- Planning  
- Integrating MI into practice³  
- Effectiveness of MI³ | - Learn what MI is  
- Learn the four processes of MI  
- Understand how MI can be integrated into clinical practice  
- Learn about the effectiveness of MI | (i) PowerPoint presentation | Instruction on how to perform the behavior (PBC) |
| **Eliciting Change Talk** | 20 | - Strategies for eliciting change talk³  
- Learn and practice strategies for eliciting change talk from patients (specifically in relation to PA) | (i) Discussion of eliciting change talk strategies  
(ii) Video example  
(iii) “Round Robin” practical activity⁴:  
- Residents split into groups where one resident within the group acted as a patient, and remaining residents acted as a single counselor; residents practiced strategies for evoking change talk | Instruction on how to perform the behavior (PBC)  
Demonstration of the behavior (subjective norms and PBC)  
Behavioral practice/rehearsal (PBC) |
<table>
<thead>
<tr>
<th><strong>Responding to Sustain Talk</strong></th>
<th>20</th>
<th>-Strategies for responding to sustain talk[^3]</th>
<th>-Learn and practice strategies for responding to patient sustain talk (specifically in relation to PA)</th>
<th>(i) Discussion of responding to sustain talk strategies</th>
<th>Instruction on how to perform the behavior (PBC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(ii) “Dodgeball” practical activity[^4]:</td>
<td>-Residents worked in teams to reply to patient statements using MI-consistent responses for responding to sustain talk, teams took turns supplying the statements and responding</td>
<td></td>
<td>Behavioral practice/rehearsal (PBC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Debrief:</td>
<td>-Residents could ask questions and facilitators provided general feedback</td>
<td></td>
<td>Feedback on behavior (targeting PBC)</td>
</tr>
<tr>
<td><strong>Full Practice</strong></td>
<td>20</td>
<td>-MI for counselling on PA[^3]</td>
<td>-Apply the principles of MI for providing PAC</td>
<td>(i) Practical activity[^4]:</td>
<td>Behavioral practice/rehearsal (PBC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Residents were placed into groups of three, where one resident acted as patient, another as counselor, and the last as an observer (who recorded strategies used), residents switched roles so everyone had a chance to play all three roles -Facilitators circulated groups and provided feedback</td>
<td></td>
<td>Feedback on behavior (PBC)</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>5</td>
<td>-Review of the workshop</td>
<td>-Short review of concepts</td>
<td>(i) Debrief:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Brief recap of content and time for residents to ask remaining questions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Instructors reinforced may be challenging to feel effective, but residents are capable of learning and mastering these skills.

Verbal persuasion about capability (PBC)

Note. MI, Motivational Interviewing; PA, Physical Activity; PAC, Physical Activity Counselling; PBC, Perceived Behavioral Control.
### Outline of Workshop Two: (Physical Activity as a Vital Sign)

<table>
<thead>
<tr>
<th>Workshop Two Items</th>
<th>Duration (minutes)</th>
<th>Content</th>
<th>Objectives</th>
<th>Activities</th>
<th>Behavior Change Techniques¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>5</td>
<td>-Barriers for discussing and prescribing PA with/to patients</td>
<td>-Understand barriers to discussing PA with patients</td>
<td>(i) Group discussion: -Facilitators prompted residents to share what barriers they feel prevent them from discussing or prescribing PA to their patients</td>
<td>(TPB Construct(s)² Targeted)</td>
</tr>
</tbody>
</table>
| **Evidence from the literature on PA** | 20 | -Prospective Data on PA showing:  
-PA associated with a reduction in risk of CVD⁶ and all-cause mortality⁶  
-PA better predictor of risk than some traditional factors⁷  
-Moving from inactive to physically inactive confers the greatest health benefit⁸  
-PA provides clinically relevant info that influences patient management⁵–⁹  
-RCT Data on PA showing:  
-Exercise is more effective than diet for reducing cardio-metabolic risk¹⁰,¹¹  
-Adhering to the PA guidelines is sufficient for reducing abdominal adiposity¹²  
-Exercising at higher amounts and intensities needed for improvements in glucose disposal¹²  
-Lifestyle modification to diet and exercise is more effective than metformin for reducing incidence of Type 2 Diabetes¹³ | -Get familiar with evidence about the health benefits of PA | (i) PowerPoint presentation | Information about health consequences (attitudes)  
Credible source (attitudes and subjective norms) |
<table>
<thead>
<tr>
<th>Practical Steps for Discussing PA</th>
<th>50</th>
<th>-Canadian PA Guidelines for adults(^{14})</th>
<th>-Learn and apply tools for discussing PA with patients</th>
<th>(i) PowerPoint presentation</th>
<th>Instruction on how to perform the behavior (PBC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-PA vital sign(^{15})</td>
<td></td>
<td></td>
<td>Information on health consequences (attitudes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Assessing readiness for PA</td>
<td></td>
<td></td>
<td>Credible source (attitudes and subjective norms)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Psychological readiness(^{16}) (using the stages of change model), and using strategies such as MI(^3) and BAP(^{17}) accordingly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Physical readiness (using PAR-Q+(^{18}) and/or ACSM risk stratification(^{18}) for CVD risk factors)</td>
<td>(ii) Case studies (x2):</td>
<td>Behavioral practice/rehearsal (PBC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Providing an PA/exercise prescription using the FITT (frequency, intensity, type and time) principle(^{19})</td>
<td>-Studies included determining risk for PA and practice providing an exercise prescription</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Developing and using a referral network(^{20})</td>
<td>-Facilitator provided feedback to residents</td>
<td>Feedback on behavior (PBC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-The importance of following-up(^{17})</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Summary**

- Review of workshop and how the workshop addressed barriers discussed at the beginning of the workshop
- Short review of concepts
  - Understand how provided PA tools can address barriers discussed at the beginning of the workshop

(i) Discussion by facilitators
(ii) Group Discussion on barriers

**Notes.** ACSM, American College of Sports Medicine; BAP, Brief Action Planning; CVD, Cardiovascular Disease; MI, Motivational Interviewing; PA, Physical Activity; PAR-Q+, Physical Activity Readiness Questionnaire Plus; PBC, Perceived behavioral control.
References for Workshop Content


14. CSEP. *Canadian Physical Activity Guidelines.* Ottawa, ON, Canada; 2011.


Supplemental Digital Appendix 2 – Process Evaluation

In order to attribute effectiveness to an intervention, intervention implementation must be understood.¹ Accurate interpretation of outcomes is dependent upon knowing what aspects of the intervention were delivered and how well they were conducted. For example, a positive impact may be achieved through an intervention that, in practice, was very different from what was intended; similarly, a negative impact may be achieved if the intervention was not implemented sufficiently.¹ Accordingly, a process evaluation (i.e., a study which aims to understand the functioning of an intervention by examining implementation)² of the workshops was conducted to complement the outcome evaluation.

Methods

The process evaluation focused on four domains of the intervention: the dose delivered (i.e., number of content items delivered); fidelity (i.e., extent to which the workshop content was implemented as intended); dose received (i.e., resident engagement and retention of material); and quality/success (i.e., whether the workshop content was delivered and implemented as intended, whether the residents received appropriate instruction and feedback, whether the goals of the workshop session were accomplished, whether residents felt the workshops were credible and useful). Checklist and questionnaire measures adapted from Galaviz and colleagues³ and guided by recommendations from Saunders and colleagues⁴ were developed to assess all implementation domains of the workshops.
Participants and Procedure

Three separate groups of participants were considered for the process evaluation: observers, facilitators, and resident attendees.

Observers

Two trained research assistants acted as observers during both workshops for both resident cohorts. During each workshop, the research assistants completed an observer checklist (Item A). Research assistants attended full workshop run-throughs where they were trained on how to use the checklists. Research assistants positioned themselves at the back of the room during each session in order to observe the facilitators and residents during the workshops.

Facilitators

Cohort A Workshop One was jointly facilitated by a PhD candidate and a physiatry resident. Cohort B Workshop One was delivered solely by the physiatry resident due to a change in the PhD candidate’s availability. A clinical exercise physiology PhD candidate and a certified exercise physiologist jointly facilitated Workshop Two for both Cohorts A and B (see Table S1). Facilitators provided informed consent to allow for the evaluation of each facilitator’s delivery of the individual workshops. Additionally, each facilitator completed a facilitator checklist (Item B) immediately following the workshop session they delivered.

Resident Attendees

All workshop attendees, regardless of whether they were participating in the outcome evaluation study, were invited to complete a workshop assessment (Item C) following each workshop.

Measures
Several measures were utilized in order to evaluate implementation of the intervention.

**Observer Checklist**

The observer checklist (Item A) was designed to assess the dose delivered, fidelity, dose received, and quality/success of the intervention.

To assess the dose delivered, the checklist included all content items to be presented and/or discussed during the workshop with space for the observers to indicate whether the item was successfully delivered.

To determine fidelity, the checklist contained comment boxes to note whether an item was not implemented as intended (i.e., content modified from the original implementation plan). The duration of each workshop section (made up of multiple items) was also recorded to examine variations from the planned duration of each section.

To evaluate dose received, space was provided for the observers to track the number of residents who were not actively engaged during the presentation and/or discussion of the corresponding item. Observers would scan the room whenever a new workshop item was introduced (approximately every three to four minutes) and would record the number of residents who appeared disengaged in the workshop material presented during that time period. Individuals were counted as ‘disengaged’ if they were on their phone or computer (e.g., charting) or reading other materials that did not relate to the workshop.

To examine overall workshop quality/success, the checklist required the observers to rate the quality and success of each workshop delivered to the resident cohorts using two questions: (1) “Quality refers to implementing the workshop as intended and providing the trainees with appropriate instruction and feedback. Please rate the overall quality of this workshop.”; and (2) “Success refers to accomplishing the goals planned for the session. How would you rate the
success of the session?”. Both questions were adapted from Galaviz and colleagues\(^3\) and were rated on a seven-point Likert scale anchored at 1 (very poor) to 7 (excellent).

**Facilitator Checklist**

The facilitator checklist (Item B) was designed to assess the dose delivered, fidelity, and quality/success of the intervention and mirrored the measures described above for the observer checklist.

**Resident Workshop Assessment**

The resident workshop assessment was designed to evaluate the dose received and quality/success of the intervention.

To measure dose received, the assessment included a knowledge test. For Workshop One (i.e., Motivational Interviewing content), the knowledge test asked residents to list (1) the four key elements of the spirit of Motivational Interviewing and (2) three strategies that could be used to evoke change talk from patients. For Workshop Two (i.e., PAC and PA/exercise prescription content), the knowledge test asked residents to (1) describe three tools that could be used to help patients increase their PA and (2) define each of the elements of the FITT principle. For both knowledge tests, responses were scored out of a total of seven. The first author evaluated the knowledge tests; a list of accepted responses to both the Workshop One and Two knowledge tests can be found in Item D.

To evaluate the overall quality/success, residents were asked to rate the quality of each workshop on a seven-point Likert scale anchored at 1 (very poor) to 7 (excellent). Residents were also asked whether they agreed that the information provided during each of the workshops was (1) credible and (2) useful, rated on a seven-point Likert scale anchored at 1 (strongly disagree)
to 7 (strongly agree). The three quality/success questions were adapted from Galaviz and colleagues.³

Data Analysis

All statistical analyses were conducted with the Statistical Package for Social Sciences (SPSS; Version 24 for Mac; IBM).

Dose delivered

Frequency counts of the number of content items delivered were computed for observer and facilitator checklists. Prevalence- and bias-adjusted kappa (PABAK) coefficients⁵ were calculated to assess inter-observer reliability on items checked as being delivered between the two observer checklists and inter-facilitator reliability on items checked as being delivered between the two facilitator checklists (for workshops with two facilitators) for each workshop for each cohort. The total recorded number of items checked as being delivered on the two observer checklists were averaged and independent $t$-tests were run to evaluate differences in the number of items delivered between cohorts for both Workshop One and Two.

Fidelity

Frequency counts of the number of workshop content item modifications were determined for both observer and facilitator checklists. PABAK coefficients were calculated to assess inter-observer reliability on item modifications between the two observer checklists and inter-facilitator reliability on item modifications between the two facilitator checklists (for workshops with two facilitators) for each workshop and cohort. The total recorded number of item modifications on the two observer checklists were averaged and independent $t$-tests
assessed differences in the number of items modified between Cohorts A and B for both Workshop One and Two.

**Dose received**

Frequency counts for the number of residents disengaged during each workshop were determined from each *observer* checklist. To assess inter-observer reliability, Intraclass Correlation Coefficient (ICC) estimates and their 95% confidence intervals were calculated based on a single-rating, absolute agreement, two-way mixed effects model with two raters. The total number of residents disengaged on the two *observer* checklists were averaged and independent *t*-tests were run to evaluate differences between Cohorts A and B for both Workshop One and Two.

Descriptive statistics were computed and independent *t*-tests were run to examine differences among workshop knowledge scores between resident Cohorts A and B for both Workshop One and Two.

**Quality/Success**

Descriptive statistics were computed and independent *t*-tests were used to examine differences between the ratings of workshop quality for the *observer, facilitator, and resident* checklists between Cohorts A and B for both Workshop One and Two.

**Results**

**Dose Delivered and Fidelity**

**Workshop One**

Twenty-two residents from Cohort A, and 24 residents from Cohort B attended their respective Workshop One. All 19 targeted workshop items (see Table S1) were delivered for
both Cohort A and B. Accordingly, there was 100% agreement on the number of topics delivered between the two observers (PABAK = 1.00) and two facilitators (PABAK = 1.00) for Cohort A. Similarly, there was 100% agreement on the number of topics delivered between the two observers (PABAK = 1.00) for Cohort B. As Cohort B’s Workshop One was delivered by only one facilitator, facilitator agreement was not assessed.

Modifications were observed for 24% of the items for both Cohort A and B (see Table S1). There was 100% agreement between the two observers (PABAK = 1.00) and two facilitators (PABAK = 1.00) for (1) the specific items modified and (2) the number of items modified for both Cohort A and B. Additionally, no differences were observed for the number of items modified between Cohort A and B for both the observer and facilitator checklists, as the averages between observers across cohorts and the averages between facilitators across cohorts were the same.

The modifications that were made were largely related to how the items were delivered vs. modifications to the content itself. Specifically, these modifications included allowing more practice time for concepts residents were struggling with (n = 1, for both Cohort A and B), providing additional explanation/clarification about content in response to questions asked by residents (n = 2, for both Cohort A and B), and consequently shortening the time spent on other items due to time restrictions (i.e., discussions and/or questions took up more time than allotted; n = 2, for both Cohort A and B). These modifications to the items delivered are reflected by variances in the amount of time spent on workshop sections in each cohort, as shown in Table S1. The duration of Workshop One was 80 minutes for Cohort A and 88 minutes for Cohort B.
Table S1. Workshop One - Dose delivered and fidelity

<table>
<thead>
<tr>
<th>Workshop Items</th>
<th>Duration (minutes)</th>
<th>Content Delivery and Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned</td>
<td>Implemented</td>
</tr>
<tr>
<td></td>
<td>Cohort A</td>
<td>Cohort B</td>
</tr>
<tr>
<td>Introduction</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>Ambivalence</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Righting Reflex</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Purpose of MI</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Spirit of MI</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Engaging</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Focusing</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Evoking</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Integrating MI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Eliciting</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>Change Talk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategies</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Video Example</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Practical Activity</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Debrief</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Responding to Sustain Talk</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>Strategies</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Practical Activity</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Debrief</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Full Practice</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Evoking practice</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>√</td>
<td></td>
</tr>
</tbody>
</table>

Note: MI: Motivational Interviewing.

Workshop Two

Twenty-one residents from Cohort A and 24 residents from Cohort B attended their respective Workshop Two. All 27 targeted workshop items were delivered for both Cohort A and B (i.e., as with Workshop One, there was 100% agreement and all PABAKs were 1.00 between observers and facilitators). Table S2 provides a condensed list of the included workshop items.
Modifications were observed for 5% of the items for both Cohort A and B (see Table S2). There was 100% agreement between the two observers (PABAK = 1.00) and the two facilitators (PABAK = 1.00) for (1) the specific items modified and (2) the number of items modified for both Cohort A and B. Additionally, no differences were observed for the number of items modified between Cohort A and B for both the observer and facilitator checklists, as the averages between observers across cohorts and the averages between facilitators across cohorts were the same.

Similar to Workshop One, modifications that were made related to how the items were delivered vs. modifications to the content itself. Specifically, these modifications included allowing more time for discussion to enhance resident learning (n = 1, for Cohort B), and providing additional explanation/clarification to residents about included content in response to questions (n = 1, for Cohort A). For Cohort A, this modification (i.e., allowing more time for discussion), was reflected in the duration of the workshop introduction, as the time spent on this section was twice the amount of time originally allotted (10 vs. 5 minutes). The duration of Workshop Two was 81 minutes for Cohort A and 80 minutes for Cohort B.
### Table S2. Workshop Two - Dose delivered and fidelity

<table>
<thead>
<tr>
<th>Workshop Items</th>
<th>Duration (minutes)</th>
<th>Content Delivery and Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned</td>
<td>Implemented</td>
</tr>
<tr>
<td></td>
<td>Cohort A</td>
<td>Cohort B</td>
</tr>
<tr>
<td>Introduction</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group discussion of barriers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA definitions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence from the literature on PA</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Prospective Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCT Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical Steps for Discussing PA</td>
<td>50</td>
<td>47</td>
</tr>
<tr>
<td>PA Vital Sign</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessing readiness for PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing an exercise prescription</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Referral network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Debrief and question period</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: PA: Physical Activity, RCT: Randomized Control Trial.*

### Dose Received

The inter-rater reliability between observers for the recorded number of residents disengaged for Workshop One ranged from excellent for Cohort A (ICC = 0.93; 95% CI = 0.84-0.97) to good for Cohort B (ICC = 0.62; 95% CI = 0.25-0.84). For Workshop Two, the inter-rater reliability between observers for the recorded number of residents disengaged was moderate for both Cohort A (ICC = 0.58; 95% CI = 0.27-0.79) and Cohort B (ICC = 0.52; 95% CI = 0.18-0.76).

For Workshop One, there were no significant differences between the number of
residents disengaged between Cohort A (1.97 ± 2.06) and Cohort B (1.79 ± 1.75; \( t(36) = 0.30, p = .77 \)). During Workshop One, the number of residents who were disengaged during each item presented and/or discussed (i.e., one scan every three to four-minutes) ranged from zero to six individuals for both cohorts. The introductory lecture portion of the Motivational Interviewing workshop for both cohorts had the highest number of residents who were disengaged in comparison to the other components of the workshop.

For Workshop Two, there were no significant differences between the number of residents disengaged between Cohort A (4.21 ± 1.73) and Cohort B (3.90 ± 1.45; \( t(50) = 0.69, p = .49 \)). During Workshop Two, the number of residents who were disengaged at any one time ranged from one to nine individuals for both cohorts. The sections of Workshop Two that yielded the highest number of disengaged residents for both cohorts included the presentation of evidence from the literature about PA and the presentation of practical steps for providing an exercise prescription.

There were no significant differences in Workshop One knowledge scores between Cohort A (4.68 ± 2.14, out of seven) and Cohort B (4.38 ± 1.64; \( t(41) = 0.54, p = .59 \)). However, for Workshop Two, Cohort B (6.63 ± 0.66; out of seven) had significantly higher knowledge scores than Cohort A (5.21 ± 1.99; \( t(39) = 3.17, p = .007 \)).

**Quality/Success**

In general, residents evaluated the overall quality of the intervention favourably (all Ms ≥ 5.05, out of seven; see Table S3). Cohort B residents rated the quality construct (a sub-category of overall quality) significantly higher than Cohort A residents for both Workshop One (\( t(41) = \))
3.67, \( p = .001 \) and Workshop Two (\( t(39) = 2.61, p = .013 \); see Table S3 for means and standard deviations).

**Table S3.** Resident workshop assessment of workshop quality

<table>
<thead>
<tr>
<th>Evaluation Constructs</th>
<th>Workshop One Cohort A ( (n = 19) )</th>
<th>Workshop One Cohort B ( (n = 24) )</th>
<th>Workshop Two Cohort A ( (n = 19) )</th>
<th>Workshop Two Cohort B ( (n = 22) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of workshop( ^a )</td>
<td>5.05 ± 0.91</td>
<td>6.00 ± 0.78*</td>
<td>5.11 ± 1.24</td>
<td>5.91 ± 0.68*</td>
</tr>
<tr>
<td>Material presented was credible( ^b )</td>
<td>5.79 ± 0.79</td>
<td>6.25 ± 0.85</td>
<td>5.95 ± 1.08</td>
<td>6.18 ± 0.96</td>
</tr>
<tr>
<td>Material presented was useful( ^b )</td>
<td>5.47 ± 1.65</td>
<td>6.25 ± 0.85</td>
<td>5.16 ± 1.42</td>
<td>5.68 ± 1.43</td>
</tr>
</tbody>
</table>

*Note:* Independent t-tests were conducted to determine whether significant differences existed between workshop evaluation constructs of Cohort A and B.

\( ^a \)Measured on a 7-point scale ranging from 1 (very poor) to 7 (excellent)

\( ^b \)Measured on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree)

\( *p < .05 \), representing a significant difference between cohorts at the same time point

Table S4 indicates the mean scores of workshop quality and success as rated by observers and facilitators. As observers and facilitators provided high scores (out of seven) on these items, it would suggest that they rated the workshop favourably. There were no significant differences in ratings of quality by observers and facilitators.
Table S4. Observer and facilitator workshop evaluation of workshop quality

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Evaluation Constructs</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quality of Workshop*</td>
<td>(mean ± SD)</td>
<td>Success of Workshop*</td>
<td>(mean ± SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop One Cohort A</td>
<td>Observer</td>
<td>6.00 ± 0.00</td>
<td>5.50 ± 0.71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facilitator</td>
<td>5.00 ± 0.00</td>
<td>4.50 ± 0.71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop One Cohort B</td>
<td>Observer</td>
<td>6.00 ± 0.00</td>
<td>6.50 ± 0.71</td>
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<td>Observer</td>
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<td>6.00 ± 0.00</td>
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<td>Facilitator</td>
<td>6.50 ± 0.71</td>
<td>6.00 ± 0.00</td>
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Note: Independent *t*-tests were conducted to determine whether significant differences existed between workshop evaluation constructs of Cohort A and B.

*Measured on a 7-point scale ranging from 1(very poor) to 7(excellent)

*bThere was only one facilitator who delivered this workshop; thus, only one rating is presented.

**Summary**

Although minor differences in quality/success and knowledge scores were observed across cohorts, significant differences were not observed in the dose delivered (i.e., number of items delivered), the number of items modified, or the number of residents disengaged across cohorts; therefore, it was possible to consider all participants as one group for the outcome evaluation analyses (i.e., questionnaires and retrospective medical chart review).

**Discussion**

Intervention dose delivered, and fidelity were not significantly different between cohorts. The few modifications that were made to the intervention items concerned delivery, rather than content of the items, and were made to enhance residents’ learning. Specifically, the modifications allowed more practice time for activities that residents found challenging, as well
as additional time for discussion and/or clarification following resident questions. Tailoring interventions to audience needs has previously been described as a key feature for improving the likelihood of successful integration of knowledge into clinical practice;\(^7\) therefore, future workshops should allot additional time to allow for tailoring of the intervention delivery to meet the needs of the attendees.

Observers noted that during both workshops, the greatest number of residents were disengaged during the didactic portions of the workshops, suggesting that intervention dose received by attendees may be influenced by the educational method utilized. Didactic techniques utilized in continuing medical education have been found to be the least effective for changing providers’ clinical behavior;\(^8\) however, as residents receive no other allocated time within their curriculum to learn about strategies for discussing PA with patients, it was important to provide them with this foundational knowledge. Active learning strategies such as role playing, case discussion, and honing newly acquired practice skills have been shown to enhance the effectiveness of continuing medical education on clinicians’ behavior.\(^7\) Although the intervention in the current study did use several active learning strategies (such as role playing and case studies), placing a greater emphasis on active learning over didactic approaches is recommended for future iterations of the intervention to enhance residents’ focus on content and thus the potential likelihood of behavior change.\(^7\)

Compared to Cohort A, Cohort B had significantly higher knowledge scores for Workshop Two and rated the quality of Workshops One and Two significantly higher. As there were no differences between the number of residents disengaged between Cohort A and B, other factors may have impacted residents’ ability to recount the information presented during the workshop on the knowledge test. A potential explanation may be that the facilitators’ self-
efficacy for delivering the workshop may have increased with successive implementation, with Cohort B receiving Workshops One and Two after Cohort A. Although facilitators practiced delivering the Workshops to EIMC-QU members prior to delivering the Workshops to Cohort A, it is possible that rehearsing intervention delivery to a less familiar audience would have been beneficial to improve facilitators’ self-efficacy prior to the first workshop delivery. Facilitators’ self-efficacy for intervention delivery has been identified as one of at least 23 implementation variables that can influence intervention effectiveness in general,¹ as well as specifically in the context of educational workshops that aim to enhance PA-discussion among health care professionals.⁹ While it is not possible to examine all factors influencing intervention implementation in any one study,¹ future process evaluations should strive to examine additional factors related to the intervention implementation.
References for Process Evaluation


Item A

Observer Checklists

Workshop One

MI TRAINING FIDELITY CHECKLIST-OBSERVER

Session date: __________________________
Session Facilitator (Introductory lecture): __________________________
Number of Attendees (Introductory lecture): __________________________
Session Facilitator (Small group practical activities): __________________________
Number of Attendees (Small group practical activities): __________________________

1. The resources used in this session included (check all that apply):
   - Lecture
   - Group discussion
   - Practice
   - Handouts

2. Quality refers to implementing the workshop as intended and providing the trainees with appropriate instruction and feedback. Please rate the overall quality of this workshop.

   1  2  3  4  5  6  7
   Very Poor  Excellent

3. Success refers to accomplishing the goals planned for the session. How would you rate the success of the session?

   1  2  3  4  5  6  7
   Very Poor  Excellent
<table>
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<tr>
<th>Topic</th>
<th>Was it implemented?</th>
<th>Notes:</th>
<th># of individuals not engaged</th>
<th># questions asked</th>
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<tr>
<td>1. Engaging</td>
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<tr>
<td>2. Focusing</td>
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<tr>
<td>a. DARN ACTS</td>
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<td>b. OARS</td>
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<tr>
<td>c. EPE</td>
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<tr>
<td>4. Planning</td>
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(Duration: __________ minutes)
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<td>Debrief</td>
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<td>Debrief</td>
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<td>Full Evoking Practice</td>
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<td>Summary and Debrief</td>
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</table>

<sup>1</sup> Individuals who are not engaged refers to residents who are not engaged with the facilitator or materials (e.g., on their phone or computer, or reading other materials)
Observations:

(E.g., trainees ask insightful questions, request assistance from the facilitator, ask for feedback from the facilitator, etc.)
Workshop Two

EXERCISE PRESCRIPTION TRAINING FIDELITY CHECKLIST- OBSERVER

Session date: __________________________
Session Facilitator (Evidence): __________________________
Number of Attendees: __________________________
Session Facilitator (Exercise Prescription): __________________________
Number of Attendees: __________________________

1. The resources used in this session included (check all that apply):

☐ Lecture  ☐ Group discussion  ☐ Practice  ☐ Handouts

2. Quality refers to implementing the workshop as intended and providing the trainees with appropriate instruction and feedback. Please rate the overall quality of this workshop.

1 2 3 4 5 6 7
Very Poor  Excellent

3. Success refers to accomplishing the goals planned for the session. How would you rate the success of the session?

1 2 3 4 5 6 7
Very Poor  Excellent
<table>
<thead>
<tr>
<th>Topic</th>
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**Introduction**

(Duration: _____________ minutes)

Group discussion

Definitions

**Evidence from Research**

(Duration: _____________ minutes)

Prospective Data Presentation
- a. Occupational PA and CHD
- b. PA and Mortality Risk
- c. PA and Risk in Women
- d. Summary of Data

RCT Data Presentation
- a. MRC Exercise and Diet Study
- b. SERENA Study
- c. Diabetes Prevention Program
- d. Recidivism
- e. ENGAGE Study
- f. Summary of Data
### Table 1: Physical Activity as a Vital Sign

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<th># questions asked</th>
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<td>No</td>
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</table>

**Physical Activity as a Vital Sign**

(Duration: ___________ minutes)

Recap

Determining the level of PA (Step 1)

**Readiness to Exercise (Step 2)**

(Duration: ___________ minutes)

- Assessing Psychological Readiness
  - Stages of Change
  - MI and Brief Action Planning
- Assessing Physical Readiness
  - PAR-Q+
  - ACSM Risk Stratification Table
  - ACSM Risk Stratification Chart
  - Case Study

**Written Exercise Prescription (Step 3)**

(Duration: ___________ minutes)

- Guidelines
- RPE Scale
- FITT
- Case Study
- High Risk – COPD and Osteoporosis

**Referral (Step 4)**

(Duration: ___________ minutes)

- Referral and resources

**Follow-Up (Step 5)**

(Duration: ___________ minutes)

- Following up with the patient

**Summary**

(Duration: ___________ minutes)

- Big Picture and Recap

---

<sup>1</sup> Refers to residents who aren’t engaged with the facilitator or materials (e.g., on their phone or computer, or reading other materials.)
Observations:
(E.g., trainees ask insightful questions, request assistance from the facilitator, ask for feedback from the facilitator, etc.)
Facilitator Checklists

Workshop One

MI TRAINING FIDELITY CHECKLIST-FACILITATOR

Session date: ____________________________
Session Facilitator (Introductory lecture): ____________________________
Number of Attendees (Introductory lecture): ____________________________
Session Facilitator (Small group practical activities): ____________________________
Number of Attendees (Small group practical activities): ____________________________

1. The resources used in this session included (check all that apply):
   - Lecture
   - Group discussion
   - Practice
   - Handouts

2. Quality refers to implementing the workshop as intended and providing the trainees with appropriate instruction and feedback. Please rate the overall quality of this workshop.

   1  2  3  4  5  6  7
   Very Poor 2 3 4 5 6 7 Excellent

3. Success refers to accomplishing the goals planned for the session. How would you rate the success of the session?

   1  2  3  4  5  6  7
   Very Poor 2 3 4 5 6 7 Excellent
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**Eliciting Change Talk**

(Duration: __________ minutes)

- Strategies for eliciting change talk handout
- Video example of MI
- Change talk round robin exercise
- Debrief

**Responding to Sustain Talk**

(Duration: __________ minutes)

- Strategies for responding to sustain talk handout
- Sustain talk dodge ball exercise
- Debrief

**Full Evoking Practice**

(Duration: __________ minutes)

- Evoking Practice Exercise

**Debrief & Summary**

(Duration: __________ minutes)

- Debrief of exercises: e.g., how to look for change talk and when receiving resistance need to shift response
Observations:

(E.g., trainees ask insightful questions, request assistance from the facilitator, ask for feedback from the facilitator, etc.)
Workshop Two

EXERCISE PRESCRIPTION TRAINING FIDELITY CHECKLIST - FACILITATOR

Session date: ___________________________
Session Facilitator (Evidence): ___________________________
Number of Attendees: ___________________________
Session Facilitator (Exercise Prescription): ___________________________
Number of Attendees: ___________________________

1. The resources used in this session included (check all that apply):
   - [ ] Lecture
   - [ ] Group discussion
   - [ ] Practice
   - [ ] Handouts

2. Quality refers to implementing the workshop as intended and providing the trainees with appropriate instruction and feedback. Please rate the overall quality of this workshop.

   1   2   3   4   5   6   7
   Very Poor Excellent

3. Success refers to accomplishing the goals planned for the session. How would you rate the success of the session?

   1   2   3   4   5   6   7
   Very Poor Excellent
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<td>e. ENGAGE Study</td>
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<td>Big Picture and Recap</td>
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Observations:

(E.g., trainees ask insightful questions, request assistance from the facilitator, ask for feedback from the facilitator, etc.)
Item C

Resident Workshop Assessment

Workshop One

Motivational Interviewing Workshop Evaluation

DATE:____________________________

Please answer the following questions relating to the material presented in today’s workshop:

1. List the four key elements that the spirit of motivational interviewing is based on:

   1.
   2.
   3.
   4.

2. List three strategies you can use to evoke change talk from patients:

   1.
   2.
   3.

The following questions concern the content and quality of the workshop:

4. The resources used in this session included (check all that apply):

   □ Lecture
   □ Group discussion
   □ Practice
   □ Handouts
5. The overall **quality** of this workshop was:

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Very Poor 2 3 4 5 6 7 Excellent

6. The information presented in this workshop was **credible**.

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Strongly disagree 2 3 4 5 6 7 Strongly agree

7. The information in this workshop was **useful to me** as a family medicine resident.

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Strongly disagree 2 3 4 5 6 7 Strongly agree

Comments:
Workshop Two

**Exercise Prescription Workshop**

DATE: __________________________

Please answer the following questions relating to the material presented in today’s workshop:

1. List three tools you can use to help your patients increase their physical activity.

   1.
   2.
   3.

2. Describe each of the elements of the FITT principle for physical activity prescription.

   **F:**
   **I:**
   **T:**
   **T:**

The following questions concern the content and quality of the workshop:

1. The resources used in this session included (check all that apply):
   - Lecture
   - Group discussion
   - Practice
   - Handouts
2. The overall **quality** of this workshop was:

   - Very Poor
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - Excellent

3. The information presented in this workshop was **credible**.

   - Strongly disagree
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - Strongly agree

4. The information in this workshop was **useful to me** as a family medicine resident.

   - Strongly disagree
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - Strongly agree

Comments:
Item D

Resident Workshop Assessment – Accepted Responses

Workshop One

1. List the four key elements that the spirit of motivational interviewing is based on:
   (Scored out of 4)

   Accepted Responses (in any order):
   1. Compassion
   2. Acceptance
   3. Partnership
   4. Evocation

2. List three strategies you can use to evoke change talk from patients:
   (Scored out of 3)

   Accepted Responses:
   • Open-Ended Questions
   • Affirmations
   • Reflections
   • Summaries
   • Asking Evocative Questions
   • Asking for Elaboration/Examples
   • Querying Extremes
   • Looking Back or Looking Forward
   • Exploring Goals and Values
   • Using Change Rulers

Workshop Two

1. List three tools you can use to help your patients increase their physical activity.
   (Scored out of 3)

   Accepted Responses:
   • Motivational Interviewing
   • Brief Action Planning
   • Physical Activity Vital Sign/ Exercise Vital Sign
   • PAR-Q+
   • ACSM Risk Stratification
   • FITT Principle
   • Written Exercise/ Physical Activity Prescription
   • RPE Scale
   • Referral (to an exercise professional or to a community program)
   • Follow-up

2. Describe each of the elements of the FITT principle for physical activity prescription. (Scored out of 4)

   Accepted Responses:

   F: Frequency, I: Intensity, T: Type, T: Time